ALESSANDRO D'ATRI
DOMENICO SACCÀ
Editors

Information Systems: People, Organizations, Institutions, and Technologies

ItAIS: The Italian Association for Information Systems

Physica-Verlag

A Springer Company

Information Systems: People, Organizations, Institutions, and Technologies

Alessandro D'Atri • Domenico Saccà
Editors

Information Systems: People, Organizations, Institutions, and Technologies

ItAIS: The Italian Association for Information Systems

Physica-Verlag
A Springer Company

Editors
Prof. Alessandro D'Atri
Centro di Ricerca sui
Sistemi Informativi (CeRSI)
Via G. Alberoni, 7
00198 Roma
Italy
datri@luiss.it

Prof. Domenico Saccà
Università Calabria
Dipto. Elettronica Informatica
Sistemistica (DEIS)
Via P. Bucci, 41 c
87036 Rende
Italy
sacca@unical.it

ISBN 978-3-7908-2147-5 e-ISBN 978-3-7908-2148-2
DOI: 10.1007/978-3-7908-2148-2
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2009929698

Cover design: WMXDesign GmbH, Heidelberg

Printed on acid-free paper

Physica-Verlag is a brand of Springer-Verlag Berlin Heidelberg
Springer-Verlag is part of Springer Science+Business Media (www.springer.com)

Foreword

D. Avison[1] and S. Conger[2]

We were honored to be asked to open the 5th Conference of the Italian Chapter of the Association for Information Systems (ItAIS) in Paris which took place over two days in December 2008. The goal of the chapter is to promote the exchange of ideas, experiences, and knowledge among scholars and professionals engaged in the development, management, and use of information and communications systems and technology. This conference was one of around 30 conferences, consortia and workshops that took place immediately before the International Conference in Information Systems (ICIS 2008).

As President of the AIS and the Vice-President AIS for Chapters and Special Interest Groups, we were particularly delighted to participate as the Italian Chapter of the AIS has proven so successful. However we were not ready for the excellent attendance and outstanding presentations that are reflected in this volume that represents the best of the conference. Further, the conference highlighted both research and practice. Too often, conferences in IS do not evidence the impact of research on practice. The conference chairs, Alessandro D'Atri and Domenico Saccà, along with the organizing and program committees, deserve our gratitude for the success of the event and the excellence of this volume.

The conference tracks that included E-Services in Public and Private Sectors, Governance, Metrics and Economics of IT, Information and Knowledge Management, IS Development and Design Methodologies, IS Theory and Research Methodologies, Legal and ethical aspects of IS, New themes and frontiers in IS Studies, Organizational change and Impact of IT, Human Computer Interaction and the Strategic role of IS, not only provide a cross section of Italian research in IS but research in IS more generally. It is common that our research informs our classrooms, and if this conference is any evidence, Italian IT programs should flourish.

It is important for the AIS that regional and country groups are fostered and grow as this helps to ensure that the discipline develops new ideas and is influenced by diverse research and scholarship contributions. The Italian chapter is a model for

[1]President of the AIS 2008 – 2009, ESSEC Business School, France, avi-son@essec.fr
[2]AIS Vice President SIGs and Chapters 2007 – 2010, University of Dallas, USA, sconger@aol.com

chapter success and we hope the Italian chapter can help lead the way in developing regional groups as well. In examining this volume, the reader might ask whether there is something different about Italian research and, more generally, research from the Mediterranean area (there is a fourth Mediterranean Conference in Information Systems (MCIS) in Athens in October 2009). This volume of papers is a good place to start answering that question.

Contents

Contributors

A.E. Adam
University of Salford, Salford, UK, a.e.adam@salford.ac.uk

Pietro Luca Agostini
Università Cattolica del Sacro Cuore, Milano, Italy, pietroluca.agostini@unicatt.it

A. Albano
Università di Pisa, Pisa, Italy, albano@di.unipi.it

F. Amato
Università degli Studi di Napoli Federico II, Napoli, Italy, flora.amato@unina.it

Pasquale Ardimento
Università di Bari, Bari, Italy, ardimento@di.uniba.it

M.T. Baldassarre
University of Bari, Bari, Italy, baldassarre@di.uniba.it

Carlo Batini
Università Bicocca, Milano, Italy, batini@disco.unimib.it

P.M. Bednar
Lund University, Lund, Sweden, peter.bednar@ics.lu.se; University of Portsmouth, Portsmouth, UK, peter.bednar@port.ac.uk

F. Bénaben
Université de Toulouse, Toulouse, France, bernaben@enstimac.fr

M.C. Benfatto
Università LUISS Guido Carli, Roma, Italy, mcbenfatto@luiss.it

Devis Bianchini
Università degli Studi di Brescia, Brescia, Italy, bianchin@ing.unibs.it

M.A. Biasiotti
Institute of Legal Information Theory and Techniques, CNR, Firenze, Italy, biasiotti@ittig.cnr.it

C. Bogdan
Ovidius University, Constanta, Romania, cbogdan@univ-ovidius.ro

Francesco Bolici
Università degli Studi di Cassino, Cassino (NA), francesco.bolici@eco.unicas.it; Syracuse University, Syracuse, NY, USA

R. Bonazzi
HEC Lausanne, Lausanne, Switzerland, riccardo.bonazzi@unil.ch

Giovanni Bruno
Università di Bari, Bari, Italy, bruno@di.uniba.it

J. Bulchand-Gidumal
University of Las Palmas de Gran Canaria, Las Palmas, Spain, jbulchand@dede.ulpgc.es

C.M. Bull
Manchester Metropolitan University Business School, Manchester, UK, c.bull@mmu.ac.uk

P. Buono
Università di Bari, Bari, Italy, buono@di.uniba.it

Francesca Cabiddu
Università di Cagliari, Cagliari, Italy, fcabiddu@unica.it

Danilo Caivano
Università di Bari, Bari, Italy, caivano@di.uniba.it

C. Calefato
Università di Torino, Torino, Italy, caterina.calefato@di.unito.it

G. Canfora
Università degli Studi del Sannio, Benevento, Italy, canfora@unisannio.it

C. Cappiello
Politecnico di Milano, Milano, Italy, cappiell@elet.polimi.it

I. Carrasco De Paula
Università Cattolica del Sacro Cuore, Roma, Italy, icarrasco@rm.unicatt.it

A. Carugati
Århus School of Business, University of Århus, Århus, Denmark, andreac@asb.dk

Nunzio Casalino
Università Telematica G. Marconi, Roma, Italy, n.casalino@msn.unimarconi.it; CeRSI – Università LUISS Guido Carli, Roma, Italy, ncasalino@luiss.it

M. Casini
Università Cattolica del Sacro Cuore, Roma, Italy, maria.casini@rm.unicatt.it

R. Cassino
Università di Salerno, Salerno, Italy, rcassino@unisa.it

S. Castano
Università degli Studi di Milano, Milano, Italy, castano@dico.unimi.it

T. Catarci
Università La Sapienza, Roma, Italy, catarci@dis.uniroma1.it

Maria Chiara Di Guardo
Università di Cagliari, Cagliari, Italy, diguardo@unica.it

N. Ciaramella
Noesis s.r.l., Pisa, Italy, ciaramella@noesis-research.com

Marta Cimitile
Università di Bari, Bari, Italy, cimitile@di.uniba.it

M. Contenti
CNR, Roma, Italy, mariangela.contenti@itb.cnr.it

Antonio Cordella
London School of Economics, London, UK, a.cordella@lse.ac.uk

Maria Francesca Costabile
Università di Bari, Bari, Italy, costabile@di.uniba.it

Alessandro D'Atri
Università LUISS Guido Carli, Roma, Italy, datri@luiss.it

V. Daloiso
Università Cattolica del Sacro Cuore, Roma, Italy, viviana.daloiso@rm.unicatt.it

Valeria De Antonellis
Università di Brescia, Brescia, Italy, deantone@ing.unibs.it

Marco De Marco
Università Cattolica del Sacro Cuore, Milano, Italy, marco.demarco@unicatt.it

Roberto De Virgilio
Università Roma Tre, Roma, Italy, dvr@dia.uniroma3.it

Pierluigi Del Nostro
Università Roma Tre, Roma, Italy, pdn@dia.uniroma3.it

C. Del Vecchio
Università LUISS Guido Carli, Roma, Italy, cdelvecchio@luiss.it

Paolo Depaoli
Università di Urbino, Urbino, Italy, paolo.depaoli@uniurb.it

S. Di Paolo
Technolabs S.p.A, S.S. 17, L'Aquila, Italy, stefaniadipaolo_e@technolabs.it; Università degli Studi dell'Aquila, L'Aquila, Italy

M.R. Di Renzo
Università LUISS Guido Carli, Roma, Italy, mrdirenzo@luiss.it

C. Diamantini
Università Politecnica delle Marche, Ancona, diamantini@diiga.univpm.it

Mauro Draoli
CNIPA - Centro Nazionale per l'Informatica nella PA, Roma, Italy, draoli@cnipa.it

John M. Eger
San Diego State University, San Diego, CA, USA, jeger@mail.sdsu.edu

M. El Mekawy
Royal Institute of Technology, Stockholm University, Stockholm, Sweden, moel@dsv.su.se

Tommaso Federici
Università degli Studi della Tuscia, Viterbo, Italy, tfederici@unitus.it

A. Ferrara
Università degli Studi di Milano, Milano, Italy, ferrara@dico.unimi.it

A. Ferrari
Università di Verona, Verona, Italy, antonella.ferrari@univr.it

G. Finocchiaro
Università di Bologna, Bologna, Italy, giusella.finocchiaro@unibo.it

K. Fischer
Deutsches Forschungszentrum für Künstliche Intelligenz, Kaiserslautern, Deutschland, klaus.fischer@dfki.de

J. Fjermestad
New Jersey Institute of Technology, Newark, NJ, USA, fjermestad@adm.njit.edu

A. Gemelli
Università Politecnica delle Marche, Ancona, gemelli@diiga.univpm.it

C. Gennaro
ISTI - CNR, Pisa, Italy, claudio.gennaro@isti.cnr.it

Giorgio Gianforme
Università Roma Tre, Roma, Italy, gianforme@dia.uniroma3.it

A. Giangreco
IESEG School of Management, Catholic University of Lille, France, a.giangreco@ieseg.fr

C. Gibson
MIT Sloan School of Management, Boston, Massachusetts, USA, cgibson@mit.edu

R. Giuliano
Università La Sapienza, Roma, Italy, giuliano.raffaele@gmail.com

Bernhard Glatt
Libera Università di Bolzano, Bolzano, Italy, bernhard.glatt@unibz.it

L. Hussami
HEC Lausanne, Lausanne, Switzerland, lotfi.hussami@unil.ch

D. Isari
Università Cattolica del Sacro Cuore, Milano, Italy, daniela.isari@unicatt.it

L.A. Kalinichenko
Russian Academy of Sciences, Moscow, Russia leonidk@ipi.ac.ru

V. Katos
Democritus University of Thrace, Xanthi, Greece, vkatos@ee.duth.gr

Gerasimos Kontos
University of the Aegean, Chios, Greece, g.kontos@aegean.gr

Konstadinos Kutsikos
University of the Aegean, Chios, Greece, kutsikos@aegean.gr

Giovan Francesco Lanzara
Università di Bologna, Bologna, Italy, giovan.lanzara@unibo.it

G. Lenart
University of Maribor, eCenter, Slovenia, gregor.lenart@fov.uni-mb.si

E. León-Soto
Deutsches Forschungszentrum für Künstliche Intelligenz (DFKI) GmbH, Kaiserslautern, Deutschland

M. Lezoche
Istituto di Analisi dei Sistemi ed Informatica "A. Ruberti" – CNR, Roma, Italy, lezoche@iasi.cnr.it.

Andrea Maggipinto
Università di Bologna, Bologna, Italy, andrea.maggipinto@unibo.it

F. Mandreoli
Università di Modena e Reggio Emilia, Italy, federica.mandreoli@unimo.it

Alessio Maria Braccini
Università LUISS Guido Carli, Roma, Italy, abraccini@luiss.it

R. Martoglia
Università di Modena e Reggio Emilia, Italy, riccardo.martoglia@unimo.it

Antonio Marturano
Università Cattolica del Sacro Cuore, Roma, Italy, marturano@btinternet.com

G. Mastelloni
University of Bari, Bari, Italy, mastelloni@di.uniba.it

A. Mazzeo
Università degli Studi di Napoli Federico II, Napoli, Italy, mazzeo@unina.it

Michele Melchiori
Università degli Studi di Brescia, Brescia, Italy, melchior@ing.unibs.it

G. Mercurio
CNR, Roma, Italy, gregorio.mercurio@itb.cnr.it

Michele Missikoff
IASI-CNR, Roma, Italy, michele.missikoff@iasi.cnr.it

L. Mola
Università di Verona, Verona, Italy, lapo.mola@univr.it

R. Montanari
Università di Modena Reggio Emilia, Reggio Emilia, Italy, roberto.montanari@unimore.it

S. Montanelli
Università degli Studi di Milano, Milano, Italy, montanelli@dico.unimi.it

M. Mordacchini
ISTI – CNR, Pisa, Italy, matteo.mordacchini@isti.cnr.it

C. Morelli
Università Amedeo Avogadro e Università Carlo Cattaneo, Italy, chiara.morelli@eco.unipmn.it

V. Moscato
Università degli Studi di Napoli Federico II, Napoli, Italy, vmoscato@unina.it

A. Motro
George Mason University, VA, USA, ami@gmu.edu

Raffaella Naggi
Università LUISS Guido Carli, Roma, Italy, rnaggi@luiss.it

Hanne Westh Nicolajsen
Aalborg University, Centre for Media, Communication and Information Technologies, Ballerup, Denmark, westh@cmi.aau.dk

S. Orlando
Università di Venezia, Venezia, Italy, orlando@dsi.unive.it

Linda Pacicco
Università Carlo Cattaneo – LIUC, Castellanza (VA), Italy, lpacicco@liuc.it

U. Pagallo
Università di Torino, Torino, Italy, ugo.pagallo@unito.it

L. Paolino
Università di Salerno, Fisciano (SA), Italy, lpaolino@unisa.it

Stefano Paolozzi
IRPPS-CNR, Roma, Italy, stafano.paolozzi@irpps.cnr.it

Loredana Parasiliti Provenza
Università di Milano, Milano, Italy, parasiliti@dico.unimi.it

Katia Passerini
New Jersey Institute of Technology, Newark, NJ, USA, pkatia@njit.edu

E. Pelino
Università di Bologna, Bologna, Italy, enrico.pelino@unibo.it

M. Pennacchini
Università “Campus Bio-Medico”, Roma, Italy, m.pennacchini@unicampus.it

Ferdinando Pennarola
Università Bocconi, Milano, Italy, ferdinando.pennarola@unibocconi.mi

W. Penzo
Università di Bologna, Bologna, Italy, wilma.penzo@unibo.it

B. Pernici
Politecnico di Milano, Milano, Italy, pernici@elet.polimi.it

G. Peruginelli
Institute of Legal Information Theory and Techniques, CNR, Firenze, Italy, peruginelli@ittig.cnr.it

Daniela Pettinao
Università degli Studi di Cagliari, Cagliari, Italy, pettinao@unica.it

A. Picariello
Università degli Studi di Napoli Federico II, Napoli, Italy, picus@unina.it

Antonio Piccinno
Università di Bari, Bari, Italy, piccinno@di.uniba.it

G. Piccoli
Università di Sassari, Sassari, Italy, lele.piccoli@gmail.com

Y. Pigneur
HEC Lausanne, Lausanne, Switzerland, yves.pigneur@unil.ch

Federico Pigni
Università Carlo Cattaneo – LIUC, Castellanza (VA), Italy, fpigni@liuc.it

H. Pingaud
Université de Toulouse, France, pingaud@enstimac.fr

M. Piva
Università La Sapienza, Roma, Italy, hyunkel82@gmail.com

A. Poggi
Università La Sapienza, Roma, Italy, poggi@dis.uniroma1.it

D. Potena
Università Politecnica delle Marche, Ancona, potena@diiga.univpm.it

A. Pucihar
University of Maribor, eCenter, Slovenia, andreja.pucihar@fov.uni-mb.si

Aurelio Ravarini
Università Carlo Cattaneo – LIUC, Castellanza (VA), Italy, aravarini@liuc.it

P. Refolo
Università Cattolica del Sacro Cuore, Roma, Italy, pietro.refolo@rm.unicatt.it

F.L. Ricci
CNR, Roma, Italy, fabrizio.ricci@itb.cnr.it

A. Ricci
Università di Bologna, Bologna, Italy, annarita.ricci@unibo.it

F. Ricciardi
Università Cattolica del Sacro Cuore, Brescia, Italy, francesca.ricciardi@unicatt.it

C. Rossignoli
Università di Verona, Verona, Italy, cecilia.rossignoli@univr.it

L. Rusu
Royal Institute of Technology, Stockholm University, Stockholm, Sweden, lrusu@dsv.su.se

Domenico Saccà
Università della Calabria, Arcavacata di Rende (CS), Italy, sacca@unical.it;
ICAR-CNR, Arcavacata di Rende (CS), Italy

D. Sacchini
Università Cattolica del Sacro Cuore, Roma, Italy, dsacchini@rm.unicatt.it

M. Sadok
Institute of Technology in Communications, Tunis, Tunisia,
moufida.sadok@gmail.com

S. Sassatelli
Università di Modena e Reggio Emilia, Italy, sassatelli@unimo.it

Ada Scupola
Roskilde University, CBIT, Roskilde, Denmark, ada@ruc.dk

M. Sebillo
Università di Salerno, Fisciano (SA), Italy, msebillo@unisa.it

L.D. Serbanati
CNR, Roma, Italy, luca@serbanati.com; "Politehnica" University,
Bucharest, Romania, luca@serbanati.com

Alberto Sillitti
Libera Università di Bolzano, Bolzano, Italy, alberto.sillitti@unibz.it

Cecilia Silvestri
Università della Tuscia, Viterbo, Italy, c.silvestri@luiss.it

A.L. Simeone
Università di Bari, Bari, Italy, simeone@di.uniba.it

A. Simons
University of Liechtenstein, Vaduz, Liechtenstein,
alexander.simons@hochschule.lit

C. Sonnenberg
University of Liechtenstein, Vaduz, Liechtenstein,
christian.sonnenberg@hochschule.li

Maddalena Sorrentino
Università degli studi di Milano, Milano, Italy, maddalena.sorrentino@unimi.it

A. Spangaro
Università di Bologna, Bologna, Italy, alessandra.spangaro@unibo.it

E.H. Spence
University of Twente, Enschede, Netherlands, e.h.spence@utwente.nl

S.A. Stupnikov
Russian Academy of Sciences, Moscow, Russia, ssa@ipi.ac.ru

Giancarlo Succi
Libera Università di Bolzano, Bolzano, Italy, giancarlo.succi@unibz.it

F. Sudzina
Copenhagen Business School, Frederiksberg, Denmark, fs.caict@cbs.dk

F. Taglino
Istituto di Analisi dei Sistemi ed Informatica "A Ruberti" – CNR, Roma, Italy,
francesco.taglino@iasi.cnr.it

L. Tarantino
Università degli Studi dell'Aquila, L'Aquila, Italy, laura.tara@gmail.com

F. Terella
Università La Sapienza, Roma, Italy, baylisstic83@gmail.com

F. Tesauri
Università di Modena Reggio Emilia, Reggio Emilia, Italy,
francesco.tesauri@unimore.it

P. Tiberio
Università di Modena e Reggio Emilia, Italy, paolo.tiberio@unimo.it

Riccardo Torlone
Università Roma Tre, Roma, Italy, torlone@dia.uniroma3.it

G. Tortora
Università di Salerno, Fisciano (SA), Italy, tortora@unisa.it

E. Tracanna
Università La Sapienza, Roma, Italy, ematrac@gmail.com

E. Traisci
Università Cattolica del Sacro Cuore, Roma, Italy, emma.traisci@rm.unicatt.it

M. Tucci
Università di Salerno, Salerno, Italy, mtucci@unisa.it

E. Ugazio
Università Carlo Cattaneo – LIUC, Castellanza (VA), Italy, eugazio@liuc.it

U. Varshney
Georgia State University, Atlanta, GA, USA, uvarshney@gsu.edu

Guia Venturoli
Università Telematica Guglielmo Marconi, Roma, Italy, venturoli@unimarconi.it

G. Vetere
IBM Italia, Center for Advanced Studies of Rome, Roma, Italy, guido_vetere@it.ibm.com

A. Virdis
Università Cattolica del Sacro Cuore, Roma, Italy, andra.virdis@rm.unicatt.it

Francesco Virili
Università degli Studi di Cassino, Cassino (NA), francesco.virili@eco.unicas.it

Giuseppe Visaggio
Università di Bari, Bari, Italy, visaggio@di.uniba.it

C.A. Visaggio
Università degli Studi del Sannio, Benevento, Italy, visaggio@unisannio.it

G. Vitiello
Università di Salerno, Fisciano (SA), Italy, gvitiello@unisa.it

Jan vom Brocke
University of Liechtenstein, Vaduz, Liechtenstein, jan.vom.brocke@hochschule.li

D. Walsh
New Jersey Institute of Technology, Newark, NJ, USA, walshd@njit.edu

C. Welch
Portsmouth Business School, Portsmouth, UK, christine.welch@port.ac.uk

Stefano Za
Università LUISS Guido Carli, Roma, Italy, sza@luiss.it

A. Zardini
Università di Verona, Verona, Italy, alessandro.zardini@univr.it

I. Zinnikus
Deutsches Forschungszentrum für Künstliche Intelligenz, Kaiserslautern, Deutschland, zinnikus@dfki.de

Ione Zuccarello
Università di Catania, Catania, Italy, izuccarello@lex.unict.it

A Feature Ranking Component for GIS Architecture

A. Gemelli[1], C. Diamantini[2], and D. Potena[3]

Abstract For a Geographical Information System, it is wanted to design a permanent architectural component which is committed to select relevant information from large databases and network of sensors, and useful in the wide range of applications that such system is destined to. This component allows the system to reach an optimal performance with savings on data acquisition costs and computational resources. The component is based on Data Mining technology and uses feature extraction algorithms to rank the relevance of the dataset features. In all applications reducible to a classification of geographical objects, the feature ranking procedure highlights the features with higher class discriminatory power. Features Ranking is also a cognitive strategy, and produces models of interest toward an artificial intelligent system. The GIS is a Decision Support System (DSS), whereas the feature ranking component supports a within processing decisional activity. A prototype of this component has been assembled and tested on several geographical dataset with promising results at current research stage.

Introduction

Explosion of data represent challenges and opportunities for the information systems involved in modelling complexity, as is in economy, environmental, large scale infrastructure management applications. On the one hand every information system can limitlessly access any data collection on a global scale to construct and to refine the models. On the other hand information systems compete on costs, promptness of response and reliability of processing results. For these opponent reasons, the performance of an information system used for modelling depends of its ability to raise the *model accuracy* to *calculus complexity* ratio. This is achieved

[1]Università Politecnica delle Marche, Ancona, gemelli@diiga.univpm.it
[2]Università Politecnica delle Marche, Ancona, diamantini@diiga.univpm.it
[3]Università Politecnica delle Marche, Ancona, potena@diiga.univpm.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_27, © Springer Physica-Verlag Berlin Heidelberg 2010

with an optimal selection of the information to be conveyed to the processing. This is the typical scenario in data-driven processing systems [23], such is the *Geographic Information Systems* (GIS) [14], either if desktop GIS or geographically distributed network of sensors. Modern GIS can therefore be envisioned as an informatics architecture which is intended to model a variety of complex real world situations, in optimal way and with limited resources. It is sought thinking to include at the core of a GIS architecture a component that is capable to decide, which is the relevant information in order to optimize the processing for each given goal, and that shall be based on computational methodology having intrinsic versatility. Terminology and concepts to define the properties of such a decisional component come from discipline of Decision Support System Engineering [1]. A *Decision Support System* (DSS) is by definition a system that supports decision-making based on vague, imprecise, and incomplete information [18]. All GIS in the modern conception are DSS, since they extract models of geographical phenomena to help the user to take decisions. Also a DSS can be a component included in a larger informative system and take decision on processing activities to optimize the processing itself, either cooperating or not with user. In the framework of a system dedicated to support geographical objects classification task, which is quite a common GIS application, we propose a architectural component that is intended to decide automatically the relative relevance of each variable (or feature) contained in a GIS database, for a given classification task and using data mining technology.

Current Scenarios

There are two general situations in which the ranking utility in a GIS can contribute. These are when: (1) the ranking is used to select relevant information stored in large database, with the objective to leverage the computational load and human understanding of the geographic complexity (2) The ranking is used to evaluate the importance of the features when designing a data acquisition scheme, with the objective to reduce the acquisition costs.

As specifications to the system we want to realize, in this paragraph we depict the basic processing operations of a GIS, and express the requirements for feature ranking facility. In GIS the data are organized in data structures called layers. A *layer* captures the geographical information along with spatial relationships in a Euclidean space. Each layer contains information related to a spatially varying feature of the geographical environment and it is conceptually similar to a thematic geographic map. With this data structure, it is possible to retrieve a feature value at each point of the geographical space. Consequently, a set of layers constitutes a multivariate dataset providing the value of each feature (or a tuple) at each location in space. Most of the GIS applications [10], from decision support to environmental forecasting, can be conceptually reduced to a classification task. For example when deciding which type of natural hazard an area is most at risk of, when deciding whether or not to intervene for civil protection purpose and how, or when making statements of the health state of vegetation coverage or land use forecasts. When processing takes place, data are taken from the layered dataset, in the form of tuples, then the classification algorithm builds a model (or classifier) capable of predicting a defined target feature. In real appliances this model will be used to predict a target feature; in other words, if variations occur in the environment the model will be used to classify the new status. The features (layers) we take into account for defining the dataset schema, affects the accuracy of the classifier. As a matter of fact, few features could not contain a sufficient discriminative power, while too many features tend to highlight the negative effect of the "curse of dimensionality". Therefore the features are ranked by between-classes discriminative power. Later, feature ranking altogether with restrictions on accuracy, system costs, computational complexity, leads to the feature selection. A GIS is expected to be versatile on a large-range of applications. Therefore it is appropriate to design a system architecture whose components have a ubiquitous valence over any kind of information. The use data mining algorithms for features ranking offers several vintages. Data mining methods are minded to be generally applicable to any kind of information, they are chosen only on the basis of generally defined tasks such as classification, clustering or feature extraction. What's more, it is wanted such architecture with this component converges, by eventual further expansions, to an intelligent system; in fact the highest versatility achievable among informative systems is represented by the class of intelligent systems. We characterize our system architecture, by assessing its significance as artificial intelligent system. Among the several approaches in artificial intelligence we find in the *Cognitivism* the optimal reference for our architecture, since the strong analogy on the goal oriented reasoning.

Existing Solutions

Looking at feature ranking/selection, there are two major approaches, one is centered on feature extraction, which consists in transforming the data in a reduced dimensional domain obtained by linear combinations of the original features. The vintage offered by this approach lies in the data volume reduction. Whereas the second approach leads to the selection of information in the original dimensional domain. The latter approach is less effective in terms of data volume reduction but has the important vintage of generating results in a cognitive form, easily readable by human. A survey of data mining techniques in data feature selection is in [7]. Other related work investigates are [25] and [11]. Current applications of feature ranking/selection in GIS concern the optimization data collection and transmission over a network of distributed sensors [20]. Another applications is *Geovisualization*, where the information selection is finalized to build efficient cognitive visual interfaces [21]. However, finding application of data mining as core component of a versatile system, finalized to optimize the processing itself is harder [5]. Examples of use of data mining methods in decision support are in [20, 23]. In DM, information reduction is implemented with a dimensional reprojection, better known as *Feature Extraction* (FE). The new extracted features (or *eigenfeatures*) are ranked by classification capability or variance caption within the dataset. A well known FE technique is the *Linear Discriminant Analysis* (LDA), based on the Fisher Criterion of class separability [8]. However a problem with LDA and all other FE techniques, is that they rank the eigenfeatures rather than the features in the original space. Therefore the ranking is not of a direct help when the selection must be compared with a specific domain of knowledge, such is when interoperability issues exist or when final human supervision is wanted over the selection process, as normally it is expected in scientific investigations.

Wanting to design architecture adaptable to any application within the geography domain, it is essential to assess its performance in the general vision of a scientific reasoning. The system we propose performs information ranking/selection, which is an important issue in geographical modelling and in general in all sciences. Feature Selection in sciences is checked against computational issues in [3]. We want to outline here that the selection of relevant information is a fundamental step in cognitive processes [24] and therefore its introduction in a GIS as a core functionality is a step toward designing a system of the artificial intelligent class [9, 22]. In a cognitive framework, the feature selection operates by translating the information from the raw undifferentiated form in which it is collected, to a form where it is sorted and selected to achieve a specific goal [15]. In geography modelling the adoption of cognitive strategy has been discussed by [12, 7].

Expanding GIS Architecture to Include Ranking Utility

In this paragraph it is described the architecture that we propose. The Fig. 1 shows the logical layout of the core GIS architecture augmented by feature ranking and selection component modules. Hereafter are described the components of such system (list numbers refer to architectural components in the figure):

1. *Multi-Source*: In modern-day scenario the GIS received data from a large database and moreover can access to huge data collections that can also be distributed over the Internet, or receive data from complex networks of sensors.
2. *Data Sampling Module*: in preliminary phase only evaluation samples are loaded from the source into the local system either to reduce the computational load or the acquisition costs.
3. *Feature Ranking Module*: this is based on a Feature Extraction algorithm. Here the mapping matrix, used to map the instances of the original feature space into a new feature space, is further manipulated to calculate the contributive weight of each original feature to the new feature space. In this module we can use every algorithm outputting a transformation matrix and whose goal is to maximize the class separability. Suitable algorithm of this type can be those based on *LDA*,

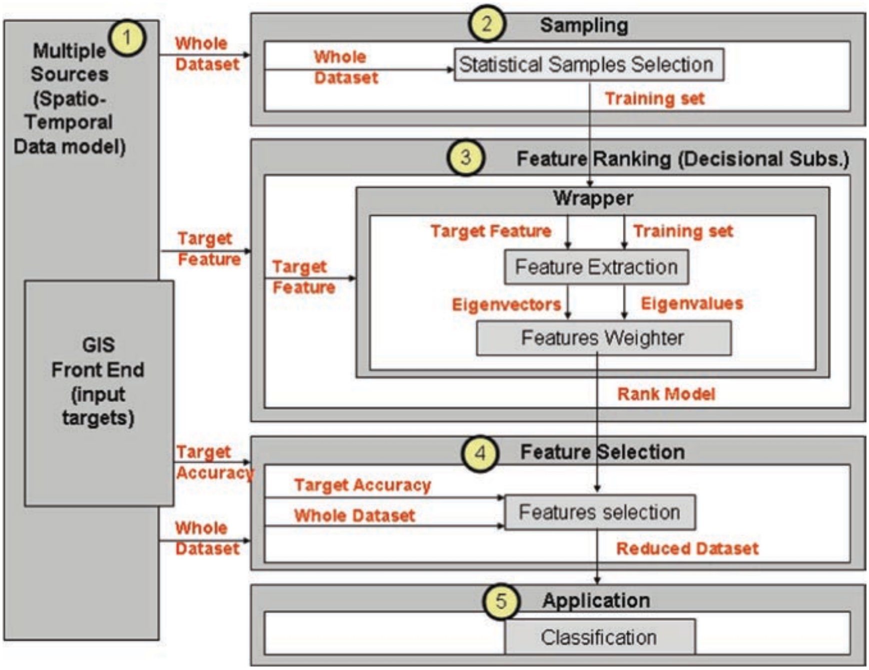


Fig. 1 In the GIS architecture, a core component which is enabled to perform feature ranking, is interposed between data acquisition channel and any further computational process

and on the *Decision Boundary Feature Matrix* (such as *EDBFE, BVQFE* and *SVM-DBA*) [7]. In particular we used the LDA, where the transformation matrix is directly generated by the eigenvalue decomposition. From theory it is known that the components of eigenvectors represent the weight of every original feature in the new space, whereas the eigenvalues are the weight of each eigenvector. Therefore for the objective of this work, firstly eigenvectors are weighted by multiplying them by the respective eigenvalues, then we sum corresponding components (the absolute values) of weighted eigenvectors. Resulting values are the contribution (or weight) of every original feature in the new feature space, whose relative comparison gives the ranking of original features. Hereafter we report the pseudocode of the algorithm within the Feature Ranking Module:

a. *Let* $X = \{x_1, x_2, \ldots, x_m\}$ *be the m-dimensional original feature space.*
b. *Let A be the transformation matrix obtained by the LDA algorithm.*
c. *Let* $Y = \{y_1, y_2, \ldots, y_m\}$ *be the eigenvectors of A, and* $\lambda = \{\lambda_1, \lambda_2, \ldots, \lambda_m\}$ *be the related eigenvalues.*
d. *For i = 1 to m* $\quad w_j = \sum_{i=1}^{m} \left|\lambda_i y_{ij}\right|$
e. *Sort* w_j

Referring to Fig. 1, the modus operandi is considered *wrapper* since the FE algorithm output is conditioned by a chosen target. Throughout a front end interface, a feature is chosen by the user as target of the classification process task. As we consider the ranking a type of modelling, we call *Rank Model* the output from this module.

4. *Feature Selection*: We detach a feature selection component, which realistically might require some interaction with the system user, and therefore represents a cooperative decisional element. The input to this module is the feature ranking model. Features are picked out from the original feature space, beginning by those with higher rank, up to put together an ensemble of features that minimize/maximize a previously given (by the user) objective function. In practice the user can supply any kind of objective function, for example, to minimize the processing costs, to maximize the ratio between accuracy and cost, and so on.
5. *Application*: whichever data processing takes place in GIS, as classification for example, that can computationally benefit from having in input only a selection of features.

The core module of feature ranking has already been tested on several dataset and using several versions of the LDA. Results encourage conferring a general validity to the method. As example we cite a validation test performed on the UCI Cover Type dataset, whose target is to predict the class of vegetation coverage, (the target layer) on the basis of various other layers from hydrology to topography, see Fig. 2. Other tests, with equal results, have been performed on other datasets concerning assessments on the natural hazards, land use, aptitude to urbanization and more. The *Cover Type* (from forestry domain) consists of 54 numerical features (elsewhere layers) and a target feature whose values represent seven mutually exclusive forest cover classes. Features that are mutually exclusive have been coded in one, that is the case of the forty features representing the soil type

RANK	CoverType Dataset Features	w_j cum. (%)	1NN Acc. cum. (%)
1	Elevation	21,9	59,5
2	Soil Type	35,5	72,3
3	Wilderness Area	47,2	73,8
4	Hillshade 3pm	57,7	79,0
5	Hillshade Noon	65,2	82,2
6	Hillshade 9am	72,7	81,8
7	Horiz. Dist. To Hydr.	79,0	86,3
8	Horiz. Dist. To Fire P.	84,7	95,2
9	Horiz. Dist. To Road	90,0	100
10	Slope	93,8	100
11	Vert. Dist. To Hydr.	97,1	100
12	Aspect	100	100

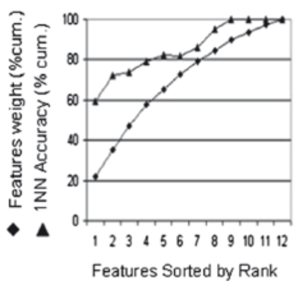


Fig. 2 Feature ranking index (first column). The dataset features (second column) ranked by weight. The cumulated weight (w_j). For comparison the accuracy (1NN Acc.) is also plot

designation, and the four features designing the Wilderness Area. After compression the dataset has $m = 12$ features plus the class. But moreover the Forest Cover-Type is a quite a large dataset containing over 500,000 instances. Then the LDA based feature ranking has been run. A classification algorithm (*1Nearest Neighbour*) has been repeated on several subset of the Cover Type, each obtained from the preceding, by adding an additional feature taken in the ranking order calculated using an LDA wrapper algorithm. As shown in the Fig. 2, this procedure outlines that a subset of the features contains most of the discriminative power, whereas the remaining features bring no contribution to classification accuracy and therefore might be selected off the dataset without affecting the classification accuracy. Other subset of features, chosen from the top rank list, can help to reach relative high accuracy in the classification. For example the first 6 features in the rank scale, hold enough information to reach over 80% of the classification accuracy obtainable with all 12 features.

Conclusions

We propose an architectural component that produces an automatic ranking of the features. This is versatile to the generality of GIS applications. Located as a core component in the system main workflow, this module assumes the role of an active/cooperative decisional support that benefits the system performance. Eventually it can be separated in two distinct components, the first dedicated to feature ranking and the second to the feature selection. The ranking model appears strongly conditioned by the goal, since ranking is almost unchanged when changing the wrapper algorithm. This has great significance of coherency and objectivity of the results. The ranking model has cognitive properties since it well fit within a process leading to knowledge production in the scientific sense. It is under study the feasibility of a base of knowledge that stores the ranking models in a unified schema constituting the system experience.

References

1. Arnott, D. & Pervan, G. (2005). A Critical Analysis of Decision Support Systems Research. *Journal of Information Technology*, 20, 67–87.
2. Baldwin, C.Y. & Clark, K. (2002). The Option Value of Modularity in Design. Harvard Business School, Boston
3. Cantu-Paz, E., Newsam, S., & Kamath, C. (2004). Feature Selection in Scientific Applications. *In International Conference on Knowledge Discovery and Data Mining LLNL.*
4. Crossland, M.D., Wynne, B.E., & Perkins, W. C. (1995). Spatial Decision Support Systems – An Overview of Technology and a Test of Efficacy. *Decision Support Systems*, 14, 219–235.
5. Delisle, S. (2005). Towards a Better Integration of Data Mining and Decision Support via Computational Intelligence. *In International Workshop on Database and Expert Systems Applications*, pp. 720–724, IEEE.

6. Diamantini, C. & Potena, D. (2007). A study of Feature Extraction Techniques Based on Decision Border Estimate. In Huan, L & Hiroshi, M (Eds.), *Computational Methods of Feature Selection* (Chapman and Hall), Boca Raton, FL
7. Gemelli, A., Diamantini, C., & Potena, D. (2007). Tecnologie Cognitive nei Sistemi per la Modellistica Geo-spaziale. In *SEBD*, pp. 148–159.
8. Jieping Ye (2005). Characterization of a Family of Algorithms for Generalized Discriminant Analysis on Undersampled Problems. *Journal of Machine Learning Research*, 6, 483–502.
9. Langley, P. (2006). Cognitive Architectures and General Intelligent Systems. *AI Magazine*, 27.
10. Maguire, D.J., Batty, M., & Goodchild, M. F. (2005). GIS, Spatial Analysis, and Modeling. ESRI.
11. Mandic, D., Obradovic, D., Kuh, A., Adali, T., Trutschel, U., Golz, M., De Wilde, P., Barria, J., Constantinides, A., & Chambers, A. (2005). Data Fusion for Modern Engineering Applications: *An Overview. In International Conference on Artificial Neural Networks*, pp. 715–721.
12. Mark, D.M., Freksa, C., Hirtle, S.C., Lloyd, R.E., & Tversky, B. (1999). Cognitive Models of Geographical Space. *International Journal of Geographical Information Science*, 13, 747–774.
13. Miller, H.J. & Han, J. (2001). Geographic Data Mining and Knowledge Discovery. Taylor and Francis, London
14. Openshaw, S. & Abrahart, R. J. (2000). Geocomputation. Taylor and Francis.
15. Pitt, M.A., Myung, I.J., & Zhang, S. (2002). Toward a Method of Selecting Among Computational Models of Cognition. *Psychological Review*, 109, 472–491.
16. Power, D.J. (2008). Understanding Data-Driven Decision Support Systems. *Information Systems Management*, 25, 149–154.
17. Rupnik, R., Kukar, M., Bajec, M., & Krisper, M. (2006). DMDSS: Data Mining Based Decision Support System to Integrate Data Mining and Decision Support. *In International Conference on Information Technology Interfaces*, pp. 225–230, IEEE.
18. Sage, A.P. (1991). Decision Support System Engineering. Wiley, New York.
19. Shim, J. P., Warkentin, M., Courtney, J. F., Power, D. J., Sharda, R., & Carlsson, C. (2002). Past, Present, and Future of Decision Support Technology. *Decision Support Systems*, 33, 111–126.
20. Thiemjarus, S., Lo, B.P.L., Laerhoven, K.V., & Yang, G.Z. (2004). Feature Selection for Wireless Sensor Networks. *In International Workshop on Wearable and Implantable Body Sensor Networks*.
21. Wachowicz, M. (2001). GeoInsight: An Approach for Developing a Knowledge Construction Process Based on the Integration of GVis and KDD Methods. *In: Geographic Knowledge* Discovery. In H.J. Miller & J. Han (Eds.), (pp. 239–259). London: Taylor and Francis.
22. Wang, Y. (2003). On Cognitive Informatic. *Brain and Mind*, 4, 151–167.
23. Wong, A.K.C. (2003). Pattern Discovery: A Data Driven Approach to Decision Support. IEEE Transactions on Systems, Man, and Cybernetics, Part C: *Applications and Reviews*, 33.
24. Zhong, Y.X. (2006). A Cognitive Approach to Artificial Intelligence Research. *In International Conference on Cognitive Informatics*, pp. 90–100, IEEE.
25. Zhou, J. (2007). Feature Selection in Data Mining – Approaches Based on Information Theory. VDM Verlag Dr. Mueller, Saarbrücken.

A Maintenance Metric Model for Open Source Governance

P. Ardimento[1], G. Bruno[2], D. Caivano[3], and M. Cimitile[4]

Abstract The adoption of Open Source in industrial applications has increased in the last years. In this context the need to provide answers to high levels of Maintenance arises. Therefore it is critical to select Open Sources components to be integrated in a software system according to their Maintenance characteristics. The work presents a Metric Model and its related Decision Model for OS Governance and in particular for selecting OSs according to their Maintenance Level. The Metric Model was obtained individuating some automatically calculable measures from a group of projects available on the Web. The measures were validated on several OSs used in industrial projects. The results are of interest and encourage future research.

Introduction

In the last years, we have been assisting to an increasing adoption of and interest towards Open Source (OS) solutions [1–5]. The OS diffusion is highlighted by a survey conducted by Wheeler [6] which points out the use of OS in the United States, South America and Europe although with different approaches and strategies.

This high use of Open Source Systems (OSs) explains the need to adequately select the proper OSs to be integrated in a defined system in order to respond to the project goals [7].

This selection should consider the OS Maintenance level, where Maintenance level increases on the base of the amount of maintenance tasks carried out for evolving, fixing or improving an OS.

[1]Università di Bari, Bari, Italy, ardimento@di.uniba.it
[2]Università di Bari, Bari, Italy, bruno@di.uniba.it
[3]Università di Bari, Bari, Italy, caivano@di.uniba.it
[4]Università di Bari, Bari, Italy, cimitile@di.uniba.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_17,

The maintenance viewpoint chosen is motivated by the observation that in the last years, a common practice has been to build software applications by assembling software components and, in this context, OSs. This implies that the evolution of a software application depends on the evolution of its components. Furthermore, maintenance problems can derive from a different evolution of the system and the OSs: for example the context could require improvements that involve the OSs it is made up of, but no maintenance requests may be available nor planned on the Project website for part or all of the OSs.

Therefore, before adopting an OS, it is necessary to investigate the level of maintenance activities performed. A low level maintenance activity may indicate a progressive project death due to the difficulties in evolving it or, simply, the lost of interest on behalf of the community. In both cases, the result is that a user cannot benefit from software upgrades and new releases. In this case the OS should be substituted with an equivalent one or, alternatively, it is necessary to start paying for its maintenance and evolution.

According to the introduced topic, the present work aims to identify a Maintenance Metric Model for the evaluation of the maintenance level of an OS. This Metric Model was obtained starting from the selection of measures from a list of measures commonly used for several Open Source Projects characterization and individuating an interpretation model that allows to associate to an OS its evaluated maintenance level.

The proposed Metric Model supports, in our opinion, the OS analyst in selecting the most adequate OS to use in an application giving him an evaluation of OS maintenance level.

The remainder of this paper is structured as follows: Section "Related Works" recalls previous works. Section "Proposed Evaluation Process" shows the proposed evaluation process. Based on these, the last Section completes the paper by providing some conclusive insights and final remarks, and showing future works.

Related Works

In general the selection of an OS is made taking into account various viewpoints. For example, some researchers [1, 9, 10], formalize a framework of Quality Assurance (QA) in an OS, elicit OS stakeholder value propositions for QA and derive performance indicators to reduce risks such as unclear requirement elicitation, ad hoc development process, maintenance activity for improving quality. Currently, the most accredited method is QSOS (Qualification and Selection of Open Source software) designed to qualify, select and compare free and open source software in an objective, traceable and argued way [11]. This method has been implemented and the tool is available under the terms of the GNU Free Documentation License. This method in terms of Maintenance Activity is lacking because some ordinal measures are used. In this way it is difficult to individuate the relationship between the measures and give a detailed interpretation of the obtained values.

A different approach has been perceived by Christley and Madey who discuss a large data set of OSs from the SourceForge.net and the Concurrent Version System (CVS) websites [12]. They describe how to extract information regarding the activities performed by users on OSs using Software repository mining techniques. To this aim, they use data regarding submitted bugs, submitted support requests, submitted patches, new forum messages, new project tasks and so on. The results of this study point out the need of further investigating data mining techniques.

In [13] authors show that sources of OSs maintenance data such as defect tracking systems, change logs, and source code, cannot, in general, be used for measuring maintainability. They propose three resources able to provide the maintenance data needed for measuring maintainability: defect tracking systems, change logs and source code. Authors also examine an indirect means of measuring maintainability, such as defect distribution and the lag time to fix defects. According to the authors, none of the found data can be used to measure OSs maintainability. The obstacles they have encountered refer to missing data, incomplete data, inaccurate data, and lack of construct validity.

The authors of this paper want to overrun the above described limits and propose an OS selection Maintenance Metric Model. The model was obtained by analyzing and comparing OS projects and considering the continuous use and application of OS in industrial contexts.

Proposed Evaluation Process

The evaluation process synthesized in Fig. 1 was used to identify the metric model. Analysis starts from the selection of a group of candidate Open Source projects called “Candidate OSs.” For each of them we collected some significant measures

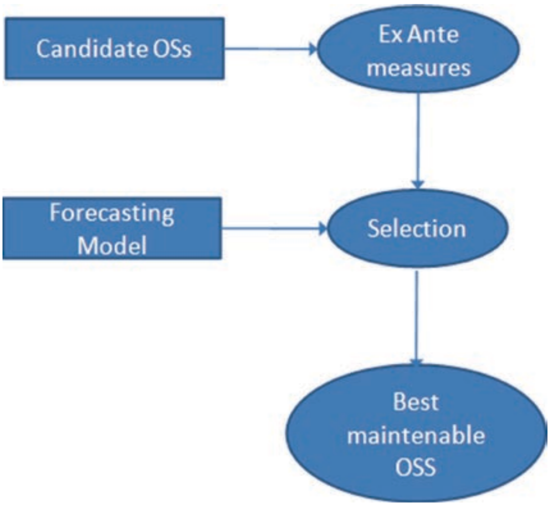


Fig. 1 Open source software evaluation process

with respect to Maintenance Level activity (Ex-Ante Measures). At this point we applied a forecasting model that allowed us to select the best maintainable OS Project among the Candidate OSs.

Forecasting Model

The first activity of own investigation was the selection of some representative OS projects. These projects were extracted by SourceForge [1,14]. It is a common OS repository and OS development website. In SourceForge the OSs are characterized using some measures. These measures are often perceived useful for evaluating whether a project is better than another one, or if it is better maintained or more stable than another one.

We considered a group of 870 projects [15] selected using a simple random sampling technique. By a discriminating analysis we selected the most significant measures to distinguish the characteristics of OSS with refer to the maintenance activity. The selected measures are shown in Table 1.

Table 1 Includes the list and the description of the selected Ex-Ante Measures

Measure	Description
Bug Fix Rating (BFR)	It expresses the ratio of bugs that are solved by developers and the total number of tracked bugs
Release For Month (RFM)	It expresses the average number of published releases per Month since the project was published until it was measured
Development Status (DS)	The Development Status expresses the level of stability of the OS, (from 1 to 6)
Number of Developers (ND)	Refers to the number of developers participating to the production of an OS.
Downloads (DSW)	Number of time the OS was downloaded.
Longevity (LSW)	Number of passed months from the publication of the OS until it was measured

Ex-Ante Measures Calculation

In order to evaluate the validity of the proposed measures and their interpretation, these measures were used to evaluate some OSs integrated in Software Projects developed within SERLAB (Software Engineering Research LABoratory) at the University of Bari in the last years [16]. For all of the integrated OSs we know the measures related to maintenance process. It is important to note that some OSs are applied in more than one project. For this reason we considered the OS once for each project. Table 2 shows the values of Ex-Ante measures in percentage assumed

Table 2 Excerpt of Ex-Ante Measures calculated for SERLAB OSs

OS name (n)	BFR (%)	RFM (%)	DS	ND	DSW	LSW
Spaghetti learning (1)	24	8,3	4	2	2,870	26
Atutor 1.5.2 (5)	60	4,4	5	6	257,697	89
Claroline (1)	55	7,2	6	11	56,679	69
CRM-CTT (3)	75	5,5	6	1	56,018	72
Typo3 (3)	0,6	2,2	6	26	3,512,425	89
Joomla (1)	0	18,1	4	3	2,834,224	11
Alfresco (1)	5,9	8,3	5	17	1,186,836	36
Openflow (1)	66	0,9	3	2	4,395	111
Pmapper (1)	0	0,49	5	1	24,513	61

by OSs integrated in SERLAB Projects. Each row should be considered (n) times, were n is the number of projects the same OS was applied to. This number is expressed in the first column near the OS name. A detailed description of the Projects can be found in [15].

Ex-Post Measures Calculation

To evaluate the maintenance of the used OS, we collected some ex-post measures of used OS. The ex post measures are the following:

Fixed Bug (FB): number of tracked bugs that were solved during the system lifecycle;

Time to Bug Fixing (TBF): number of days required to fix the bug;

Implemented Evolutions (IE): number of required evolutions during the system lifecycle;

Time to Evolution Implementation (TEI): number of days required to implement the Evolution.

According to the combination of values assumed by these measures, we divided own OS in: High Maintenance (HM), Medium Maintenance (MM) and Low Maintenance (LM).

In [15], we show a Decision Table to associate each used OS to a Maintenance Level on the base of the ex post measures values.

In Table 3 OSs used in SERLAB Projects are distributed on the base of their Maintenance Level (TR):

As shown in Table 3, OSs are distributed quite equally among the three considered groups. The projects classified as LM are: Spaghetti Learning, Joomla, Openflow, Pmapper; MM are Claroline, CRM-CTT (3), Alfresco; HM are Atutor 1.5.2 (5), Typo3 (3).

So we can consider our set of projects as useful to obtain observations about projects of different level.

Table 3 Maintenance level of OSs used in SERLAB Projects

Maintenance level	Number of OSs
LM	4
MM	5
HM	8

Ex-Ante Classification

The classification analysis between Ex-Ante Measures and Maintenance Level permitted us to evaluate how Ex-Ante measures can be used to forecast OSs Maintenance Level.

The obtained classification can be expressed by a Decision Table, shown in Fig. 2. For space reasons the Decision Table represents only Ex-Ante measures of OSs integrated in SERLAB Projects. Decision Table allows, giving an OS, to evaluate on the base of the Ex-Ante Measures its Maintenance Level:

Considering for example Column 1 we observed that a NM level is predicted for an OS assuming the following values: BFR≥50%, RFM≤2%, DS≥5, ND≤2, DSW<100,000, LSW<36.

Moreover, the correlation analyses allows to identify the optimal range for the Ex-Ante Measures: BFR≥50%, 2<RFM<5%, DS≥5, ND>2, DSW≥100,000, LSW<36.

The Decision Table can be improved adding new observations (executed projects). In this way the classification results become more reliable. Therefore, the Decision Table can be considered useful for collecting experiences deriving from OS Governance projects.

CONDITIONS	STATES																				
BFR																					
RFM	<=2%																				
DS	>=5								<5												
ND	<=2				>2				<=2				>2				<=			2	
DSW	<100000		>=100000		<100000		>=100000		<100000		>=100000		<100000		>=100000		<100000			>=100000	
LSW	<36	>=36	<36	>=36	<36	>=36	<36	>=36	<36	>=36	<36	>=36	<36	>=36	<36	>=36	<36	>=36		<36	>=36
LEVEL																					
HM	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-		-	-
MM	-	X	X	X	X	X	X	-	-	-	-	X	-	X	X	X	X	X		X	X
LM	X	-	-	-	-	-	-	-	X	X	X	-	X	-	-	-	-	-		-	-
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	...	95	96

Fig. 2 Classification of OSs integrated in SERLAB projects

Conclusions and Future Work

The work aims to introduce a Metric Model for selecting an OS project according to its Maintenance Level. The Metric Model definition requires: the identification of a set of measures, the identification of their interpretation model.

According to the established goal we obtained a group of measures automatically calculable. It means that given an available OS on the Web, we can calculate the Ex-Ante Measure in a quick and economic way.

To the proposed measures we have associated an interpretation model. This model provides an evaluation of the OS Maintenance Level according to the Ex-Ante measures. Moreover, the OS evaluation can be executed through a proposed Decision Table.

The proposed Metric Model represents a preliminary model, in fact it needs to be improved and validated using a statistically significant set of applications.

As future works, some empirical investigations aiming to improve the proposed model and to empirically confirm our primary results will be conducted. According to this scope we are interested in sharing our research experience with other researchers.

Acknowledgments We would like to express our thanks to Prof. Giuseppe Visaggio for his contribution and suggestions during this work.

References

1. Spinellis, D. and Szyperski, C. (2004) How is open source affecting software development?, IEEE Software 21(1): 28–33.
2. Madanmohan, R. De' (2004) Open Source Reuse in Commercial Firms, IEEE Software 21, (6): 62–69.
3. Conover, W.J. (1980), Practical Nonparametric Statistics, New York, Wiley.
4. Capiluppi, A., Lago, P. and Morisio, M. (2003) Evidences in the Evolution of OS Projects through Changelog Analyses- Taking Stock of the Bazaar: 3rd Workshop Open Source Software Engineering, 25th International Conference on Software Engineering: 19–24.
5. Fitzgerald, B. (2004) A Critical Look at Open Source, IEEE Computer 37(7): 92–94.
6. Wheeler, D.A. Why Open Source Software/Free Software (OS/FS, FLOS, or FOS)? Look at the Numbers!, http://www.dwheeler.com/oss_fs_why.html.
7. Wheeler, D.A. How to Evaluate Open Source Software/Free Software (OS/FS) Programs, http://www.dwheeler.com/oss_fs_eval.html
8. Dueñas, J.C., Parada, G., Cuadrado, H.A., Santillán, F. and Ruiz, J.L. (2007) Apache and Eclipse: Comparing Open Source Project Incubators, IEEE Software 24(6): 90–98.
9. Wahyudin, D., Schatten, A., Winkler, D. and Biffl, S., (2007) Aspects of Software Quality Assurance in Open Source Software Projects: Two Case Studies from Apache Project, Software Engineering and Advanced Applications, 33rd EUROMICRO Conference: 229–236.
10. Basili, V.R., Briand, L. and Melo, W.L. (1996) A Validation of Object-Oriented Design Metrics as Quality Indicators, IEEE Transactions on Software Engineering 22(10): 751–761.
11. QSOS method available at http://www.qsos.org/download/qsos-1.6-en.pdf.

12. Madey, C. (2007) Analysis of Activity in the Open Source Software Development Community, 40th Annual Hawaii International Conference on System Sciences, HICSS.
13. Liguo, Y., Schach, R.S. and Kai, C. (2005) Measuring the Maintainability of Open-Source Software, Empirical Software Engineering: 17–18.
14. http://sourceforge.net/.
15. Ardimento, P., Cimitile, M., Bruno, G. and Visaggio, G. (2008) Open Source Governance, TR02 (available on request).
16. http://serlab.di.uniba.it/.

A Methodological Approach to Enable Cooperative Process Design Through Web Services

D. Bianchini[1], C. Cappiello[2], V. De Antonellis[3], and B. Pernici[4]

Abstract Web services are rapidly becoming the key technology for enterprises to enable IT development and modernization. By now, organizations have experienced the Service Oriented Architecture (SOA) technology by developing and using simple internal applications or by searching for information provided by external services, thus enabling the interactions among different organizations. SOA is also an appropriate platform-independent approach to implement cooperative business processes. In this scenario, the service is a unit of work provided by a service provider and offered to the other organizations involved in a common network. In order to share services and knowledge, organizations have to standardize their own process descriptions and model them through services using the same approach and principles. The paper proposes a methodology to support the designer in the identification of services to produce by considering the initial process flow. The adoption of the presented approach would guarantee a homogenous description of services and their interaction along the enterprise network and thus facilitate the collaboration.

Introduction

The revolution in business caused by the Internet and related technologies demonstrates that information systems and IT can provide a strategic platform to support the collaboration among enterprises. In general, when enterprises share applications, services and knowledge, they are called Internetworked Enterprises (IE) [1]. IE can be seen as a borderless organization whose processes are transformed and integrated with the ones of its partners. Collaboration implies the adoption of standards and suitable infrastructures to communicate. The Service Oriented Architecture (SOA)

[1]Università degli Studi di Brescia, Brescia, bianchin@ing.unibs.it
[2]Politecnico di Milano, Milano, cappiell@elet.polimi.it
[3]Università degli Studi di Brescia, Brescia, deantone@ing.unibs.it
[4]Politecnico di Milano, Milano, pernici@elet.polimi.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_25,

promises significant benefits in this scenario. In particular, organizations in the IE network can share their own applications by using the Software as a Service paradigm (SaaS). They can place their own implemented functionalities at the other organizations' disposal by creating services and providing them to the others across the Internet and thus designing operating information systems able to connect IEs each other. By eliminating the need of installing and running the application on the customer's own computer, SaaS alleviates the customer's burden of software maintenance, ongoing operation and support. In such a way, the adoption of SOA technology also enables small and medium enterprises (SMEs) to join IE networks, since it promises to reduce costs and complexity for connecting systems and businesses.

At the heart of the SOA paradigm there is a catalog of available services that can be shared across IE and reused to build up collaborative processes. Service descriptions in the semantic catalog should be homogeneous, that is, similar functionalities have to be mapped to the same ontological concept possibly maintaining the same granularity. The level of granularity should be apt to guarantee the comparability among different services. In fact, coarse-grained services (e.g., a service associated with more tasks of a process) could not be compared with elementary services (e.g., a service that corresponds to a single task of a process). In this scenario, starting from a high level process representation, we aim at building a methodology to support process designers in the identification of reusable services. Our approach guarantees that the service description will be homogeneous for all the organizations involved in the network since the minimum granularity level will be adopted.

Some contributions in literature address similar issues by supporting the transformation of legacy applications into orchestrated services [2–4]. Other approaches attempt to assist service providers and service aggregators in orchestrating multi-party business processes. In particular, [5] discusses how the business process should be described so that services can be properly identified and provides strategies and principles regarding functional and non-functional aspects of Web service design. Furthermore, in [6] authors propose a methodology that aims at defining a foundation of development principles for Web services based on which business processes can be assembled into business scenarios. All these approaches provide guidelines for the service identification without giving an operational support. The use of coupling and cohesion metrics to evaluate process decomposition into sub-processes or activities has been suggested in [7–9], but the proposed techniques are mainly devoted to compare different decompositions to choose the best one. To the best of our knowledge, there are no approaches in literature that propose a semi-automatic methodology that supports the designer in identifying the component services in a business process.

Methodology

In our approach, the business process is modelled using a workflow-based notation (e.g., BPMN). In general, a business process is defined recursively starting from a set of simple tasks aggregated through control structures (such as sequence, choice, cycle or parallel) to form composite tasks, also denoted as sub-processes. Simple tasks are featured by their name, I/O parameters, pre- and post-conditions. Data exchanged between process tasks and control flows connecting them are modelled as data dependencies and control flow dependencies between tasks, respectively. A service can also be defined as a collection of tasks. However, the definition of service imposes a series of additional constraints such as: (1) services are self-contained, that is, they do not require context or state information of other services; (2) services are connected to other services and clients using standard, dependency reducing, decoupled message-based methods such as XML document exchanges. Moreover, a service takes one or more inputs and creates outputs that constitute a tangible value to an actor involved in the process. Values are data associated to interactions between the process and actors. The main difference between a service and a process is that a service is the minimal set of tasks that performed together create an output that is a value for the user.

In [10] a service is recognized as a recurrent communication pattern, where the requester of the service sends a request (that can be accepted or refused) and receives a response that is of value for the user. Between the request and the response, the service can be identified as a (set of) tasks that, from the user viewpoint, are executed together by the service provider. The response can be, in turn, accepted or refused by the user requiring the service. On the other hand, the service provider can invoke other services to execute his/her tasks, becoming requester for those services. The overall business process can consequently be viewed as a complex structure of nested and chained service invocations. Moreover, services are self-contained, that is, they do not require context or state information of other services.

According to these viewpoints, we propose a methodology that is organized in four main phases:

1. *Semantic process annotation* – in a distributed heterogeneous environment, where different SMEs provide independently developed process representations, a preliminary phase in which business process elements (input and output data, task names) are semantically annotated with concepts extracted from available and shared ontologies is required.
2. *Identification of candidate services* – according to an external perspective, process actors involved in the task execution and the values they expect from the business process are identified to determine the number of candidate services; in particular, we distinguish among the requester and the provider of a service; an actor can act both as requester of some services and provider of other ones.
3. *Evaluation of service cohesion/coupling* – according to an internal perspective, evaluation of service cohesion/coupling is useful to identify distinct decoupled and internally cohesive services supplied by each provider.
4. *Refinement of process decomposition* – an additional phase is performed to detect multiple invocation of the same service throughout the process workflow by means of proper coefficients applied to each pair of candidate services to check if they perform the same operations or operate on the same I/O information.

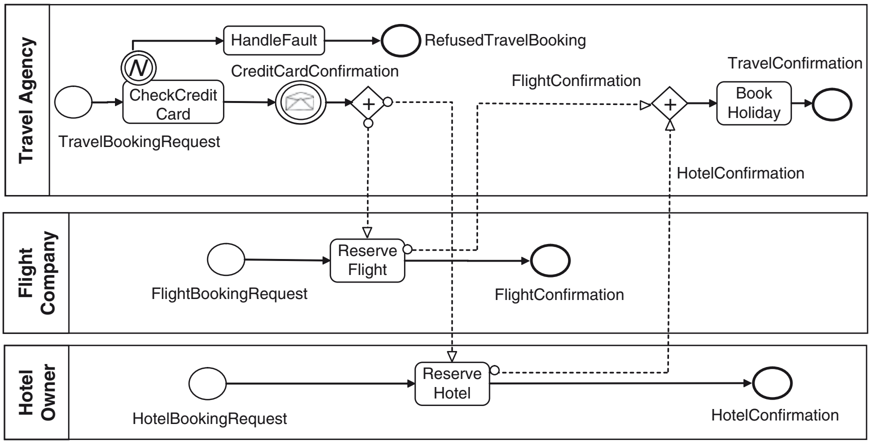


Fig. 1 Business process used as running example

As a running example, we consider the process for holiday booking shown in Fig. 1. The owner of this process is the travel agency, that is in charge of finding a hotel and a flight by sending a request to the hotel owner and to the flight company, respectively.

Phase 1: Semantic Process Annotation

We suppose that SMEs aiming at collaborating through their business activities agree on a common reference ontology, whose concepts names (atomic concepts) are associated with business process elements. In the reference ontology two atomic concepts n_1 and n_2 can be related by equivalence and IS-A relationships to denote that they represent the same concept or that n_1 is more specific than n_2. Since terms used as inputs/outputs and task names do not necessarily coincide with atomic concepts, the reference ontology is extended with pre-existing, domain independent terminological knowledge extracted from an underlying lexical system (e.g., WordNet), that relates each term that is not already included in the reference ontology to atomic concepts by means of synonymy (SYN) and broader/narrower term (BT/NT) relationships properly weighted. It is possible to quantify $Aff(n_1, n_2)$, that is, the name affinity between two generic terms n_1 and n_2 (either atomic concepts or not) as the product of weights associated to the chain of relationships that relate n_1 to n_2.

Phase 2: Identification of Service Candidates

During the execution of business process, actors cooperate to obtain *values* through task execution. Values identify the actors' goals obtained from the process. Since

Table 1 Process values identification

Value producer	Value	Producing task	Value consumer
TravelAgency	TravelConfirmation	BookHoliday	Final user
	RefusedTravelBooking	HandleFault	Final user
HotelOwner	HotelConfirmation	ReserveHotel	TravelAgency
FlightCompany	FlightConfirmation	ReserveFlight	TravelAgency

services have been defined as self-contained sets of tasks that provide tangible values to satisfy users' needs, values will be exploited to recognize component services of the process. Values are associated with data that are outputs of some tasks with participating actor A and not used as inputs of other tasks with the same participating actor or of other tasks at all. The application of this phase to the running example is shown in Table 1.

For each actor A_i, the following steps are executed in this phase.

Step 1 - The values that are returned to A_i are identified; these values are produced by candidate services provided to actor A_i; for example, in Table 1, for the travel agency two values are recognized, that is, four candidate services are recognized as well.

Step 2 - For each value V_j provided to the actor A_i, the task t_k that provides V_j is included in the corresponding service; the third column of Table 1 shows tasks that produce values for the business process in Fig. 1; for example, the HotelConfirmation value is produced by the ReserveHotel task of the hotel owner.

Step 3 - Each task t_h whose outputs (or a subset of outputs) are used as inputs for task t_k is included in the same service of t_k, that is, there is a data dependency between t_h and t_k; this step stops when a task t_h, whose inputs are provided by A_i (that identifies the service requester), is found; for example, starting from task BookHoliday, that provides TravelConfirmation value to the final user, the resulting component service is constituted by ReserveFlight and ReserveHotel (that provide data to BookHoliday) and CheckCreditCard (that provides data to the ReserveFlight and ReserveHotel tasks). Thus, the whole process is considered as a unique service for the final user, who provides inputs for CheckCreditCard task; following the same criteria, ReserveFlight and ReserveHotel constitute two distinct services for the travel agency and will be invoked in an orchestrated way inside the service provided to the final user; another service for the final user is the one constituted by HandleFault and CheckCreditCard tasks, that provide the RefusedTravelBooking value.

The list of candidate services is proposed to the process designer, that validates or refuses them, according to his/her own domain or process knowledge.

Phase 3: Evaluation of Service Cohesion/Coupling

Once the candidate services have been identified as sets of tasks, data dependencies and task cohesion/coupling inside and between services are applied to further structure them or to figure out parallelisms among tasks in a service. Given a task t_i, considering that $OUT(t_i) = f(IN(t_i))$, where $f(x)$ is the transformation associated with the task t_i, and given a task t_{i-1} such that there is a flow dependency from t_{i-1} to t_i, we say that t_{i-1} and t_i present a data dependency if and only if $OUT(t_i) = f(OUT(t_{i-1}))$. Two tasks t_{i-1} and t_i are considered:

1. *De-coupled*, if there are no data dependencies between them.
2. *Loosely coupled,* if there are data dependencies and $Aff_{TOT}(OUT(t_{i-1}),IN(t_i)) < \delta$, where δ is a threshold set by the designer ($\delta \in [0,1]$).
3. *Strongly coupled,* if there are data dependencies and $Aff_{TOT}(OUT(t_{i-1}),IN(t_i)) \geq \delta$.

where $Aff_{TOT}(N_1,N_2)$ is the total affinity between two sets of terms N_1 and N_2 defined as the sum of name affinity for each pair of concepts $n_1 \in N_1$ and $n_2 \in N_2$, normalized with respect to the cardinality of N_1 and N_2. In this specific case, the affinity between output and input data of two subsequent activities is evaluated in order to define the degree of service cohesion/coupling.

Tasks are aggregated according to their level of coupling by applying a hierarchical clustering algorithm. Firstly, each task constitutes a cluster with only one element (*singleton*). Two clusters C_1 and C_2 are merged together if there exist two tasks $t_1 \in C_1$ and $t_2 \in C_2$ such that there are data dependencies between t_1 and t_2 or viceversa. Clusters are iteratively merged until a unique cluster is obtained for the overall process or there are no data dependencies among the tasks of clusters that have been identified. Clusters that present tasks with highest data dependencies are merged first.

After clustering has been applied, the system allows the designer to further split services identified in the previous phase if they contain tasks belonging to different clusters (that is, having no data dependencies between each other) to allow their parallel execution. On the other hand, the collaborative process designer may be suggested to merge services if they contain coupled tasks. The designer can decide to treat loosely coupled tasks as strongly coupled ones or as de-coupled ones, thus implementing different business process reengineering procedures.

Phase 4: Refinement of Process Decomposition

Services identified in the previous phases are sub-processes constituted by one or more tasks that identify service operations. However, similar services that are invoked in distinct points throughout the process are identified as different services. To detect possible overlapping services in the business process, coefficients already introduced in [11] are applied. In particular, the *Entity-based similarity coefficient* between two services S_1 and S_2, denoted with $ESim(S_1, S_2)$, is used to state if S_1 and S_2 work on the same data. Denoting with S^{IN} and S^{OUT} the union sets of inputs and outputs of the tasks inside a service S, the *ESim* coefficient is computed as:

$$ESim(S_1, S_2) = Aff_{TOT}(S_1^{IN}, S_2^{IN}) + Aff_{TOT}(S_1^{OUT}, S_2^{OUT}) \in [0,2]$$

The *Functionality-based similarity coefficient* between two services S_1 and S_2, denoted with *FSim*(S_1, S_2), is used to state if S_1 and S_2 perform the same operations. *FSim* is based on the *Operation Similarity coefficient* between two tasks t_1 of S_1 and t_2 of S_2, denoted with *OpSim*(t_1,t_2) and computed as:

$$Aff(nt_1, nt_2) + Aff_{TOT}(IN(t_1), IN(t_2)) + Aff_{TOT}(OUT(t_1), OUT(t_2))$$

where nt_1 and nt_2 are the names of tasks and $OpSim \in [0,3]$, since it is the sum of three elements in the range [0,1]. The *FSim* coefficient is evaluated as:

$$FSim(S_1, S_2) = \frac{2 * \sum_{h,k} OpSim(t_h, t_k)}{|S_1| + |S_2|} \in [0,3]$$

where $|S_1|$ and $|S_2|$ denote the number of tasks of two services. This last phase of the methodology aims at identifying multiple invocation of the same service throughout the process workflow. For example, the credit card checking procedure can be applied more than one time in a complex process and, each time, a different service can be identified. Entity-based and functionality-based service similarity supports the designer to recognize that they can be unified in the same component service.

Conclusion

The methodology presented in this paper aims at constituting a semi-automatic approach for the identification of the subset of functionalities that can be exported as Web services to implement a collaborative business process. The methodology has been presented with a simple example, but future work will prove the proposed approach on a complex case study. Moreover, the aim is to make the overall methodology a semi-automated tool to support the collaborative process designer. Currently, modules that implement some phases of the methodology have been already developed. Future work will be devoted to the design of the tool and to the integration of modules that support the four phases.

Acknowledgements This work has been partially supported by the TEKNE (Towards Evolving Knowledge-based internetworked Enterprise) FIRB Project (http://www.tekne-project.it/), founded by the Italian Ministry of Education, University and Research.

References

1. O'Brien, J.A. (2000) Introduction to Information Systems: Essentials for the Internet-worked Enterprise, *McGraw-Hill,* New York.
2. Lewis, G., Morris, E., O'Brien, L., Smith, D., Wrage, L. (2005) SMART: The Service-Oriented Migration and Reuse Technique, *Technical Note CMU/SEI-2005-TN-029*, Carnegie Mellon University, Software Engineering Institute.
3. Lawrence, C. (2007) Adapting Legacy Systems for SOA, *Technical report, IBM*.
4. Microsoft (2007) The Business Value of Legacy Modernization, *Technical report, Microsoft*.
5. Papazoglou, M.P., Yang, J. (2002), Technologies for E-Services, chapter in *Design Methodology for Web Services and Business Processes*, Springer Berlin/Heidelberg, pp. 175–233.
6. Papazoglou, M.P., Van den Heuvel, W.J. (2007) Business Process Development Life Cycle Methodology. *Communications of ACM*, 50(10): 79–85.
7. Vanderfeesten, I., Reijers, H.A., van der Aalst, W.M.P (2008) Evaluating Workflow Process Designs using Cohesion and Coupling Metrics, *Computer in Industry*, 59(5): 420–437.
8. Castano, S., De Antonellis, V., Melchiori, M. (1999) A Methodology and Tool Environment for Process Analysis and Reengineering, *Data and Knowledge Engineering*, 31(3): 253–278.
9. Baresi, L., Casati, F., Castano, S., Fugini, M., Mirbel, I., Pernici, B. (1999) WIDE Workflow Development Methodology, *Proceedings of International Joint Conference on Work Activities Coordination and Collaboration*: 19–28.
10. Dietz, J.L.G. (2003) The Atoms, Molecules and Fibers of Organizations, *Data and Knowledge Engineering*: 47(3):301–325.
11. Bianchini, D., De Antonellis, V., Pernici, B., Plebani, P. (2006) Ontology-based methodology for e-Service discovery, *Journal of Information Systems, Special Issue on Semantic Web and Web Services,* 31(4-5): 361–380.

A Peripheral Notification Display for Multiple Alerts: Design Rationale

S. Di Paolo[1] and L. Tarantino[2]

Abstract This paper presents the design rationale of a notification system based on a peripheral display, able to deliver information with different levels of severity, coming from multiple sources. Though originally conceived for a telecommunication management system, the design exhibits a level of abstraction allowing applicability in different contexts, provided that information to be notified satisfy a few basic requirements. The system include a visual coding technique and transitions such that low severity alarms are associated with a few data conveyed in a subliminal way, whereas more urgent alarms are associated with notifications requiring focal attention and technical intervention.

Introduction

*Notification (*or *alerting*) *systems* are used to deliver important information in an efficient and effective manner, without distracting users from other primary ongoing tasks (see, e.g., [1]). More precisely, notification systems deliver at *discrete* intervals *critical* information coming from *multiple sources* in a *parallel multitasking approach* (while ambient systems continuously display non critical information coming from a number of sources without demanding full attention of users). Generally, notification systems can be used to:

- Receive interesting news (weather forecasts, stock prices, traffic information, etc.), by asynchronous notifications aimed at communicating changes in the information sources (like in the *Irwin* system [2]).
- Increase cooperation within social groups or among co-located or distant colleagues, working on common projects (as in the *What's Happening* system [3]).

[1] Technolabs S.p.A, S.S. 17, L'Aquila, Italy, stefaniadipaolo_e@technolabs.it
[2] Università degli Studi dell'Aquila, L'Aquila, Italy, laura.tara@gmail.com

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI: 10.1007/978-3-7908-2148-2_60,

- Deliver critical information (battery warning, scheduled meetings, etc.) by notifications including time-sensitive data, and, as such, classified as *alerts.*

One of the main issues to be faced in the definition of a notification mechanism is to prevent unwanted interruptions from ongoing tasks, while guaranteeing a timely delivery of information. Data criticalness may require a level of attention close to the one associated to the primary task: the higher the notification severity, the higher the required amount of attention. Users tolerate interruptions from ongoing activities when incoming information is useful and implies an immediately reaction or a long-term content comprehension.

The three parameters denoted *interruption, reaction*, and *comprehension* have been proposed in [4] to define a characterization framework, by considering for each of them two possible levels (*low*, *high*). For example, an office worker writing a document, and at the same time interested in receiving stock information, is better served by an ambient information system (*high comprehension goal*, *low reaction goal* e *low interruption goal*) if s/he wants to control the long-term trend and is not interested in short term negotiations. On the contrary, if s/he has to control the stock prices to carry on transactions on a daily basis, s/he will be better served by an alerting system that provokes appropriate distraction from the primary task (*high interruption goal*), stimulates an immediate reaction (*high reaction goal*) and visualizes information understandable with low cognitive effort (*low comprehension goal*).

In this paper we sketch the design rationale of a notification system based on a peripheral display, capable to deliver information with different level of severity, coming from multiple sources. After discussing, in Section "Main Features of the Information Sources," the main features of the data we deal with, in Section "A Peripheral Display Based Alerting Mechanism" we address design choices related to visual coding technique and transitions. Section "Taxonomic Characterization" provides a taxonomic characterization of the proposed system, and finally, in Section "Conclusion and Future work," future work is briefly outlined.

Main Features of the Information Sources

Our project aims at designing an innovative solution for managing alarms in a Telecommunication Management System [5]. Though the initial goal was quite specific (focused on a system for optical fiber networks used in Technolabs S.p.a, an Italian ICT company), the analysis of the involved critical information led us to a design exhibiting a level of abstraction and a generality that guarantee applicability in different contexts as well, provided that critical information to be notified satisfies few basic characteristics outlined later on in this section.

The studied system reveals and notifies faults of Network Elements (NEs) in order to solicit technical interventions depending on the fault severity. A fault generates an *alarm* whose life cycle ranges between two states denoted *raised* and *cleared* (once the *alarm raised notification* is received, the alarm remains active until a corresponding *alarm cleared notification* arrives). It may be the case that multiple notifications are issued simultaneously (or within short intervals) by distinct NEs or by a single NE.

We deal with critical information that may be classified along two dimensions:

- *Alarm class* (in our case we have the following six classes: communication, environment, equipment, processing, quality, and security).
- *Severity level* (in our case we identified the following five levels: cleared, warning, minor, major, and critical).

Each individual *alarm* is described by a tuple of data items. For notification policy purposes, a further step of analysis is required, to hierarchically rank attributes of the tuple schema.

A Peripheral Display Based Alerting Mechanism

Traditional alarm management in such kind of telecommunication systems provides an incremental alarm data visualization, which discloses in successive steps additional levels of details according to the above mentioned attribute ranking: the system puts on the user the burden of determining and accessing the correct information level of detail, according to the alarm severity. A pervasive ambient approach, conversely, moves on the system the burden of capturing user attention when necessary, by means of a peripheral display constantly and unobtrusively visible in a corner of the primary monitor, without demanding user awareness unless required by the network based on fault gravity.

The system is responsible for determining the alarm severity and for visualizing the corresponding level of details by using visual coding technique consistent with the urgency degree of the notification: low severity alarms are associated with a few data conveyed in a subliminal way, whereas more urgent alarms are associated with notifications requiring focal attention and technical intervention.

The design must "serve" the IRC parameters by (1) the *visual coding technique* (oriented to comprehension and reaction), which has to take into account notification simultaneity as well, and (2) *transitions* (oriented to interruptions).

The Visual Coding Technique

In order to ensure glanceability, the visual coding technique is based on visual design variables (color, shape, position, contrast). The display is a small rectangular area partitioned in three sub-areas (see Fig. 1): (1) an upper bar containing temporal data, (2) a middle area containing data about the currently active alarms, and (3) a lower bar containing user data. The middle area is in turn divided into a *synthetic component* and a *detailed component*: the former communicates alarm severity, while the latter visualizes an alarm description with the level of detail associated to its severity.

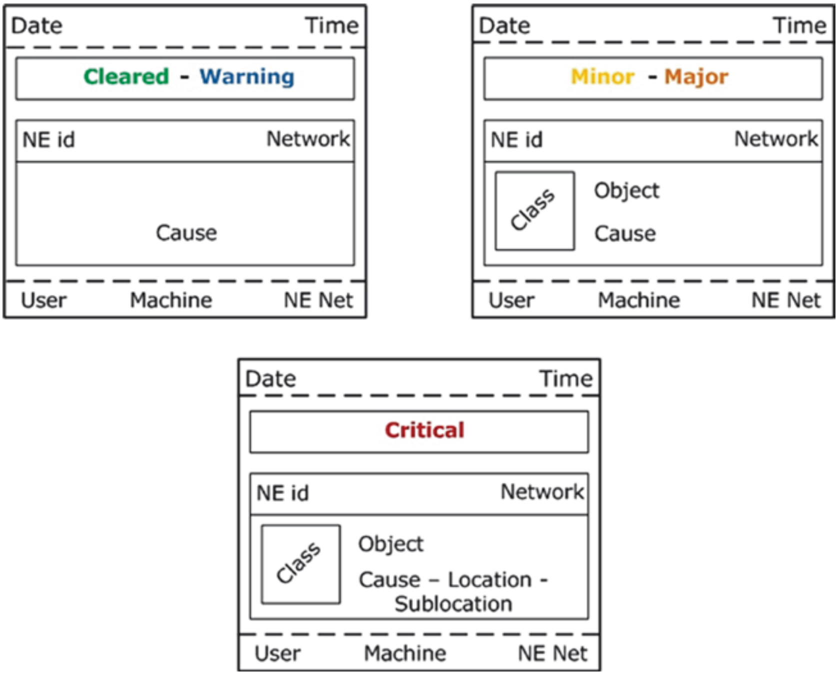


Fig 1 Display structural schemata

Figure 1 shows how the five levels of severity are mapped onto three abstract schemata, in which the middle area gets progressively denser of information while the alarm severity increases. For critical alarms the quantity of data items to be displayed (cause, location, sublocation) requires also tickering. Some examples of alarm visualizations with different severity are then depicted in Fig. 2, where one may notice that color coding is always associated to additional coding mechanisms to guarantee a correct display interpretation even to users with color vision diseases.

Transitions

Since the display is located in the visual periphery, visually dynamic stimuli are necessary to move it to foveal vision. Interruption related design choices must hence be based on in-place animation. Before discussing the main characteristics of the design, it is worth recalling that human attention may be divided into four main zones denoted *pre-attention*, *inattention*, *divided attention* and *focused attention* [6]. Accordingly, peripheral displays may be classified into *ambient displays* (showing non critical information) and *alerting displays* (showing critical information demanding focal attention), as illustrated in Fig. 3, which also highlights how our five severity levels map to the attention-awareness graph.

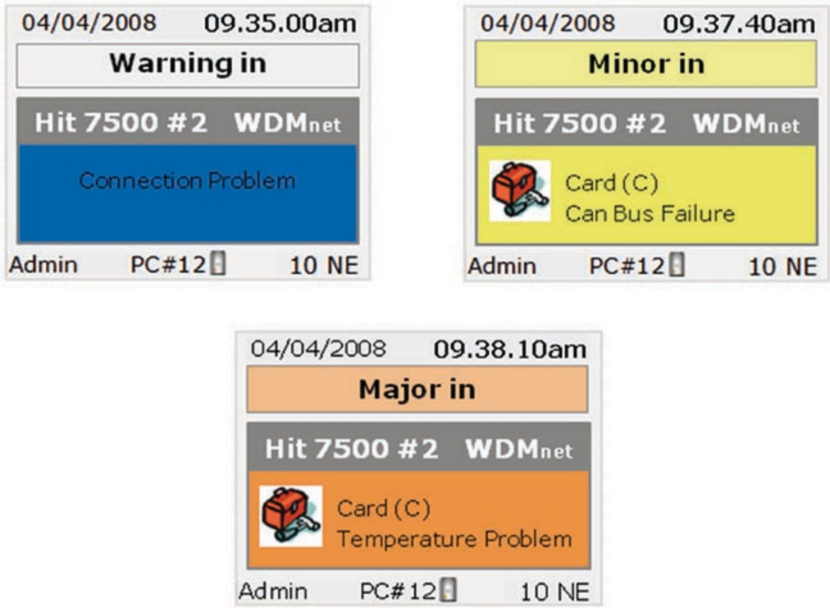


Fig. 2 Sample of notifications

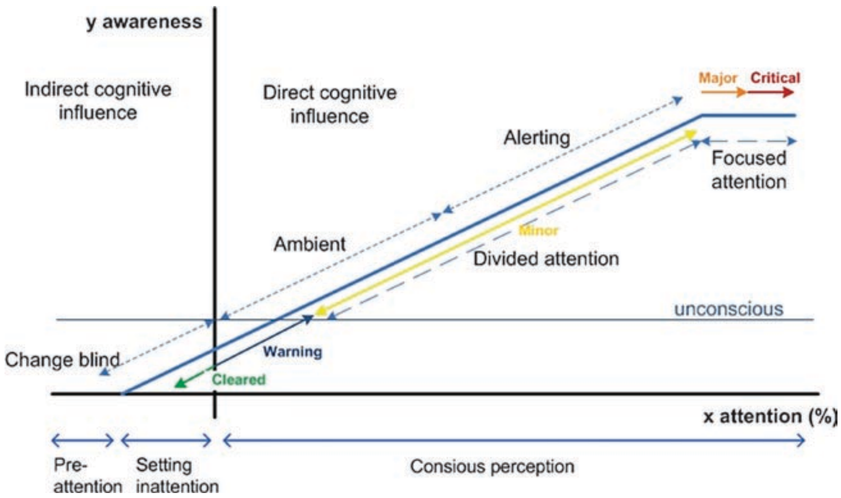


Fig. 3 Mapping notification levels to the attention-awareness graph

Our design choices conform to the framework presented in [6], which proposes five notification levels (ignore, change blind, make aware, interrupt, demand attention) and, correspondingly, distinct transition types to grab the appropriate amount of attention from the user. Our set of alarm severity levels is mapped to the above mentioned

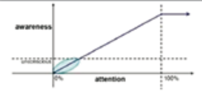
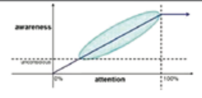
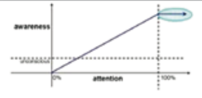
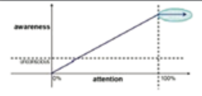
Attention Type		Notification Level	Transition
	Inattention	Change blind (Cleared -Warning)	Slow motion, tiny updates
	Divided	Make aware (Minor)	Discrete, abrupt updates
	Focused	Interrupt (Major)	Flashing, beeping, vibration
	Focused + interaction	Demand action (Critical)	Interrupt until user does action

Fig. 4 Mapping transition types to notification levels

framework as follows: *cleared* and *warning* are associated with *change-blind* (non important information), *minor* is associated to *make- aware* (information directed to divided attention of which user has to be made aware), *major* is associated to *interrupt* (information directed to focal attention which demand interruption from current task), *critical* is associated to *demand- attention* (notification with the highest urgency).

The third column in Fig. 4 shows design choices about transitions, associated to in-place animation of different types.

Handling Notification Simultaneity

Multiple simultaneous faults may occur in a single NE or in distinct NEs. To adapt the display to manage these situations, the synthetic component gets divided into as many portions as the number of simultaneous alerts, each showing the severity of the associated alarm. As to the detailed component, for simultaneity on a single NE, the more urgent alarm is visualized, while less urgent ones are notified by flags (see Fig. 5a); simultaneity in distinct NEs is handled by customary transitions analogously to faults sequences (Fig. 5b shows an example).

Taxonomic Characterization

With reference to the taxonomy proposed in [7] (based on four design dimensions denoted *information capacity*, *notification level, representation fidelity* and *aesthetic emphasis),* our proposal is to be considered an *Information*

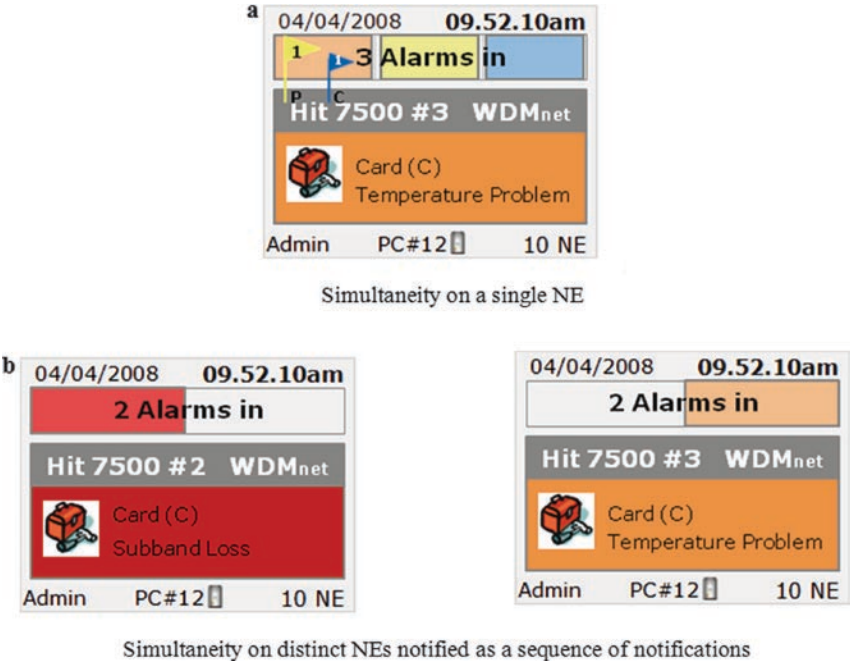


Fig. 5 Examples of simultaneity

Monitor Display. As other systems in this category, it is located in a peripheral area of the desktop, it can visualizes information from a high number of discrete information sources, allows several notification levels, and is not characterized by high aesthetic emphasis (given the visual and not tangible information coding).

With reference to the IRC framework, we have to underline that the system behaves differently based on the alarm severity:

- For low severity alarms (*low interruption*) display changes allow longer term awareness (*high comprehension)* of notification items with glances that do not invoke immediate reaction (*low reaction*). In this case the system is mapped to the 001 IRC triple and behaves like as an ambient display (as one may notice in Fig. 3, it is located in the lower part of the awareness-attention graph).
- For higher severity alarms, display changes requires higher amount of attention, up to requiring urgency awareness (*high comprehension*), interruption of all ongoing tasks (*high interruption*) and quick intervention (*high reaction*). The system is now mapped to the 111 IRC triple and behaves like as an alerting display (as one may notice in Fig. 3, it is located in the higher part of the awareness-attention graph).

Conclusions and Future Work

In this paper we sketched the design rationale of a peripheral display for alarm notification. The design, constantly conducted in cooperation with users, led to the definition of the system mock-up. A Java-based monitor-oriented prototype is currently being implemented. The particular display structure makes us foresee mobile-oriented implementations running on PDAs and/or ad-hoc devices.

Bibliography

1. McCrickard D.S., Czerwinski M., and Bartram L. (2003) Introduction: Design and Evaluation of Notification User Interfaces. *Intl. Journal on Human-Computer Studies*, 58(5):509–514.
2. McCrickard D.S. (1999) Maintaining Information Awareness with Irwin. In Collins B., Oliver R. (Eds.), *ED-MEDIA 99 World Conference on Educational Multimedia, Hypermedia & Educational Telecommunication Proceedings* (pp. 552–557). Charlottesville, AACE.
3. Zhao Q.A. and J.T. Stasko (2002) What's Happening?: Promoting Community Awareness through Opportunistic, Peripheral Interfaces. In De Marsico M., Levialdi S., Panizzi E. (Eds.), *Proceedings of the Working Conference on Advanced Visual Interfaces AVI 2002* (pp. 69–74). New York, ACM Press.
4. McCrickard D.S., Chewar C.M., Somervell J.P, and Ndiwalana A. (2003) A Model for Notification Systems Evaluation - Assessing User Goals for Multitasking Activity. *ACM Transactions on CHI* 10(4):312–338.
5. Di Paolo S. (2008) *Peripheral Information Visualization: Studio e tassonomia di sistemi, e una proposta per il trattamento di notifiche multiple in apparati di comunicazione*, Master Thesis, Dipartimento di Ingegneria Elettrica e dell'Informazione, Università degli Studi dell'Aquila.
6. Matthews T., Dey A.K., Mankoff J., Carter S., and Rattenbury T. (2004) A toolkit for managing user attention in peripheral displays. In Feiner S., Landay J.A. (Eds.), *Proceedings of the 17th Annual ACM Symposium on User Interface Software and Technology* (pp. 247–256). Santa Fe, ACM.
7. Pousman Z. and J.T. Stasko (2006) A Taxonomy of Ambient Information Systems: Four Pattern of Design. In Celentano A., Mussio P. (Eds.), *Proceedings of the Working Conference on Advanced Visual Interfaces AVI 2006* (pp. 67–74). New York, ACM Press.

A Reference Architecture for Semantic Knowledge Coordination

S. Castano[1], A. Ferrara[2], and S. Montanelli[3]

Abstract In this paper, we present iCoord, a reference architecture for knowledge coordination in open, multi-knowledge information systems. iCoord is a peer-oriented architecture where each node represents a single agent (e.g., an enterprise, a peer) which performs knowledge design as a consequence of or in order to collaborate/interoperate with other external partners for knowledge sharing. A key aspect of iCoord is the capability to support knowledge design not only with the traditional "from scratch" approach, but also by enforcing (re)use through alignment and/or assimilation of externally harvested knowledge chunks.

Introduction

The Semantic Web vision together with the widespread use of open networked infrastructures, such as P2P and Grid, have generated new information system architectures where a high number of independent nodes dynamically collaborate and interoperate by sharing their information resources and services [1]. In such architectures, ontologies and Semantic Web techniques semantically enhance the capability of automatically retrieving and effectively sharing distributed resources [2, 3]. In such open and collaborative contexts, each single party needs to evolve its ontology knowledge over time to correctly assimilate new external knowledge describing resources acquired from outside during collaboration/interaction [4, 5]. On the other side, it is more and more advocated the capability to enable ontology knowledge design by relying as much as possible on other existing knowledge specifications on the same topic available either in specialized P2P networks/communities or in the semantic web to promote knowledge sharing and (re)use. To harvest knowledge for (re)use, the demand shifts from focused ontology matching tools to more compre-

[1] Università degli Studi di Milano, Milano, Italy, castano@dico.unimi.it
[2] Università degli Studi di Milano, Milano, Italy, ferrara@dico.unimi.it
[3] Università degli Studi di Milano, Milano, Italy, montanelli@dico.unimi.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI: 10.1007/978-3-7908-2148-2_22, © Springer Physica-Verlag Berlin Heidelberg 2010

hensive *ontology coordination systems*, capable of providing a suite of complementary and coordinated components that exploit ontology matching to enhance the processes of external knowledge discovery, mapping, assimilation, and evolution. Moreover, in order to ensure a high level of flexibility and a service-oriented interaction with knowledge-intensive applications such as data integration, semantic search, semantic web services, peer-to-peer systems, and social networks, an ontology coordination system must implement an open architecture and must consider the dynamism and heterogeneity requirements posed by the interaction-driven collaboration paradigm typical of open, networked architectures.

In this paper, we present iCoord, a reference architecture for knowledge coordination in open, multi-knowledge information systems. iCoord is a peer-oriented architecture where each node represents a single agent (e.g., an enterprise, a peer) which performs knowledge design as a consequence of or in order to collaborate/interoperate with other external partners for knowledge sharing. A key aspect of iCoord is the capability to support knowledge design not only with the traditional "from scratch" approach, but also by enforcing (re)use through alignment and/or assimilation of externally harvested knowledge chunks. A further distinguishing feature of iCoord is that a natural-language facility is enforced to hide the details related to language-dependant syntax, as argued in [6]. In the paper, we will focus on presenting knowledge harvesting as the enabling technology for probing and acquiring external knowledge sources to be used as suggestions during knowledge design. Examples and use cases of knowledge coordination in iCoord will be also discussed in the paper.

The iCoord Architecture

The iCoord architecture is based on the K^3 methodology which is articulated in three main tasks, namely *knowledge design*, *knowledge harvesting*, and *knowledge evolution* (see Fig. 1) that can be cyclically executed by the designer according to the specific coordination goals that are required.

Knowledge Design

The knowledge design task has the role of supporting the designer, responsible for information and knowledge management, in interfacing/coordinating both internal knowledge repositories and external sources acquired from outside. As a typical scenario, when the designer starts typing name/structural definitions of a new concept draft, a set of *knowledge chunks* harvested from the external sources, automatically appears to provide concept definition suggestions for possible (re)use. Moreover, terminology hints derived from harvested knowledge are directly suggested as long as new elements are typed, in order to enforce lexical consolidation and standardization

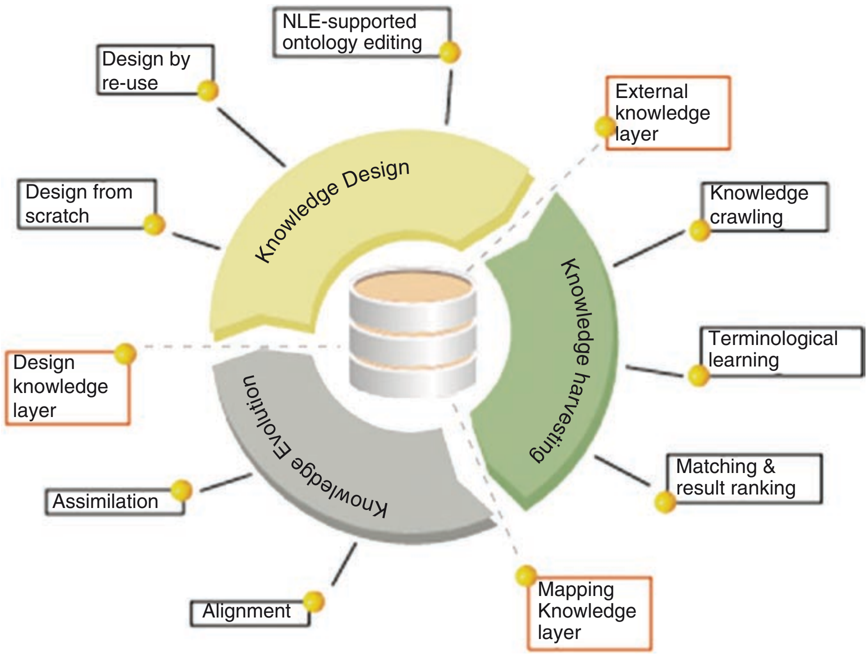


Fig. 1 The K^3 methodology for knowledge coordination in iCoord

in a given domain and across the Semantic Web. To this end, the NLE tool[4] has been developed and integrated in iCoord to support (1) knowledge editing through predefined patterns for guiding the designer in writing correct OWL ontology assertions, and (2) knowledge visualization through a natural-language explanation providing a high-level, descriptive presentation of the ontology concepts.

Knowledge Harvesting

The knowledge harvesting task has the role of finding external knowledge useful for knowledge design. To this end, harvesting works as a web-crawler and it periodically retrieves external knowledge sources that are acquired and cataloged using a triple storage system. According to the concept draft under definition, the harvested knowledge is exploited in iCoord to provide "on-the-fly" suggestions to the designer in terms of both pertinent terminology and similar knowledge chunks. Ontology matching techniques are exploited in iCoord to match the design draft against the harvested knowledge in order to detect similarities and thus to refresh suggestions. To this end, the HMatch 2.0 ontology matching suite is integrated in

[4] The Natural Language Explanation tool (http://islab.dico.unimi.it/nle/).

iCoord [7]. A more detailed description of the knowledge harvesting task will be provided in Section “Coordination-Oriented Knowledge Harvesting”.

Knowledge Evolution

The knowledge evolution task updates the design knowledge to assimilate knowledge chunks selected by the designer and (re)used in the concept draft. In particular, two main evolution strategies, namely *coordination-by-alignment* and *coordination-by-assimilation*, are supported in iCoord. With coordination-by-alignment, we refer to the capability of iCoord to support a sort of *lightweight* coordination approach by which a concept definition in the design draft is linked to similar harvested knowledge chunks through ontology mappings. With coordination-by-assimilation, we refer to the capability of iCoord to support a sort of *pervasive* coordination approach where the harvested knowledge chunks are directly used and merged to derive/enrich the concept definition of the design draft at hand. iCoord guides the assimilation of this knowledge by automatically proposing a possible (consistent) integration in the editing area where the draft concept is being defined. The designer can confirm/revise the integration proposal according to the specific goals/preferences to be pursued [5].

Knowledge Repository

The K^3 methodology relies on the iCoord knowledge repository organized as follows:

- *Design knowledge*. This layer contains the ontological specification of the design process, resulting from editing and from knowledge evolution according to the alignment/assimilation of harvested knowledge.
- *External knowledge*. This layer contains knowledge specifications (e.g., OWL, RDF(S)) of harvested knowledge sources that will be used for providing suggestions during knowledge design.
- *Mapping knowledge*. This layer contains the mappings between ontology concepts of the design knowledge layer and matching concepts of the external knowledge layer related to the knowledge chunks that have been selected in coordination-by-alignment.

Coordination-Oriented Knowledge Harvesting

Goal of the knowledge harvesting process is to find and retrieve knowledge from external ontologies and to organize the acquired knowledge in terms of knowledge chunks. Knowledge harvesting is articulated in two activities, as shown in Fig. 2.

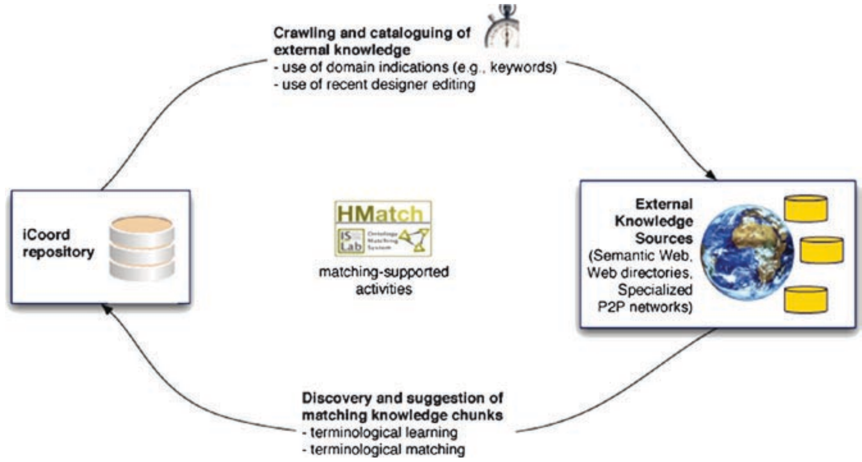


Fig. 2 The knowledge harvesting process

Crawling and Cataloging of External Knowledge

The first activity of knowledge harvesting aims at the identification of external knowledge sources of interest to be acquired and stored into the external knowledge repository of iCoord. Knowledge retrieval is executed according to two different strategies that depend on the context in which iCoord is (actually) used. When iCoord is used in the context of the Semantic Web, knowledge retrieval is enforced like a crawling of OWL resources on the web. Existing search engines for the semantic web, like Swoogle[5], can be used to support the crawling process. Crawling is performed periodically, to continuously bring new external knowledge into the iCoord design process for subsequent use. Keywords extracted from committed design results can be used for driving the retrieval process. When iCoord is used in a P2P network, useful external knowledge is discovered by probing the knowledge sources that are published by the peers on the network [2]. Retrieved external knowledge is acquired and submitted to cataloging for insertion in the Sesame triple storage system[6]. On top of the triple store, we have defined a catalog which contains metadata about the acquired knowledge sources, such as their original location and all the information required to access knowledge source contents. During cataloging, a terminological learning process is also performed by relying on the RDF graph of the knowledge source in order to associate with each ontology element (i.e., concept, property, individual) the set of terms featuring its definition in the knowledge source of provenance. We call this set *terminological equipment*. In other words, a knowledge chunk is defined as the set of axioms that define an

[5] http://swoogle.umbc.edu/.
[6] http://www.openrdf.org/.

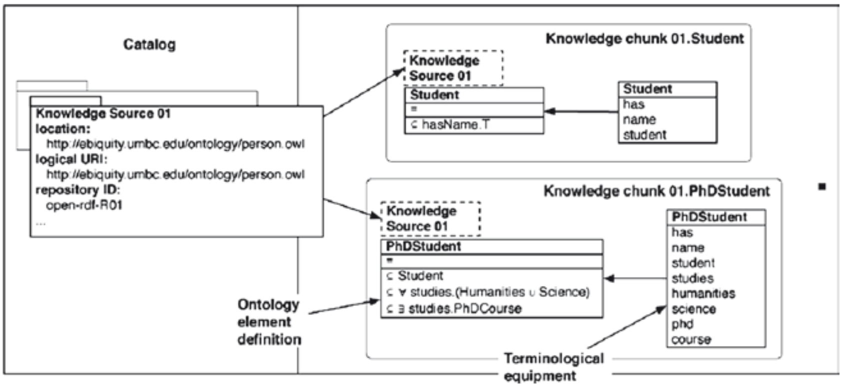


Fig. 3 Example of organization of the external knowledge layer of the iCoord repository

ontology element plus its terminological equipment. Terminological equipments are used for two purposes: (1) during the design phase, to provide the designer with terminology suggestions for the specific design draft at hand; (2) during the harvesting phase, to discover ontology elements of the external knowledge layer of the iCoord repository similar to the current design draft, by relying on ontology matching.

Discovery and Suggestion of Matching Knowledge Chunks

Discovery has the goal of finding the best matching knowledge actually available in the external knowledge layer to be proposed in form of knowledge chunks to the designer for possible (re)use in the design draft at hand. Such an activity is activated as long as the designer types names/structural specifications of ontology elements in his draft. iCoord takes such names to invoke the terminological matching service of HMatch 2.0 against the external knowledge repository layer, which is organized as shown in Fig. 3. The top-k matching ontology elements are retrieved and proposed in the suggesting area of the editing environment in form of knowledge chunks.

Example of Knowledge Coordination with icoord

Assume that the designer is interested in defining the concept Student and starts the design from scratch. The iCoord editing tool is divided in two main areas: the editing area and the suggestion area (see Fig. 4). During editing, the designer writes OWL axioms in form of natural language sentences by exploiting the NLE facility of iCoord. At each step of sentence composition, the designer is guided in what can be done in the next step, either typing a concept/property name or an OWL construct.

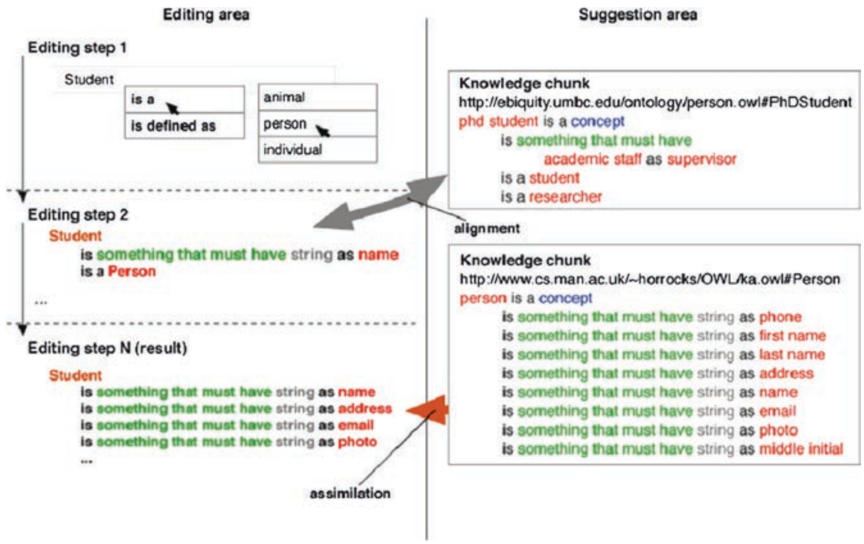


Fig. 4 Example of the knowledge design phase using the iCoord editing tool

The typical activity pattern in iCoord expects the designer to type name/structural definition of OWL elements and the system to automatically propose design suggestions in form of similar knowledge chunks and name hints. Every time the designer composes a new sentence, the concept draft is matched against the external knowledge layer of the repository and the suggestion area is populated/refreshed with retrieved matching knowledge chunks. In our example, the sentences "Student is a Person" and "Student is something that must have a string as name" typed by the designer trigger the retrieval of the similar chunks PhDStudent and Person (i.e., the right side of Fig. 4). The designer can interactively select which knowledge chunk to use for the definition of the Student concept. With coordination-by-assimilation, the designer can decide to take the knowledge chunk Person and to merge it with the draft concept Student. A unique concept definition is then proposed by the system to the designer for validation and/or further editing. For merge, element names and constraints of Person (i.e., address, email, and photo) are added to the definition of the unified concept Student. Moreover, element names and constraints appearing both in Person and in the concept draft Student are then combined into an integrated expression in the unified concept definition proposed by the system. A detailed description of concept merge procedure is given in [5]. The editing process is iterated until the designer commits the design draft and decides to store the concept definition in the design knowledge layer of the iCoord repository. With coordination-by-alignment strategy, the designer autonomously specifies his own concept definition and invokes HMatch 2.0 for setting appropriate mappings between the newly defined concept and the concepts described by similar knowledge chunks previously selected. Mappings are finally stored in the mapping knowledge layer of the iCoord repository. In Fig. 4, we show an example of alignment of the concept Student with the concept PhDStudent harvested from the ontology Person.

Related Work and Concluding Remarks

Work related to iCoord is proposed in [8] where the problem of semantic coordination is intended as a discovery mapping issue. In the same direction, Scarlet [9] provides techniques for discovering relations between two concepts (i.e., mappings) by making use of harvested ontologies as background knowledge. The idea to support coordination-oriented ontology design through (re)use of portions of existing online knowledge is also being appearing in the literature and some interesting work are presented in [10, 11]. In this respect, original contributions of iCoord and related K^3 design process concern: (1) specification/visualization of OWL ontologies through natural language-like facilities, to enable also non OWL-experts to define correct OWL assertions; (2) promotion of terminology consolidation/standardization in a given domain and across the Semantic Web, by suggesting terminological equipments for term (re)use; (3) support to knowledge sharing and (re)use in a given domain and across the Semantic Web, through matching-based knowledge harvesting and discovery and through merge/alignment of external knowledge chunks. Ongoing and future work on the iCoord system is devoted to improve the capability of the system in supporting the design of new ontology elements. To this end, NLE and editing functionalities will be extended to support all the constructs of OWL-DL. Moreover, we are investigating matching/learning techniques that can be used for extracting from the external knowledge sources some general purpose templates for the concept design.

Acknowledgments This paper is partially funded by the EU FP6 BOEMIE (Bootstrapping Ontology Evolution with Multimedia Information Extraction) project.

References

1. Androutsellis-Theotokis, S., Spinellis, D. (2004) A Survey of Peer-to-Peer Content Distribution Technologies. *ACM Computing Surveys* 36(4), 335–371.
2. Castano, S., Ferrara, A., Montanelli, S. (2006) Web Semantics and Ontology, chap. Dynamic Knowledge Discovery in Open, Distributed and Multi-Ontology Systems: Techniques and Applications, pp. 226–256. Idea Group.
3. Halevy, A. et al. (2004) The Piazza Peer Data Management System. *IEEE Transactions on Knowledge and Data Engineering* 16(7), 787–798.
4. Arenas, M., et al. (2003) The Hyperion Project: From Data Integration to Data Coordination. *SIGMOD Record, Special Issue on Peer-to-Peer Data Management* 32(3), 53–58.
5. Castano, S., Ferrara, A., Montanelli, S. (2006) Evolving Open and Independent Ontologies. *International Journal of Metadata, Semantics and Ontologies* 1(4), 235–249.

6. Cimiano, P., Haase, P., Heizmann, J., Mantel, M., Studer, R. (2008) Towards Portable Natural Language Interfaces to Knowledge Bases - The Case of the ORAKEL System. *Data & Knowledge Engineering* 65(2), 325–354.
7. Castano, S., Ferrara, A., Montanelli, S. (2006) Matching Ontologies in Open Networked Systems: Techniques and Applications. *Journal on Data Semantics (JoDS)* V.
8. Bouquet, P., Serafini, L., Zanobini, S. (2005) Peer-to-Peer Semantic Coordination. *Journal of Web Semantics* 2(1), 5–24
9. Sabou, M., d'Aquin, M., Motta, E. (2008) Exploring the Semantic Web as Background Knowledge for Ontology Matching. *Journal of Data Semantics (JoDS)* 11, 156–190
10. Alani, H. (2006) Ontology Construction from Online Ontologies. In: *Proc. of the 15th. Int. WWW Conference*. Edinburgh, UK. Position paper.
11. Stecher, R., Niederée, C., Nejdl, W., Bouquet, P. (2008) Adaptive Ontology Re-use: Finding and Re-using Sub-ontologies. *International Journal of Web Information Systems* 4(2), 198–214.

Actual vs. Planned ERP System Implementation Costs in Slovak and Slovenian Companies

F. Sudzina[1], A. Pucihar[2], and G. Lenart[3]

Abstract Enterprise resource planning (ERP) systems are still more and more common in companies, not only in large ones but also in small and medium enterprises. Although virtually nobody really doubts their importance for running business, there is a sentiment regarding their implementation – both in terms of time and cost. We focus on the latter in this paper. The research question is to what extent do ERP system implementation costs exceed the planned costs in European context, which is characterized by fixed price policy. The questionnaire research, which focused on this issue, was conducted in Slovakia and Slovenia. The dependent variable was a percentage of actual ERP system implementation costs vis-à-vis the planned ones. The independent variables were the country, company size, information strategy, and representation of the IT department on board level. According to the collected data, companies with information strategy, and small companies as opposed to large ones, are more likely to stay on budget. Overall, 68.5% of companies stayed on budget and companies, on average, spent 106.0% of what they originally planned to.

Introduction

The enterprise resource planning (ERP) system is an integrated set of programs that provides support for core business processes, such as production, input and output logistics, finance and accounting, sales and marketing, and human resources. An ERP system helps different parts of an organization to share data, information to reduce costs, and to improve management of business processes [1]. Wier et al.

[1]Copenhagen Business School, Frederiksberg, Denmark, fs.caict@cbs.dk
[2]University of Maribor, Faculty of Organizational Sciences, University of Maribor, Slovenia, andreja.pucihar@fov.uni-mb.si
[3]University of Maribor, Faculty of Organizational Sciences, University of Maribor, Slovenia, gregor.lenart@fov.uni-mb.si

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_55,

[2] argue that ERP systems aim to integrate business processes and ICT into a synchronized suite of procedures, applications and metrics which goes over firms' boundaries.

ERP systems used to be a domain of large companies but there is a still increasing number of small and medium enterprises adopting adopt them as well. The reasons could be found into the saturation of the market, as most large organizations have already implemented an ERP system, increasing possibilities and need for the integration of systems between organizations and the availability of relatively inexpensive hardware [3].

Although there is a common understanding about ERP importance for running business, there is a sentiment regarding their implementation – both in terms of time and cost. Cunningham [4] investigated 7,400 IT projects and discovered that 34% of them were late or over budget. According to [5], about 90% of ERP implementations are over budget or late. According to the Standish Group report on ERP implementation projects, cited in [6], projects are on average 78% over budget and take 2.5 times longer than intended. Numerous researches noted that time and costs are key criteria for measuring ERP project implementation success [11, 12, 14]. According to research results [13] cost is a more important variable than time in judging overall ERP project success.

The research question of this paper is to what extent ERP system implementation costs exceed the planned budget. This is an important issue for the investigation on the Third Generation of ERP Systems research project (www.3gerp.org), which aims to provide suggestions for decreasing total cost of ownership of ERP system from an end-user company view to 50%. Total cost of implementation is an important part of total cost of ownership, and therefore it is important to know what is the disparity between actual and planned total cost of implementation of ERP systems. Obviously, additional costs might be outweighed by additional benefits but total benefits of ownership are not defined as a success factor of the research project. Therefore, the paper focuses only on actual compared to total planned implementation cost.

Data and Methodology

This exploratory paper is based on a questionnaire survey. It was conducted in Slovakia and Slovenia in May and June 2007. In 2007, Slovakia had a population 5,448 million and Slovenia of 2,009 million inhabitants. Gross domestic product per hour in 2007 EKS$ was 27.90 in Slovakia and 32.53 in Slovenia. The Networked Readiness Index (NRI) is a measure of the propensity of countries to exploit the opportunities offered by information and communications technology (ICT). The NRI tries to comprehend the impact of ICT on the competitiveness of nations. According to the NRI 2006–2007 rankings [7], Slovakia was the 41st with a score of 4.15, and Slovenia the 30th with a score of 4.41.

Questionnaire forms in respective languages accompanied by cover letters were mailed to randomly selected companies. Lists of addresses and information about the number of employees were retrieved from respective Statistical Bureaus in Slovakia and Slovenia. In each country, 600 questionnaires were sent to small, 300 to medium enterprises, and 300 to large companies. The number of questionnaires mailed to small companies was double the number of medium and large companies because small companies constitute the highest proportion of companies and based on our personal experience, they are less likely to respond. In total, there were 202 responses (112 from Slovakia, and 90 from Slovenia) out of 2400 mailings, i.e. the response rate was 8.4%.

Respondents were to answer what the actual total cost of ERP system implementation was – whether it was less than planned, as planned, or more than planned. In case that the total implementation cost did not match the planned one, they were asked how many percent less or more they actually spent on implementation. There were 111 responses, which compared actual and planned implementation costs and 105 provided enough input to calculate the actual percentage. The distribution of the answers provided is presented in Fig. 1. For the purpose of this histogram, the values were rounded to tens of percents.

Independent variables are country, company size, representation of the IT department on the board level, and information strategy. The questionnaire research was conducted in Slovakia and Slovenia. Analyzed are small, medium and large companies, where companies from 10 to 49 employees are considered to be small enterprises, companies from 50 to 249 employees are considers to be medium enterprises, and companies with 250+ employees are considered to be large enterprises. This framework is consistent with [8]. Information strategy stands for formal information strategy. Representation of the IT department on the board level means that there is a CIO or alike director for IT on the board level. Therefore, it will be described as CIO in Figs. 2–5.

In this paper, two approaches are used to investigate the actual ERP system implementation cost vis-à-vis planned costs. The first one looks into how many companies did not exceed their planned budget. There were only three Slovenian companies, which spent less than planned; they were merged with companies,

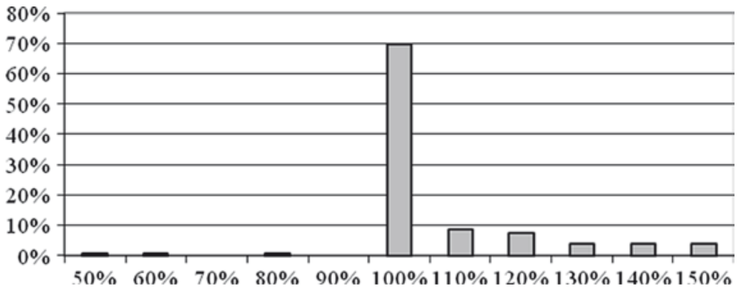


Fig. 1 Distribution of actual ERP system implementation cost vis-à-vis planned costs

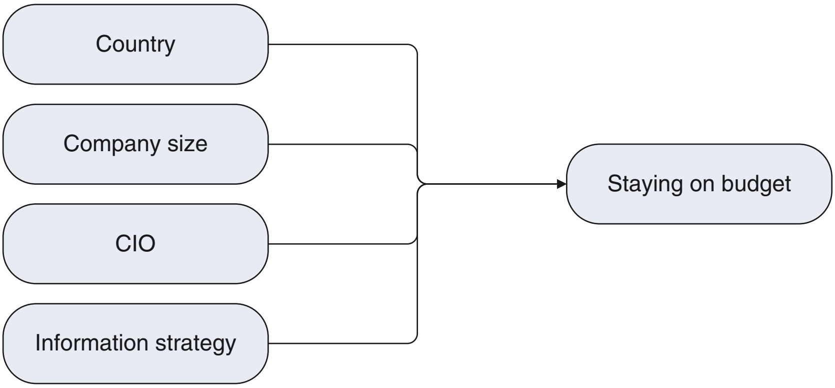


Fig. 2 Research model for the first approach

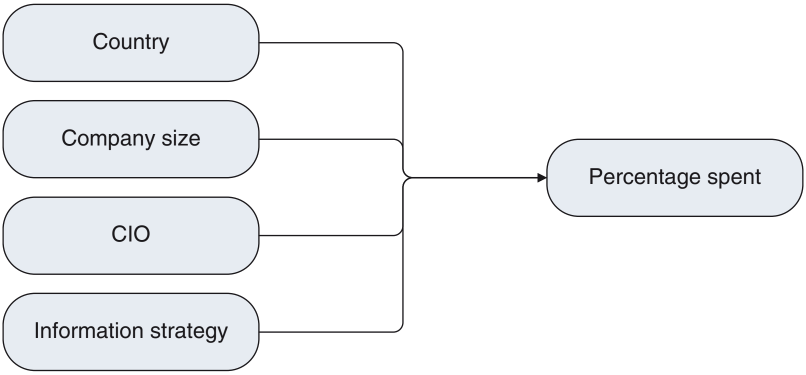


Fig. 3 Research model for the second approach

which spend exactly the amount they planned, since both can be classified as staying on budget. The research model is presented in Fig. 2.

The second approach focuses on the percentage spent compared to the planned amount. The research model is presented in Fig. 3.

Regarding the methodology, logistic regression was used for the first approach and analysis of variance (ANOVA) for the second one. Multivariate approach was used in both cases. Additionally, binomial test was used to test if there is a significant difference between the percentage of companies that stayed on budget and 50%; Tukey-Kramer multiple-comparison test was used to identify differences between individual instances of independent variables; t-test and Wilcoxon signed-rank test were used to test if there is a significant difference between the average ratio of actual ERP system implementation cost vis-à-vis planned costs and 100% (i.e. companies spending exactly according to plan). Results of the statistical tests are commented on confidence level $\alpha = 0.05$.

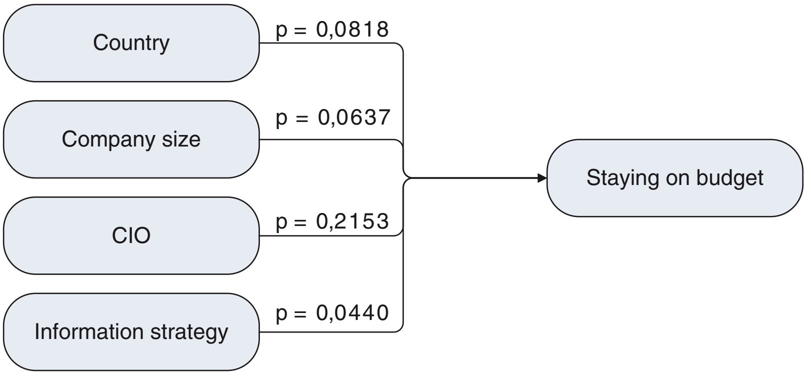


Fig. 4 Research results from the first approach

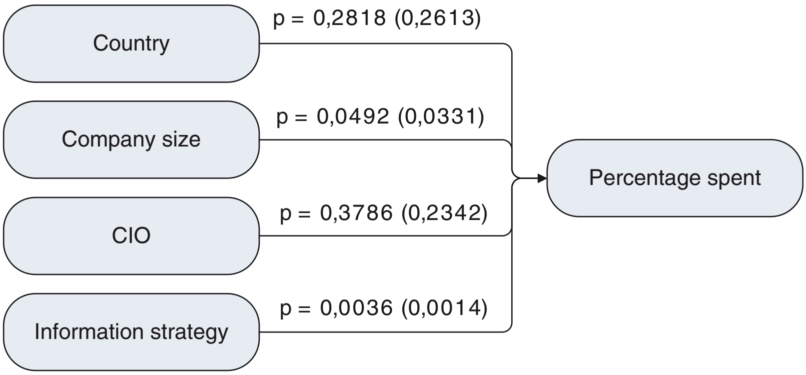


Fig. 5 Research results from the second approach

Results

The findings from the first approach are summarized in Fig. 4. There is a significant relationship between staying on budget and having a formal information strategy. Companies with formal information strategy seem to be more likely to stay on budget (74.2%) than companies without information strategy (61.2%). Based on the p-values, it is possible to theorize that if the research sample was larger, also company size and the country might have a significant impact. Overall, 68.5% of companies stayed on budget; this percentage is significantly different from 50% (p-value = 0.0001), i.e. more than one half of companies actually manages to stay on budget.

For the second approach, data were transformed into percentages and these were analyzed. Since there were six respondents, who did not provide an estimate, how much over budget they were, a dummy variable of 119.78 was introduced (it was the average percentage calculated from companies exceeding their planned budget). The findings from the second approach are summarized in Fig. 5.

Table 1 Actual vis-à-vis planned ERP system implementation cost by size and information strategy

	Information strategy	No information strategy
Small	95.0%	107.5%
Medium	98.7%	110.4%
Large	106.2%	113.0%

In Fig. 5, p-values from the analysis of data not including and including dummy variables are provided; p-values from the analysis of data including dummy variables are in brackets. Regardless whether the dummy variable was used or not, ANOVA identified a significant relationship between the percentages of actual spending compared to planned one and information strategy, and company size. Companies with a formal information strategy were less over budget (102.8%) than companies without one (110.3%). Regarding company size, there is a significant difference between small (103.3%) and large companies (108.3%); the percentage in medium companies was 104.1%. It is consistent with Hunton et al. [9], who suggest that smaller companies posses fewer resources and are less able to attract resources compared to large companies, “thus large companies can more easily absorb and withstand ERP implementation costs.

Overall average was 106.0%. There is a significant difference between the overall average of 106.0 and 100% (no disparity between planned and actual costs). P-value is smaller than 0.0001 regardless whether t-test for difference between mean and value, or Wilcoxon signed-rank test for difference in medians is used.

Since the percentage of actual vis-à-vis planned ERP system implementation cost depends on company size and information strategy, we provide subtotals in Table 1.

These averages do not include dummy variables mentioned before; if included, averages are less than 1 percentage point higher.

Based on the results, it can be summarized that, when it comes to small and medium enterprises, companies with formal information strategy are likely to spend about 12 percentage points less than companies without information strategy. It suggests that ERP system vendors need to be sensitive to companies without information strategy, since these have either wrong expectations of costs or lack of technical skills beneficial for ERP system implementation.

Known Limitations and Future Research

There are two known limitations of this paper, which are actually inherent for most of questionnaire surveys – response rate and reliability of data. Usually, there is an average response rate of 10% expected in questionnaire surveys. But a response rate of 80% and less (that is a case of almost all questionnaire surveys) can already lead to biased results. To overcome this problem. Two thousand four hundred questionnaires were sent out to the random selected companies. The percentage of companies being over budget (i.e. ones, which would be more likely to complain about their bad experience) is only 31.5%, i.e. less than 34% (which included also projects going over time) mentioned in [4], and surveyed companies were only 6% over budget, i.e. much less than 178% mentioned in [6]. Regarding the reliability, it is not possible to check it without being allowed to look into accounts and to talk to people involved in the implementation, who would provide insight necessary to understand the accounting data.

The future research should look into what caused additional costs. For example, customization of ERP is a crucial, lengthy, costly aspect of the implementation of ERP systems [10]. Studies have shown that many organizations exceed their budgets due to the need for more customization than they originally planned [11, 12, 16]. Besides customization, companies often run into higher than expected costs for temporary and overtime labor, re-skilling, and training during the implementation process [11, 12, 16].

Last but not least, it might be useful to investigate whether additional costs arose because of the misalignment (the gap between the standard version of the ERP system and the organization) or was it spent in order to increase benefits. Investigation of both total costs of ownership and total benefits of ownership might provide a different angle for looking at expenditures.

Conclusions

To sum up, although not all companies manage to stay on budget when it comes to EPR system implementation, the situation is not too critical. It can be evaluated from two points of view. Firstly, about two thirds of companies still manage to stay on budget. Secondly, companies exceeded their budgets only by 6% on average. A contributing factor for Slovak and Slovenian, i.e. European, companies staying more-or-less on budget is the prevalent fixed price policy for ERP implementation projects in Europe. So, the findings might be generalized in European context but definitely not for the U.S., where effort-based pricing policy is prevalent.

A formal information strategy implies more comprehensive planning, so there should be also smaller discrepancies between the plan and the reality. Company size matters probably because large companies have more resources to invest in case it turns out that they are needed or could bring additional benefits. A slight difference between countries can be attributed to the economic situation. Probably because of the worse economic situation in Slovakia, Slovak companies do not have as much of available resources as Slovenian companies. Therefore the percentage of companies staying on budget is higher and the average excess of implementation costs is lower in Slovakia than in Slovenia. It might be a bit surprising that representation of the IT department on board level does not seem to have any impact on staying on budget. However, a chief information officer (CIO) might contribute to a very similar variance to one in companies without CIOs by deciding on-the-fly to add or to cut on certain modules of ERP system implementation.

References

1. Aladwani, A. M. (2001) Change management strategies for successful ERP implementation, *Business Process Management Journal* 7(3): 266–275.
2. Wier, B., Hunton, J. and HassabElnaby, H. R. (2007) Enterprise resource planning systems and non-financial performance incentives: The joint impact on corporate performance, *International Journal of Accounting Information Systems* 8(3): 165–190.
3. Gable, G. and Stewart, G. (1999) SAP R/3 implementation issues for small to medium enterprises, in *Proceedings of the Fifth America's Conference on Information Systems*, 779–781, Milwaukee, WI, USA.
4. Cunningham, M. (1999). It's all about the business, *Information*, 13 (3): 83.
5. Seewald, N. (2002) Enterprise resource planning tops manufacturers' IT budgets, *Chemical week* 164(35): 34.
6. Basoglu, N., Daim, T. and Kerimoglu, O. (2007) Organizational adoption of enterprise resource planning systems: A conceptual framework, *Journal of High Technology Management Research* 18(1): 73–97.
7. World Economic Forum, The Global Information Technology Report 2006-2007, accessed on 10 June 2008, available at http://www.greaterzuricharea.ch/content/05/downloads/ 2007_nri_wef.pdf
8. European Commission. (2008) SME Definition: Recommendation 2003/361/EC Regarding the SME Definition, accessed on 10 June 2008, available at http://ec.europa.eu/enterprise/enterprise_policy/sme_definition/index_en.htm
9. Hunton, J. E., Lippicott, B. and Reck, J. L. (2003) Enterprise resource planning systems: Comparing firm performance of adopters and non-adopters, *International Journal of Accounting Information Systems* 4(3): 165–184.
10. Gefen, D. (2002) Nurturing clients' trust to encourage engagement success during the customization of ERP systems, *Omega-International Journal of Management Science* 30(4): 287–299.
11. Markus, M. L., Axline, S., Petrie D. and Tanis, C. (2000) Learning from adopters' experiences with ERP: problems encountered and success achieved, *Journal of Information Technology* 15(4): 245–265.
12. Markus, M. L., Tanis C. and Van Fenema, P. C. (2000) Multisite ERP implementations, *Communications of the ACM* 43(4): 42–46.
13. Peslak, A. R., (2006) Enterprise resource planning success :An exploratory study of the financial executive perspective. *Industrial Management + Data Systems, 106(9), 1288–1303*.
14. Schwalbe, K. (2006), Information Technology Project Management, 4th ed., Thomson Course Technology, Boston, MA.
15. Swan, J., Newell S. and Robertson, M. (1999) The illusion of 'best practice' in information systems for operations management, *European Journal of Information Systems* 8(4): 284–293.
16. Sumner, M. (2000) Risk factors in enterprise-wide/ERP projects, *Journal of Information Technology* 15(4): 317–327.

Agent Technologies in the Future Internet

K. Fischer[1], I. Zinnikus[2], and E. León-Soto[3]

Abstract The article presents perspectives of how future directions in the development of the Internet could look like and how agents could support this evolution. The article describes recent Internet trends, discusses some ideas how future developments of the Internet might look like, presents some basics of agent technologies and discusses how agent technologies can contribute to the further development of the Internet.

Motivation

When it comes to the future of the Internet, the time scale we think about of course makes a difference. In a longer term perspective we can expect that we will have a network in which highly intelligent entities – be it humans or computer-based virtual entities – seamlessly interact. In such a setting it will be difficult to tell where the computer-based virtual environment starts or ends, because the physical world will be directly coupled with the virtual world. How rich and interesting the virtual part of this environment will be depends highly on the level of intelligence the individual entities have reached. This is especially important for the entities that are completely and solely controlled by computer programs. In present days people struggle with simple things and there are problems to solve when users try to interact and collaborate using computer-based infrastructure. It is safe to assume that today almost anybody with reasonable education would be able to connect a PC to the Internet and start to use email and the World Wide Web (WWW). Problems, however, already start when a user wants to interact with a bank in a bit more sophisticated manner other than by using the pure Web interface the bank offers.

[1]Deutsches Forschungszentrum für Künstliche Intelligenz, Kaiserslautern, Deutschland, klaus.fischer@dfki.de
[2]Deutsches Forschungszentrum für Künstliche Intelligenz, Kaiserslautern, Deutschland, zinnikus@dfki.de
[3]Deutsches Forschungszentrum für Künstliche Intelligenz, (DFKI) GmbH, Kaiserslautern, Deutschland, zinnikus@dfki.de

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_44, © Springer Physica-Verlag Berlin Heidelberg 2010

The limited ways financial information tracking programs can adapt to continuous changes in the service interfaces make the whole experience rather unpleasant. Problems get worse when companies start to interact, because there are neither widely accepted standards for representing information and for sharing it nor for how specific processes should actually be executed. Even within larger companies one can see that business critical data is scattered between databases that have different data schemas for identical types of information and, if at all, can only communicate with each other in a rather limited manner.

Current Internet Trends

In [6] Handley describes the past development of the Internet and the problems that had to be solved while this development took place. Handley mainly focuses on the evolution of the network infrastructure without taking too much into account the evolution of the applications that run on top of it. WWW, E-mail, Instant Messaging, News, Internet Radio, and Internet Telephony are today the most widely used applications running on the currently existing infrastructure in private and commercial contexts. On top of these applications, companies today try to implement e-business applications like Web Shops or business to business applications. Online banking might be the most obvious example of a business where serious money is involved and at least in some cases already today some banks purely operate on the Internet. A prominent example of a company whose business is focusing on the Internet is of course Google. Starting as a provider of a Web search engine, Google recently developed a set of innovative applications like Google Maps, Google Earth, and Google Desktop. Other innovative applications competing for the interest of the Internet user are Facebook, MySpace, YouTube, etc. The list is not meant to be exhaustive but to highlight some recent examples. Because of limited space in this article, in the following we can only pick out some major trends of current developments that we believe will have an important impact on the future development of the Internet regarding its infrastructure and the applications that might become main stream in the next years.

Service-oriented Architectures

Service-oriented architectures (SOAs) as an architectural style for distributed systems have steadily been gaining momentum over the last couple of years and are now considered as mainstream in modern enterprise computing. In this context SOA can be considered as a methodology for systems development and integration where functionality is grouped around business processes and packaged as *interoperable services*. Compared to earlier middleware products, SOAs put a stronger emphasis on loose coupling between the participating entities in a distributed system. Service orientation is characterized by the following basic principles: explicit boundaries, autonomy of services, declarative interfaces, data formats and policy-based service description. Web Services are the technology that is most often used for implementing SOAs. Currently, Web Services are a standards-based stack of specifications that enable interoperable interactions between applications that use the Web as a technical foundation [2]. The emphasis on loose coupling also means that the same degree of independence can be found between the organizations that build the different parts of a SOA. The teams involved have only to agree on service descriptions and policies at the level of abstraction prescribed by the different Web Service standards. Web services are supported by a stack of Internet standards (HTTP, XML, SOAP, WSDL, and UDDI) which needed to be complemented by a process layer, since business scenarios are process-driven. The term process-driven emphasizes the importance of process models created on the engineering layer. At the execution layer, these models are used for process orchestration and choreography. *Orchestration* in this context describes the composition of business objects in a process flow. In detail, it defines a complex interaction between business objects, including business logic and execution order of the interactions. *Choreographies* on the other hand define collaborations between interacting parties.

Semantic Web

The Semantic Web is an evolving extension of the WWW in which semantic annotations are added to information and services to make content better accessible for automated processing. In this thread of research service-orientation is also in the focus of interest. The main reason for this is that “Web services have little value if others cannot discover, access, and make sense of them” [5]. So it is clear that when it comes to using services, the aim of the Semantic Web is ad hoc usage. Major results in this area have been so far the development of languages to semantically describe services (OWL-S, WSMO, SAWSDL) and algorithms to do matchmaking on such representations where matchmaking usually means the comparison of queries with service descriptions to find out which of the described services comes closer to the service the query asks for. Despite this effort the task to actually find the service that is most appropriate for a given situation is not solved to a degree that it would be completely satisfactory. Ontologies are a basic means the semantic service descriptions refer to. These are formal descriptions of concepts of some application domain and how they relate to each other. Although ontologies are useful in dealing with the problem of formally describing the meaning of some piece of information, it is the ultimate grounding in some application domain that actually gives the semantics to formal expressions.

*Web *.0*

Web 2.0 is a living term describing changing trends in the use of WWW technology that aims to enhance creativity, information sharing, collaboration and functionality of the Web. The concept of "Web 2.0" began with a conference brainstorming session between O'Reilly and MediaLive International [7]. Web 2.0 concepts have led to the development and evolution of web-based communities and hosted services, such as social-networking sites, image and video sharing sites, wikis, blogs, folksonomies, and RSS feeds. The term became notable after the first O'Reilly Media Web 2.0 conference in 2004. According to Tim O'Reilly Web 2.0 is characterized by the following themes: The Web as platform, data as the driving force, an architecture of participation, lightweight business models, end of the software adoption cycle, software above the level of a single device, innovation in assembly, and "the power of the Tail" [1]. More recently the mashup concept has emerged. *Mashups* are Web applications created by mixing an already-existing open mapping platform with original software to bring discrete data from services together and create more meaningful data sets. By extension, service mashups aim to design and develop novel and modern Web applications based on easy-to-accomplish end-user service compositions. Examples are comparison shopping sites (e.g. with currency conversion) and travel agencies or guides. Combining Web service technologies, Web data management and semantic technologies offer exciting challenges for researchers building a new generation of Web-based applications. Following the introduction of the phrase "Web 2.0" as a description of the recent evolution of the Web, the term "Web 3.0" has been introduced to hypothesize about a future wave of Internet innovation. Views on the next stage of the WWW's evolution vary greatly. Increases in Internet connection speeds, modular web applications, and advances in computer graphics are likely to play a key role in the evolution of the WWW. The current infrastructure still has the potential to create innovative applications, but the infrastructure supposedly needs to change to foster the needs of future applications.

Internet of Things

The term Internet of Things refers to a, most of the time wireless and self-configuring, network of objects, such as household appliances, machine tools or goods that need to be transported. The idea is as simple as its application is difficult. If all cans, books, shoes or parts of cars are equipped with small identifying devices, daily life will change. Things like running out of stock or wasted products will no longer exist as companies will know exactly what is being consumed on the other side of the globe. If all objects of daily life, from pizza to ships, cars or airplanes, are equipped with radio tags, they can be identified and managed by computers in the same manner as by humans. The next generation of Internet applications is likely to require a new protocol infrastructure (IPv6?) which supports the identification of more objects than IPv4 which is currently most widely in use. Such systems would be able to instantaneously identify any kind of object. An alternative view from the world of the Semantic Web focuses instead on making all "things" (not just those electronic, smart, or RFID-enabled) addressable by the existing naming protocols, such as URI. The objects themselves do not communicate with each other, but they may be referred to by other agents, such as powerful servers acting on behalf of their human owners. Obviously these two approaches converge as more objects become progressively addressable and more intelligent. This is unlikely to happen in a short-term perspective. But the two views have significantly different implications in the interim. In particular, the universal addressability approach rapidly includes things that cannot have communication behaviors of their own, such as abstract data documents.

3D Internet and Multimedia Content

As broad-band high-speed Internet got available to larger numbers of users, online games and social interaction in game-like or fantasy situations got more and more popular. Massively multiplayer online role-playing games are the genre of games in which a large number of players interact with one another in virtual worlds. In role-playing games players adopt the role of a fictional character (often in a fantasy world), and take control over many (in some cases all) of that character's actions. The number of concurrently active users can vary from small numbers (<100) to huge numbers ($>10{,}000$). To make the user's experience realistic and appealing, in many cases the world the users interact in is represented as a 3D fantasy image that comes at least in parts close to what we see in the real world around us. There are two major aspects in these genre of games: (1) to allow the user to share his or her experience with other users, i.e. make it a social experience, and (2) to make the experience at least in some aspects as realistic as possible. Some instances of such games include violent interactions and here of course the desire to be realistic has its limits. In some instances the users have to form groups to actually achieve an objective. Other instances do not specify such an objective and leave the result of how the "game" evolves completely to the activities of the participants. Second Life is an example of the latter where some people argue that Second Life is not really a game because it misses a clearly specified mission the users should fulfill. The idea behind Second Life is actually that all content and interaction is created by the human users. However, role playing and even violent interaction are part of Second Life and it is just clear that the main aim of the providers of the infrastructure on which it runs is to make the experience of the users' interactions as appealing as possible, whatever this means in the end. Giving the users the impression that their avatars are living in a 3D world that is at least in major parts close to the real-world that they know is a major aim of the underlying infrastructure. Also multimedia content like music, video and audio in the sense of spoken interaction is a major aspect. Although in present days the major part of it means that the user just gets the content that is made available for example by an Internet radio station or by some video broadcast, even today more and more the user him/herself provides this content. This is most obvious in the case of audio interaction like in voice chat in Second Life or Internet telephony, but it can also be interesting for the user to provide his or her own music or video. It is quite likely that applications like Second Life, Skype/VoIP, Internet Radio, and Internet TV grow together to an infrastructure in which one can enjoy all of it at the same time.

Where Can Agents Help?

All the applications mentioned so far have in common that a large amount of data is involved that in many cases is difficult to deal with for a human user. Active software entities – in many cases referred to as agents – can help the user to better deal with this situation. When we use the term *agent* in this article we refer to the following definition: An agent is a computer system that is situated in some environment, and that is capable of autonomous action in this environment in order to meet its design objectives [8].

We want now to highlight some aspects of the application areas mentioned above where we believe that agents can help to improve the situation for the user.

Service-Oriented Architectures

The two major aspects in service architectures where the currently available technologies are not really satisfying are (1) search and retrieval of relevant services and (2) flexible use and provisioning of services that allows smooth composition and integration. At least to the degree the currently used descriptions of services can actually support it, agent technologies can help to improve the situation by providing a solid theory as well as a design and execution framework for flexible service composition and execution [9].

Semantic Web

When the ultimate goal of the Semantic Web, where virtual entities like services and information on the net are described with semantically meaningful representation, is achieved, it will be much easier for agents to use these artifacts in a productive manner. Service-oriented architectures are likely to get improved in this development regarding their effectiveness. Even general information processing will be significantly improved, but it will take some time until this vision might come true.

*Web *.0*

Regarding Web 2.0 it is obvious that the amount of data involved is overwhelming and this means text as well as multimedia data. It is clear that techniques of artificial intelligence are needed to mechanically deal with this data. Agents can use these techniques in an active manner and in doing so support users to actually find the information they like to have.

Internet of Thing

The main characteristic of this development is the vast number of entities that interact with each other and with the systems that control them. Because of the constant changes (new such entities are produced and existing entities change their geographical position or are transformed in some other manner), it is obvious that a self-managed and self-controlled system is needed to deal with this situation. Agent technologies inherently are active and can cope with the constantly changing situation. Agents can track and monitor the entities, sense for specific situations and raise and react to events. Even when such entities group together and form new entities that again form new structures (like for example the chassis and the motor of the car go together in car production) agent technologies can be adopted to deal with this situation [3, 4].

3D Internet and Multimedia Content

The vision of a photo and physically realistic virtual environment in which human users can interact with each other and do business has many advantages. The most obvious one of these is to make shopping on the net a much more interesting and realistic experience. To act in such an environment will however be also demanding on the users side. A user might want to do complex tasks and even might end up in a situation where a group of avatars is needed to achieve the desired goals. Agent technologies are likely to play a key role in making such environments acceptable for mainstream users. On the one hand they will give support to users but they also might be used to learn the user's behavior to eventually be able to act directly on his or her behalf. To still control and restrict the agent's autonomy will be an important aspect. Multimedia content and multi-modal interaction between the system and the users as well as among the users just adds to the complexity of such settings.

Although agent technologies provide interesting features to such environments they have an inherent problem. If they reach a high level of intelligence, they might have their own ideas what to do and how to do it. Stanley Kubricks' film "2001: A Space Odyssey" is an instance of a futuristic story that shows where this might lead to. So it is clear that the system engineers and the human users would like to have means to describe how the agent's actions should be constrained so that the behavior of an agent meets the design objective of its creator. Current trends of system design use modeling approaches to provide representations that can be intuitively understood. They are, however, powerful enough to allow a system designer to provide complex descriptions that might in the future lead to agents that can be considered to be truly intelligent.

Conclusion

The Internet offers already applications where implications on our real-life cannot be completely predicted. In the last years the Internet has changed from a basically text-based medium to a platform on which massive amounts of multimedia data are exchanged. Some applications work fine when they are used bilaterally between two users, but even when the numbers increase to smaller groups there can be a significant decrease in performance. It is likely that the performance of the Internet's infrastructure will continue to improve to meet the increasingly demanding requirements of these applications. The following trends in future development are likely to increase the need for higher bandwidth and scalability of the Internet:

- Massive amount of users and systems provide content and access content at any time from everywhere.
- Structured virtual worlds where the spectrum goes from simple text-based media to complex photo-realistic environments where it is hard to tell whether one looks at the real world or a simulation of it. In this spectrum there might be other forms of virtual environments that might be combinations of the two that could provide new for now unknown information spaces.
- Objects will be directly linked to the Internet and each object might play an active part in the interactions with other entities in the Internet, be it humans, agents, or just simple software components.
- Digital right management will be needed to regulate access to a massive amount of virtual artifacts.

What these future trends have in common is the need for high bandwidth peer-to-peer transfer of vast amounts of data. Even when we take into account the costs of the required infrastructure it is certain that such a setting has the potential of being a market with enormous growth rates. Although the future development of the Internet cannot be certainly predicted, it is as good as certain that the future will be exciting.

References

1. J. Battelle and T. O'Reilly: web2.0 Conference, 2004 (http://conferences.oreillynet.com/pub/w/32/presentations.html).
2. G. Cabri, L. Leonardi, and M. Puviani. Service-Oriented Agent Methodologies. In *5th IEEE International Workshop on Agent-Based Computing for Enterprise Collaboration (ACEC-07)*, 2007.

3. K. Fischer. Holonic Multiagent Systems – Theory and Applications. In P. Barohona and J. J. Alferes (Eds.): Proceedings of the 9th Portuguese Conference on Progress in Artificial Intelligence (EPIA-99), LNAI 1695. Springer, Berlin, pp. 34–48, September 1999.
4. K. Fischer, M. Schillo, and J. Siekmann: Holonic Multiagent Systems: A Foundation for the Organisation of Multiagent Systems. In V. Marík, D. McFarlane, and P. Valckenaers (Eds.): Proceedings of the 1st International Conference on Industrial Applications of Holonic and Multi-Agent Systems, HoloMAS 2003, LNAI 2744, Springer, Prague, Czech Republic, pp. 71–80, September 2003.
5. Ian F Service-Oriented Science. Science, 308(5723):814–817, 2005.
6. M. Handley Why the Internet only just works. BT Technology Journal, 24(3):119–129, 2006.
7. T. O'Reilly: What Is Web 2.0—Design Patterns and Business Models for the Next Generation of Software. 30.9.2005 (http://oreilly.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html).
8. M. Wooldridge: Intelligent Agents. In G. Weiss (ed.): Multiagent Systems, The MIT Press, Cambridge, MA, 1999.
9. I. Zinnikus, C. Hahn, and K. Fischer: A model-driven agent-based approach for the integration of services into a collaborative business process. In: Proceedings of the 7th International Conference on Autonomous Agents and Multiagent Systems (AAMAS), Estoril, Portugal, pp. 241–248, May 2008.

An Experience About User Involvement for Successful Design

P. Buono[1] **and A.L. Simeone**[2]

Abstract This paper describes the experience in designing and developing the CET system according to user-centred and participatory approaches. CET is a web-based system used by industries and experts of the regional government that monitor air quality. With CET, industries can officially declare their pollutant emissions in the atmosphere, while air quality experts can easily visualize how the industries are distributed in the regional territory, the type and quantity of emissions coming from their production processes and other important information to support their decision-making process. The experience provides hints about proper user involvement for designing successful systems.

Introduction

The air quality is a pressing problem all around the world. Since the industrial era, human beings started to pollute the environment and now we are aware that air quality must be carefully monitored. Emission inventories are the tools by which governments can control the presence of emissions, especially in urban areas. Building effective emission inventories is still challenging and they are the basis for developing models that allow governments to make good decisions about the environment. Quantity and type of pollutants may change during time, thus the emission inventory needs to be carefully updated after several years.

Most strategies to get data in order to produce an inventory focus on estimates of the produced pollutants in a certain area where industries or other sources of pollution are located. In this paper we present a system that provides information about the quantity and quality of emissions (pollutants) by processing data that have been inserted in the system directly by industries, as required by the

[1]Università di Bari, Bari, Italy, buono@di.uiba.it
[2]Università di Bari, Bari, Italy, simeone@di.uniba.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_58, © Springer Physica-Verlag Berlin Heidelberg 2010

government of the Puglia region, in Southern Italy, that sponsored the project. The system focuses on industrial emissions in the atmosphere because they are the most relevant factor for air pollution; it actually represents an electronic cadastre of industrial emissions, thus it is called CET as acronym of “Catasto Emissioni Territoriali”, which in Italian means Territorial Emissions Cadastre. CET also supports experts of the regional government to perform analysis on the distribution of industrial plants and their emissions in the atmosphere.

CET has been developed according to user-centred and participatory approaches [1, 2]. The development experience, described in the next section, provides hints about a correct involvement of users in the development process, in order to design successful systems. An overview of the system is then provided and last section summarizes our findings.

The Design Experience

CET has been designed by following a User-Centered approach in order to build a system that satisfies clear usability objectives. Data for requirement analysis were collected from different sources: (a) survey on the state of the art, (b) study of other systems having the same goals, c) contextual analysis involving domain experts and real users. About (a), a survey on the state of the art was performed by also taking into account legacy systems and Italian laws about environment and pollution. About (b), among the systems we considered in our analysis we focused on INEMAR, since it has been adopted by most regional agencies in Italy [3]. Like other similar systems, INEMAR performs estimates about the quantity of pollution emitted in the atmosphere by using aggregated data provided by various associations (of industries, of consumers, etc.). It does not take into account single data coming from each chimney of the registered industries. CET was developed with the aim of collecting and storing more precise information about the industries and their emissions. An added value of CET is that it considers specific information about each industrial plant by requiring that the industry declares the composition of each plant, the characteristics of each chimney and the processes it operates. Thus, data stored by CET are actual data, not estimated ones, so that very detailed queries on very small geographic areas can be performed.

As part of our contextual analysis, we visited and interviewed people from industries and from the regional association for environment protection. It is now well acknowledged that people who will use the system and experts of the system domain must be involved in the design, since they bring their domain expertise, which is fundamental for the success of the final product. Thus, chemists and environmental experts were involved in a participatory design team [1]. Within this team, these experts explained in details how the emissions inventories are usually built by considering aggregated data that come from multiple sources. Often, the pollution estimate in a geographic area is provided by collecting data from industry or food associations. Since disaggregated data are also needed, the disaggregation is done by applying models. The problem with such models is that they are specific for some geographic area.

As we said, a part of the system is devoted to companies that, accessing it via web, have to provide various data about their production processes and the type and quantity of emissions produced. We were able to find seventeen companies that agreed to collaborate with us in the development of the system. Therefore, based on indications provided by the domain experts, including a set of guidelines defined by the Chemistry Department of the University of Bari, during the early design stage we designed paper prototypes of the forms that should be used by companies to provide such data through the Web. These prototypes were sent to the seventeen industries together with a questionnaire asking for comments about the prototypes.

System developers did not directly speak with companies, they only analyzed, together with the domain experts, the feedback provided with the questionnaires. As a result, a new version of the prototype was produced (Fig. 1). This time it was an application developed in Java since, based on the discussions with the experts, they were pretty sure it was the proper version complying with all defined requirements. We selected twelve other companies and scheduled a calendar of on-site visits, since we insisted for having the real users put their hands on the electronic prototype system, so that we could perform direct observation of users inserting data. During on-site visits, computer scientists and chemists briefly trained the

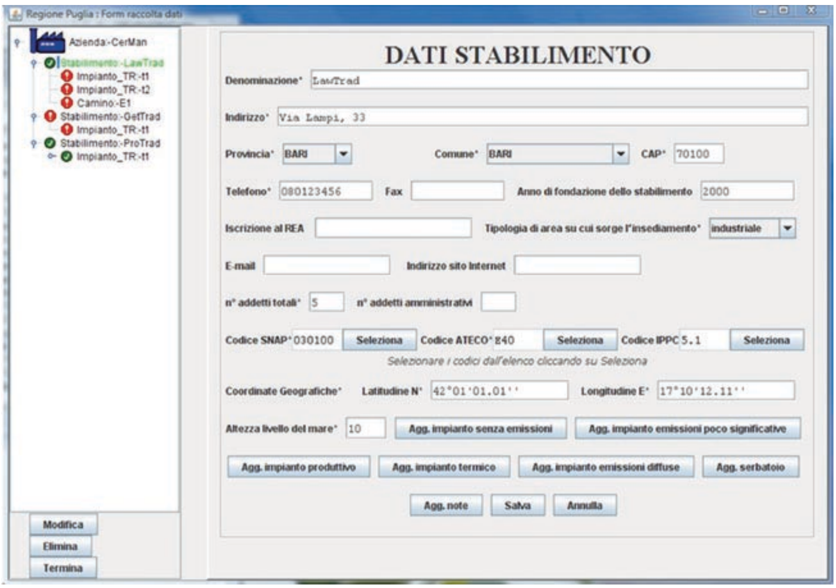


Fig. 1 The interface of the electronic prototype. The users are assisted by an error detecting mechanism that indicates, in the upper left corner, the sections in which there are mistakes or omissions

company's employees in using the prototype. The data entry phase led to unexpected results:

– The prototype required that data was typed into specific labeled fields of the visualized forms. The labels decided by the chemists in our participatory design team turned out to be too complicated for end users. The chemists were often engaged in long discussions with the company representatives to explain for the meaning of the various terms.
– The "idealized" company organization that the chemists envisioned during the design team discussions did not exist in reality. For example, our prototype considered only one emission point for each production plant, whereas in many actual plants there were multiple emission points.
– Several data about industry production and consumption were not available individually but only aggregated per year; again, there was a difference between the data our prototype expected and the data available in the real world.

Because of these problems, company people found very difficult to fill the required forms. It was clear that, if we want to create a successful system that can satisfy end users' needs and expectations, the system should be re-designed, no matter how many new resources this would imply. Once the new version was ready, we put it online in order to have more people working with the new system, and we asked the companies to input the data. At this stage of development, in the database there are data of more than one hundred of the biggest industry plants in the Puglia region.

Our experience is in line with what it is discussed in [4, 5]: if we want to design successful systems, it is fundamental to engage end users at right times, when they can really provide useful contribution. What we reported above shows that we initially failed in properly involving the users, and this compromised a lot the system we were developing. We could realize our failure only when end users put their hands on the system in their working place, because they could provide right indications about what was working well and what was not.

An Overview of CET

Being a Web-based application, the system has a classical client-server architecture with three tiers. The Regional Environmental Agency is the server and companies and air quality operators are the clients. The system has an underlying database containing all data related to the companies that supply emissions data in the Puglia region, namely data about accounts, organizational structure, yearly production activity, periodical checks of the plants emissions, etc. At the database layer, there is also a spatial database that enables to perform spatial queries.

According to the Italian and regional regulations, data to be provided by industries are numerous and complex. To simplify users' input, data entry has been broken down into several successive steps. Once data is correctly stored, CET

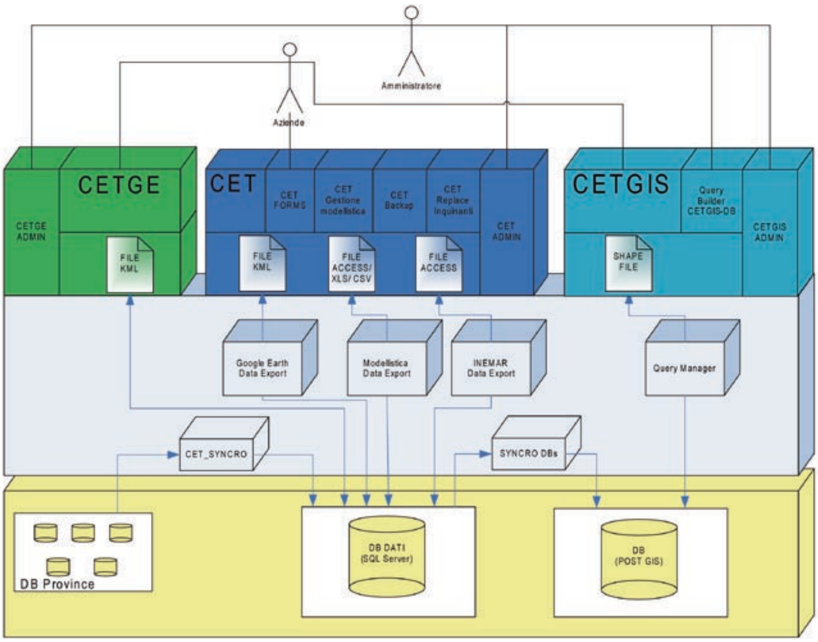


Fig. 2 The architecture of the CET system is divided in three layers: the data layer, a middle layer containing common services and the user interface layer

offers the possibility of automatically compiling a series of detailed reports about company data, production processes, etc.

Figure 2 shows the CET architecture. The bottom layer comprises the shared databases while the middle layer contains services used for synchronizing, exporting and querying the database. Finally, the topmost layer shows how CET makes use of two supporting systems called CETGIS and CETGE.

As we said, CET is used by air quality monitoring experts for getting information to support their decision-making process, such as information about the type and quantity of emissions and production processes of industries. An important feature of CET is the possibility of visualizing the location and type of chimneys and other objects inside Google Earth [5], as shown in Fig. 3. Objects are displayed as 3D models.

As shown in Fig. 3, the system is able to visualize the various chimneys in the correct positions. To support users in providing the chimney positions in cases when s/he does not know the precise coordinates, we built a module that allows users to indicate the position of their chimneys by pointing directly on the visualized map. The error measure could reach 500 m at most, that is acceptable for air pollution. Once the systems gets the positioning of the company, with coordinates of plant and chimneys, the 3D model to be shown on the map can be generated according to the physical characteristics declared by the user in the filled form.

Fig. 3 A visualization of an industry in Google Earth. The overall plant is visible, together with several chimneys and even other objects, that will be more evident when the user zooms in the image

The generated 3D models are superimposed onto the satellite orthophotos imagery, displayed within the Google Earth application. Although factories and chimneys are represented in a stylized form, they convey to users an effective view of what kind of industry is located in the portion of space that they are currently viewing. In this way, company users can check the correctness of supplied data by looking at the displayed image. Mistakes can be ruled out and promptly corrected as missing or incorrect chimney data will be rapidly spotted.

As represented in Fig. 2, at the topmost layer CET includes two supporting systems: CETGIS and CETGE. CETGIS is a GIS-based system that handles spatial user query, such as visualizing the distribution of a pollutant according to the town distribution on the region or according to the provinces. CETGIS supports arbitrarily complex views composed by various layers. Users have the possibility of customizing the maps of interest.

As we said, CET exploits the 3D representations provided by Google Earth to visualize the 3D models of an industry, including chimneys and other objects, in these representations. In order to improve the capability of the system to visualize the results of more complex queries in Google Earth, CETGE has been developed. For example, the user may request to display all chimneys whose CO2 emissions are above a given threshold. The output of the query is a KML [7] file that is opened with Google Earth.

The visualized data can also be compared with those produced by other systems. Figure 4 displays data generated from the European Pollution Emission Register [8]. The bars indicate emissions of pollutants. The bar height is proportional to the emission quantity. The bar referring to the industry shown in Fig. 4 is circled.

Fig. 4 The bars show data stored in the European Pollutant Emission Register database. The same industry shown in Fig. 3 is circled; the red bar indicating the considerable quantity of pollutants this industry emits can be compared with the other bars, corresponding to different industries

Discussion and Conclusions

This paper has described the web-based CET system used by industries and by experts of the regional government of the Puglia region to monitor air quality. The focus has been on the design and development of the system according to user-centred and participatory approaches. Therefore, domain experts, representative of end users, and end users themselves had an active role in the whole process. They participated in the requirement analysis, which was fundamental for developers to understand the domain of interest and the user needs, skills and current working practices; they evaluated the initial paper prototypes and provided feedback; they tested the successive system prototypes.

We have to admit that, despite our efforts in designing a system that could be really efficient and effective for its users, we made mistakes that we had to correct, no matter how many more resources this required. A first mistake was that, initially, in our participatory design we primarily involved domain experts and not real end users; the latter are the people who will use the final system, namely company employees, air quality monitoring experts and operators working at the region government. This happened because the domain experts claimed to know everything about the functionalities to be implemented, the data to be entered in the system, the way they should be entered, and so on. As we have described, the test with end users, who worked with a prototype built through a participatory design that involved only domain experts, demonstrated that we failed. Such experts, as it often happens to university professors, had in mind in ideal company organization that did not exist in reality. The many difficulties end users encountered in entering the complex data to the system convinced us to re-design the system, because our goal was to build a successful system adapted to people that have to use them and not requiring people to adapt to the system, as it usually happens with the software systems available in the market.

The other lesson we learned is similar to what it is discussed in [4, 5]: end users provide the most valuable feedback about their possible problems only once they work with the new system in real settings. We got the most important indications from end users when we observed them interacting in their workplace with a running prototype pretty close to the final version, since, for the data entry module, it included all functionalities identified at the requirement phase, Only when a new system impacts their daily practices, end users are able to evaluate it and raise significant issues about its usability. This does not mean that involving users in early phases of the design process is of no value, because they certainly provide useful feedback; it suggests that we have to re-think the different stages of system development and, as clearly said in [4], legitimize post-implementation activities that, instead of being considered a sign of system failure, can help manage end users' expectations. For this reason, even if CET is not yet completed in all its components, we have some modules already available on the web and industries are using it and entering their data. This module is running on line since 2007. We got only one call of a user for a technical problem (it was a bug that was quickly fixed during a week-end) and one request from an expert of the region government for a particular data format that was not considered during the design process. People are using the system without any problem. This is the best evidence for us that the current version is really successful.

References

1. Schuler D, Namioka A (1993) Participatory Design: Principles and Practices. L. Erlbaum Associates. Hillsdale, NJ
2. ISO 13407 (1998) Human-Centered Design Process for Interactive Systems. *International Organization for Standardization*
3. ARPA Regione Lombardia (1999) Progetto INEMAR,http://www.ambiente.regione.lombardia.it/inemar/e_inemarhome.htm. Cited 26 Sept 2008
4. Wagner JL, Piccoli G (2007) Moving beyond user participation to achieve successful IS design. *Commun. ACM* 50-12: 51–55
5. Costabile M F, Mussio P, Parasiliti Provenza L, Piccinno A (2009) Supporting End Users to be Co-designers of their Tools. *LNCS*, Springer (in print)
6. Google Earth, http://earth.google.it/Google Earth. Cited 26 Sept 2008
7. Keyhole Markup Language, http://code.google.com/apis/kml. Cited 26 Sept 2008
8. European Pollutant Emission Register (2000) EPER Databasehttp://eper.ec.europa.eu/eper/. Cited 26 Sept 2008

B2G Electronic Invoicing as Enforced High Impact Service: Open Issues

P.L. Agostini[1] **and R. Naggi**[2]

Abstract Although electronic invoicing is considered one of the most promising instruments to improve the efficiency of economic systems, in Europe it has not yet achieved significant adoption rates, especially among Small and Medium Enterprises. The reasons for this missed diffusion have been largely discussed in the literature. In particular it has been stated that the penetration of e-invoicing among SMEs needs the cooperation of specialised Service Providers. The theme has gained relevance also in a Public Policy perspective: advanced e-solutions in the B2G context (e-Government high impact services) should enable a further propagation of similar innovations in the B2B context. Legislation-based approaches are often used in order to obtain a critical mass of users in a short time.This paper aims at achieving a deeper understanding on whether juridically enforcing the adoption of procedures, which have not achieved an established consensus under "normal" circumstances, can be considered a winning and legitimate strategy. This will help establishing a revised framework for further empirical research.

Introduction

The theme of the digitalization of documents (dematerialization) managed by organisations is increasingly getting central to both academic research and practitioners. Dematerialisation is regarded as one of the main "instruments" to achieve drastic cuts in the administrative costs and to improve the efficiency of document-based workflows, while obtaining processes transparency and traceability. The leading idea is to substitute office-automation – where the use of ICT has not succeeded in avoiding paper-based and hand-managed transactions and archiving – with Straight-Through-Processing (STP), that is a full automation of administrative

[1]Università Cattolica del Sacro Cuore, Milano, Italy, pietroluca.agostini@unicatt.it
[2]Università LUISS Guido Carli, Roma, Italy, rnaggi@luiss.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_9,

processes in a end-to-end fashion. In the STP oriented vision, full automation is not limited to internal processes, but must be extended to the management of the transactions with external subjects, trying to integrate in a smooth and completely digitalised flow (defined as "financial supply chain") the traditional supply chain and financial value chain. In particular, the dematerialisation of invoices (i.e. electronic invoicing) is considered a main step in the implementation of STP, being invoice the connecting document between the order and delivery cycle, and the payment cycle [1–3]. Dematerialisation of invoices is pivotal also for the integration of the administrative systems of enterprises with those of public bodies. In other terms, as we will clarify better in the work, the topic has to be analysed also under an e-Government perspective.

The broad aim of this paper is to gain a deeper understanding on policies that might be used to boost the adoption of B2G innovative ICT-based procedures also in the B2B environment. In particular we will focus on the employment of enforcing policies aiming at a widespread diffusion of electronic invoicing procedures. The main question is whether enforcing the adoption of processes, which have not achieved an established consensus under "normal" circumstances, is a winning and legitimate strategy under an e-Government perspective. Also, purely efficiency-driven and technology-driven approaches are questioned: there is a need to consider the institutional context [4–8] in which the adoption problem is set, and, preliminarily, it is essential to understand why the adoption of e-invoicing is failing to gain non-enforced legitimacy in the B2B sector.

This work is limited to a first identification of the terms of the problem and to the delineation of a framework within which to organise them. More rigorous implications for strategies to be adopted by government-level policy makers should then be drawn through further research.

The Dematerialisation of B2G Transactions

Dematerialisation has become an essential topic not only in the B2B context, but also in the re-organisation of processes within public bodies, and consequently in the integration of processes used to manage B2G transactions. In January 2007 the European Commission has adopted – within the broader framework traced by the Lisbon Agenda – an Action Plan [9] with the goal of reducing by 25% the administrative burden for businesses in Europe within 2012. To improve efficiency in B2G transactions, special attention is paid to the delivery of high impact e-services tailored around the needs of enterprises, focusing policies on the necessities of small and medium sized ones (SMEs). High impact services are defined as "large-scale, flagship services" delivered to support applications that imply frequent transactions and reciprocal data exchanges, such as, in the B2G context, on-line tax declarations, e-procurement, electronic invoicing. In general terms, the delivery of high-impact services achieves the expected impact on public bodies internal efficiency only if they are widely adopted by enterprises.

We may also underline that some services involve activities that are specific to the B2G context (e.g. tax declarations), while others attain procedures that are used both in the B2G and in the B2B environments (e.g. invoicing). In the latter case, the implementation of innovative procedures in the B2G context (pushed through a governmental initiative) has often the declared function to boost their adoption also in the B2B environment. In other terms, the implementation of such services might be regarded as a lever to gain efficiency in the economic system as a whole. This line of reasoning is increasingly used to justify the enforcing of the adoption of the new processes in the B2G transactions, in particular when enterprises are not spontaneously adopting procedures that are considered pivotal to improve the efficiency of national and supranational economic systems [10]. This is the case of the dematerialisation of invoices, i.e. electronic invoicing.

It is important to underline that the use of this approach implies that enforcing initiatives can be considered successful only if they achieve B2B widespread adoption. On the contrary, the risk is to improve internal efficiency for public bodies, while negatively affecting enterprises, which are in fact obliged to duplicate their invoicing and invoicing-connected procedures. Therefore ex-ante analysis aimed at reasonably forecasting B2B adoption rates become crucial. This statement is consistent with what the OECD is constantly recommending since the issuing of the Regulation Impact Analysis (RIA) Decalogue in 1995 [11]. In the OECD approach, (compelling) regulation has to be employed as an “estrema ratio,” after having verified that it is the sole and the best solution. Also, in this perspective the theme switches on the identification of the correct methodologies to adopt in order to lead this kind of analysis.

Recently the above-described approach has been used to justify the introduction of the obligation to send invoices towards public bodies using the electronic modality in Denmark (2005) and in Italy (2008), while Spain, Sweden and Finland are already announcing similar initiatives.

Denmark has been the first State in the EU to use a legislation-based approach in order to enhance the diffusion of e-invoicing. Since 2005 all invoices sent from any Danish operator to any Danish public office have to be issued and delivered in digital format. Despite the obtained e-Government Award and the encouraging results in terms of public bodies internal savings (estimated in about € 200 million per year, half in the national and half in the regional and local procurement [12]), the outcome in diffusion in the B2B context is still questionable [13].

Italy is about to proceed along a similar path, partially following the Danish experience. The e-Invoicing European Directive (2001/115/EC) was accomplished in Italy in 2004. During these 4 years adoption rates in the private sector have been low. The recently issued 2008 General Budgetary Law [14] provides the juridical enforcement for digital transactions with public bodies, with the explicit target to push a general diffusion of the new processes [15]: presumably starting from 2009 all public-sector organizations in Italy will gradually accept only invoices in electronic format.

Doubts about the effectiveness of compulsory procedures are not unmotivated. Just to make an example, since the 1990s Italian enterprises are obliged to send their annual balance sheet to the Chamber of Commerce in electronic format. But, after 10 years, the around 2 millions digital signatures are not being largely employed in other procedures.

How e-Invoicing Low Adoption Rates are Justified in the Literature

Despite unanimous opinions consider e-invoicing as "a win-win solution to all players bringing better competitiveness to the economy as a whole" [16] the dematerialisation of invoices and, in a STP perspective, their integration within Electronic Invoice Presentment and Payment (EIPP) procedures are not as of now widespread procedures. The European market carries more than 28 billion invoices per year, of which over 90% are still on paper [17–19]. The reasons why e-Invoicing and EIPP have not yet achieved significant adoption rates have been largely discussed in the literature. A first order of considerations underlines how B2B transactions involve more participants and more complex processes than B2C ones, so creating a longer, more intricate value chain [20]. The management of B2B invoices includes procurement, agreement administration, financing, insurance, credit ratings, shipment validation, order matching, payment authorization, remittance matching, and general ledger accounting. Furthermore, B2B transactions are more likely to be disputed than B2C ones. Also, only large enterprises get economies of scale [21]. Other main problems affecting a pervasive diffusion of e-Invoicing and e-archiving processes among SMEs have been pointed out in [19, 22–24]: the diverse interpretations of the legislation; the continuing differences in national regulatory requirements, even within the EU; the lack of a common international standard (XML) for layout and data elements.

While in large companies the "perceived potential for efficiency gains" [2] has been driving investments in EDI electronic payment processes and in the correlated billing processes since the 1980s, the so-called "EDI phase" [18] has not involved SMEs, due to costs resulting prohibitive to many of them [20]. Nor has the so-called "Internet phase" [18] that started in the late 1990s.

Legner and Wende [18] argue that "this low penetration can be explained by 'excess inertia' or 'start-up problems' typical of e-business scenarios in which positive network externalities prevail" and that "the value for members within a network would increase with every new member joining, but too many standards and diverse technical solutions prevent potential members from taking the disproportionate risk of deciding on a specific implementation". The complexity of B2B transactions and major differences among e-invoices formats, transmission channels and National legislative requirements generate a many-to-many matrix of relations in the exchange of invoices among trading partners. Such a complexity is hardly manageable by large companies and absolutely overwhelming for SMEs, without the support of specialised outsourcers [17]. Therefore, both the literature and the market have thought to have found the response to the problem of SMEs' low adoption rates in the so called “Consolidator Model” [17, 18, 20, 21], where an external provider (e-Invoicing service provider, banking service, postal service, internet service provider) “acts as an intermediary, collecting or aggregating invoices from multiple sellers for multiple buyers, eliminating the need for point-to-point connections” [20]. The “Consolidator phase” has started in 2002 [18].

But it is a matter of fact that, by now, in 2008, although the services currently offered by outsourcers are considered compliant with quality and cost-reduction requirements, enterprises (and SMEs in particular) are still not widely implementing e-invoicing procedures. Actually, the only model that has in some way functioned is the buyer-direct model, where a large buyer is able to impose to its (small) suppliers the issuing of invoices in its preferred electronic format. It is this kind of pressure-driven model that enforcing policies try to emulate, where competitive pressure is substituted by compelling rules. But two basic remarks are here due for our purposes. First, it is evident that such a model brings process advantages only to the dominant subject [20]. Second, (competitive) pressure has not pushed the small suppliers to further adopt e-invoicing to support transactions with other trading partners.

A New Conceptual Framework for Further Research

Extant literature seems to fail in identifying models that are able to push SMEs to e-invoicing adoption. Therefore it is legitimate to suppose that this failure is due to some lack in the correct identification of inhibiting factors that slow down or impede adoption. In particular, we suppose that efficiency is not that main driver in SMEs’ own perspective.

Actually, much of extant e-invoicing literature has centred the analysis about e-invoicing mainly with a focus on the Supply-Chain Management and Inter Operative Systems (IOS) theories. Typical adoption drivers for IOS are efficiency, effectiveness and competitive position. As previously observed, the latter is particularly worth focusing on for our analysis. Morrell and Ezingeard [25] in their investigation on IOS implementation among SMEs underline how competitive pressure and imposition by trading partners push organisations to adoption even if they are not prepared to gain full advantage of the implementation, and point out that SMEs’ efficiency might even be reduced if external pressures are uncontrolled.

The scenario here is similar in that uncontrolled external pressure is represented by the compulsoriness imposed by a law (without alternative options) [10]. In line with this parallel, we can presumably deduce that the results of this pressure are not always positive. Furthermore, the logic of a national policy should obviously embrace a different perspective. In the OECD approach, using the lever of coercive rules can find a justification only in a homogeneous gain of efficiency throughout the whole economic system, with consequent positive repercussions on enterprises themselves, by winning the SMEs’ typical “excess in inertia”. It therefore becomes crucial for policy makers to focus on enterprises’ institutional dynamics [26], needs and beliefs, before putting into action the compulsory procedures. This principle mirrors to some extent the definitively shared concept of "putting private users first" that has been up to now the very "image" of all European e-Government policies. Given the specific context – where heterogeneous actors (enterprises, outsourcers, public bodies, supranational institutions) interrelate, have multiple or diverging goals and adopt differentiated perspectives – our speculation is that presumably variables used in the IOS literature are failing to capture all the facets of the specific problem.

To try to contribute to further analysis, that is evidently needed on the matter – also in a RIA perspective – we here propose a first listing of main inhibitors that might have been underestimated in traditional analysis. Actually, RIA analysis asks for a deep understanding of the needs of enterprises. An appropriate method to widely collect data for a survey on SMEs' point of view might be the use of questionnaires. But it is also true that questionnaires must contain the appropriate queries, in particular when answering subjects' awareness of the matter is low and resources dedicated to response are potentially limited and not highly qualified.

Drawing on preliminary confrontation with professional operators, institutional working groups and directly involved actors in the SME context [27], we have selected the following topics as a starting point for our future work on the matter.

The Structure of Accounting Books. The variety of possible technical standards used by the different accounting systems (even among enterprises that are similar in terms of dimension or of market sector) often goes beyond the standard services offered by outsourcers. The accounting and documental framework designed for paper is, so to say, not always directly feasible of digitalization as it is. The conversion process often requires a detailed analysis and consequent changes, both in the outsourcer's service and in the outsourcee's system. Not all enterprises are prepared to fully understand technical impediments and even if they are, they are not inclined to sustain additional investments to overcome them. Outsourcers, on the other side, tend to keep to the standard services, in order not to overrun the average tariffs offered on the market. In sum, a major impediment can derive from the specific way accounting books are structured: standardization of invoicing procedures is not always easily achievable, because they parallel an internal operational organization that can deeply vary from enterprise to enterprise.

Through the digitalisation of invoices a valuable bulk of information is easily accessible. An often undervalued question is how a complete set of invoices can contain the whole story of a company. Invoices (sent and received) display an extremely sharp image of the behaviour of the enterprise they derive from.

Need for security guarantees in the archival phase. A digital repository kept on handy devices as DVDs, provided with search indexes (compulsory in Italy), offers easier access than a paper archive. Enterprises will not easily subcontract with an external outsourcer to manage the informative contents included in its invoices, if not in virtue of a relationship based on well-grounded trust.

Unbalanced availability of (correct) information: the role of consultants. An apparently obvious issue ahead the low diffusion rates of e-Invoicing among SMEs might question the extent to which they are informed at all about the new option they have. The agency problem between consultant (as main information source for SMEs) and enterprise might become significant: radical changes in procedures, new rules for tax inspections, particularly strict norms about digital archives' maintenance are just some of the aspects that might motivate an external consultant (not) to advise the adoption of e-Invoicing, depending on his individual readiness or incentives.

Lack of Perceived Incentives. In a RIA-driven perspective, the lever of legislation needs to find a justification in a homogeneous gain of efficiency throughout the whole economic system. Unbalanced (in favour of the PA's side) e-Government initiatives might end up having a negative domino effect on the business environment. Designing solutions tailored on SMEs' needs and focusing on the perceived incentives, on the contrary, might prove to be an effective solution.

The increased traceability of documents and processes obtained through the electronic modality. Fighting the grey market is one of the aims of introducing e-invoicing systems [19]. Firms and enterprises that are fiscally or juridically "non-compliant" perceive electronic procedures as dangerous. Even the outsourcing solution, in this context, is hardly accepted.

Future Research

Next step in our research plan is to integrate and refine the selected inhibitors, also through further confrontation and discussion with professional operators (in particular outsourcers), experts, institutional, and academic working groups [27]. More rigorous propositions ought then to be formulated and structured.

References

1. Arthur D. Little (2005) Electronic Invoicing and the Financial Processing Requirement. Presentation to ITPWG - TBG15 UNECE Project. Bruxelles, www.unece.org
2. Furst, K. and Lang, W.W. and Nolle, D.E. (1998) Technological Innovation in Banking and Payments: Industry Trends and Implications for Banks. Special Studies on Technology and Banking, *Quarterly Journal* 17 (3):1–9
3. UNECE – United Nations Economic Commission for Europe (2005b) Second Meeting of Revision of UN/CEFACT Recommendation 6 to Accommodate Electronic Invoicing Working Group – Minutes. Brussels.
4. Avgerou, C. (2000) IT and Organizational change: An institutionalist perspective, *Information Technology and People* 13 (4): 234–262.
5. Avgerou, C. (2002) The Institutional Nature of ICT and Organisational Change, in *Information Systems and Global Diversity*. New York, Oxford University Press.
6. Barca, C. and Cordella, A. (2006) Seconds Out, Round Two: Contextualising E-Government Projects within their Institutional Milieu – A London Local Authority Case Study, *Scandinavian Journal of Information Systems* 18 (1): 37–60.
7. Orlikowski, W. J., & Barley, S. R. (2001) Technology and institutions: what can research on information technology and research on organizations learn from each other?, *MIS Quarterly* 25(2): 145–165.

8. Teo, H. H., Wei, K. K., and Benbasat, I. (2003) Predicting intention to adopt interorganizational linkages: An institutional perspective, MIS Quarterly, 27(1): 19–49.
9. Commission of the European Communities (2007) Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions - Action Programme for Reducing Administrative Burdens in the European Union, COM(2007) 23 final. Brussels, http://ec.europa.eu.
10. European Commission, Directorate-General for Enterprise and Industry (2006) Benchmarking of Existing National Legal e-Business Practices, from the Point of View of Enterprises (e-Signature, e-Invoicing and e-Contracts), Draft Final Report. Brussels, http://ec.europa.eu.
11. OECD (2008) Building an Institutional Framework for Regulatory Impact Analysis (RIA): Guidance for Policy Makers. Paris, Regulatory Policy Division Directorate for Public Governance and Territorial Development.
12. European Commission Informal Task Force on e-Invoicing (2007) European Electronic Invoicing (EEI) Final Report (v. 3.2). Brussels, http://ec.europa.eu.
13. Vavalli, V. (2008) Corporate Payments and Financial Supply Chain. Interview, AITI.
14. Legge 24 dicembre 2007 n. 244 ("Finanziaria 2008") – Art. 1, §§ 209–214.
15. Senato della Repubblica Italiana (2007), Relazione Illustrativa allegata al Disegno di Legge n. 1817 – Finanziaria 2008: 33–34.
16. TIEKE Finnish Information Society Development Centre (2005) ICT Cluster Finland Review 2005, vol. 4. www.e.finland.fi www.tieke.fi
17. Hornburg, M. - SAP AG (2005) SAP Biller Consolidator E-Document Exchange Platform. Presentation to ITPWG - TBG15 UNECE Project, www.unece.org
18. Legner, C. and Wende, K. (2006) Electronic Bill Presentment and Payment. Paper for *ECIS 2006* (Göteborg). Universität St. Gallen, www.alexandria.unisg.ch
19. UNECE – United Nations Economic Commission for Europe (2005a) UN/CEFACT puts its weight behind e-invoicing. www.unece.org
20. NACHA (2001) Business-to-Business EIPP: Presentment Models and Payment Options, Part I and Part II. Council for Electronic Billing and Payment of the National Automated Clearing House Association, http://cebp.nacha.org
21. Fairchild, A.M. (2002) Value Positions for Financial Institutions in Electronic Bill Presentment and Payment (EBPP). In Sprague, R. (Ed) *Proceedings of the 36th Hawaii International Conference on System Sciences*, p. 196.
22. CEN/ISSS (2003) Report and Recommendations of CEN/ISSS e-Invoicing Focus Group on Standards and Developments on Electronic Invoicing relating to VAT Directive 2001/115/EC – Final. Brussels, www.cen.eu.
23. Gobert, D. (2000) Vers une discrimination de traitement entre la facture papier et la facture électronique?, *Cahier du Juriste* 4.
24. Tanner, C. and Koch, B. (2004) Die elektronische Rechnungsabwicklung in der Schweiz (EBPP). In *E-Business mit betriebswirtschaftlicher Standardssoftware* (Schubert, P., et al. Ed.): 157–168. München, Hanser
25. Morrell, M. and Ezingeard, J. (2002) Revisiting adoption factors of inter-organisational information systems in SMEs, *Logistics Information Management* 15 (1): 46–57.
26. DiMaggio, P. J. and Powell, W. W. (1983) The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality In Organizational Fields, *American Sociological Review*, 48(2): 147–160.
27. Van de Ven, A.H. (2007) *Engaged Scholarship. A Guide for Organizational and Social Research*. New York, Oxford University Press.

Business Process Driven Solutions for Innovative Enterprise Information Systems

F. Taglino[1] and M. Lezoche[2]

Abstract Existing limitations and problems in the current life-cycle of software applications will encourage new development paradigms. New technological trends, aiming at responding to current needs, such as flexibility, dynamicity, scalability will certainly drive the envisaged changes. In this paper, possible solutions for innovative enterprise information systems (IS) development and maintenance are outlined. In particular, it will be argued about business process driven approach to information systems development, and how, through the support of new and emerging technologies, it can address nowadays requirements and overcome current limits. Business process driven approach to IS development is here characterized by: (1) business process modelling for representing the business logics; (2) enhanced SOA paradigm for business process execution; (3) business rules based approach to software applications maintenance and evolution.

Introduction

Enterprise information systems (IS) are continuously evolving over the time. This is due to their increasing diffusion, emerging of new needs, and evolution of the supporting technologies. Nowadays, the traditional model of information systems development is increasingly problematic with a poor reflection of the needs of real information systems use. Analysis from the well known market watchers, such as Gartner Group and Standish Group, report that software applications development still suffers high probability of failure [1, 2]. Furthermore, it has long been known that the maintenance phase of the enterprise IS lifecycle can consume more than half of the total lifetime costs of an information system [3].

[1]Istituto di Analisi dei Sistemi ed Informatica "A Ruberti" – CNR, Roma, Italy, francesco.taglino@iasi.cnr.it
[2]Istituto di Analisi dei Sistemi ed Informatica "A Ruberti" – CNR, Roma, Italy, lezoche@iasi.cnr.it.

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_47, © Springer Physica-Verlag Berlin Heidelberg 2010

Consequently, the nowadays needs for new generation of enterprise IS are towards:

- Flexible, agile, and non monolithic applications.
- Adaptability, with capability of dynamically reflecting new business requirements.
- Openness, to ensure interoperability among applications and support the development and sustainability of business ecosystems.

The current technological trend, in particular due to the evolution of the Internet, towards the so called Future Internet, appears in line to the above needs to support new enterprise information systems. In fact, the intention of the Future Internet, recently embraced by the European Union with the Bled Declaration3 (31 March 2008), will be characterized by openness, scalability dynamicity and proactiveness that should ease the transition towards new, flexible and dynamic information systems.

On these premises, it is unavoidable to think about significant changes in the development of next generation enterprise IS, and a significant contribution could come from a business process driven approach.

Business Process design involves the identification and sequencing of work activities, tasks, resources, exchanged messages, decisions, and responsibilities across time and space, with clearly identified inputs and outputs.

In traditional approach for development of information systems, business process modelling is mostly used as a mean for specifying high level business requirements to be implemented by IT people. However, this does not guarantee an effective correspondence between the designed business processes and the final applications. Furthermore, this traditional approach also suffers the cultural gap between business experts and software analysts/developers. Traditionally, they belong to two separated communities which operate without a systematic interaction and cooperation, causing the problem of Business/IT alignment. The OMG MDD/MDA (Model Driven Development/Architecture) [4] approach has been proposed to close this gap. However, real integrated solutions have not been provided yet.

With business process driven IS, it is here referred to an emerging approach for software applications generation. Business process driven IS are here characterized by the following key aspects:

- The application business logics is represented by business processes which are designed by using graphical notations, to increase the intuitiveness and the immediacy of the development, and reduce the need of writing code.
- Execution of software applications is demanded to specific business process execution engines, which are able to run business processes and keep track of the control flow.

[3] http://www.future-internet.eu/index.php?id=47.

- Execution of process tasks is accomplished by accessing available services over the Internet. Business process execution engines are able to invoke external services when it is required. This approach is supported by Software Oriented Architectures (SOA), and new concepts like Software as a Service (SaaS)[4] which is towards the delocalization of software services and an on demand service provision. Semantics-based techniques will help for service discovery and composition.
- Business rules based approach for supporting IS maintenance and evolution.

Related Work

Today, there are a great number of methods and tools to model BPs. There are also international organizations, such as OMG[5] and WfMC,[6] very active in the field. New business process modeling notations and languages like BPMN (Business Process Modelling Notation) [9] and BPEL (Business Process Execution Language) [10], for design and execution respectively, are emerging. New open source and commercial tools, supporting such languages, are now available (i.e., INTALIO,[7] uEngine[8]). For instance, there are several BP editor tools based on different graphical notations (around 70 adopt the XPDL, from WfMC)

In particular, such tools, allow business process diagrams building, and automatic generation of executable format. Business processes are modelled by using graphical notations which make their construction more intuitive and available also to not highly technological people (say business people).

Traditional workflow systems are not suited for highly interactive online systems. There are several new proposed solutions because the problem is challenging and the solution appears to be complex and depending to the application context. At the IBM Watson Research Center the researchers propose a state machine based workflow system, named FlexFlow [5], which formally describes Internet applications using statecharts. The FlexFlow engine uses these descriptions to directly control the execution of web applications. Different versions of an application can be generated by visually editing its FlexFlow description, with minimal incremental effort in rewriting application code or related web pages. FlexFlow provides an efficient way to customize online systems and supports different versions of business processes in the same e-business system for different sets of industries, organizations, users, or devices.

At IDS Scheer Thomas Andres [6] shows how to integrate classic business process design into a software development project as an elementary component using

[4] http://en.wikipedia.org/wiki/Software_as_a_service.
[5] http://www.omg.org.
[6] http://www.wfmc.org.
[7] http://www.intalio.com.
[8] http://www.uengine.org/web/guest/home.

ARIS UML Designer [7]. The result is a completely model-based and integrated approach for the development of management applications: from business process analysis right through to system design.

Smith and Whittington patented, in 2007, a method [8] for creating a process-driven information system. The method comprises the steps of creating a process model comprising one or more elements which are available in a browser-compatible format, creating one or more software components which are accessible in a browser compatible format and generating a process-driven information system comprising one or more elements of the process model which act as the user interface to the one or more software components. This method allows the rapid creation by non-technical users of process models describing the working of an organization with the models being used as the user interface for directing the operation of a collection of software components.

One of the characteristics grouping the above solutions is the lack of semantics, which on the other end is one of the relevant elements of the proposed approach.

Business Process Modeling for IS Development

BP modeling is progressively spreading among business people. It represents an important opportunity to allow business experts to play a new, central role in the development of new generation enterprise software applications. The need for a tighter cooperation between business experts and IT specialists is growing in momentum, and it is unavoidable. If software industry wants to reduce costs and risks in developing more complicated and sophisticated applications it has to develop new methodologies to fill the gap between the two communities.

A relevant contribution to solve this problem, could be represented by the use of ontologies for a semantics-based approach.

Ontology-Based Semantic Support

An ontology is defined as "a formal, explicit specification of a shared conceptualisation" [11]. This means that an ontology is: (1) the result of a consensus reached among a group of domain experts (shared conceptualisation) and more in general (by using special tools, like a folksonomy) of a wider community; (2) a formal specification and as such it is interpreted by a machine for reasoning and querying activities.

As such, ontologies can contribute in several ways to the development of business process driven information systems. Some of them are here briefly reported. As the result of the consensus of domain experts, an ontology represents a common reference and as such, it can establish a shared playground which different kinds of actors, with different know how and roles (i.e., business and IT people), can play on.

Furthermore, as a formal representation, an ontology can be used for:

- Supporting business process design by verifying semantic alignment of a business process against a reference ontology. This goal can be achieved by performing consistency checking through the use of semantic reasoning techniques.
- Annotating existing processes and software services to let feasible the semantics binding between these entities.
- Supporting business process design and reengineering providing suggestions to business experts during the modelling phase of a BP.
- Business experts can be supported in finding, for instance, alternative elements of a business process by performing semantic search and similarity reasoning over the business ontology.

Service Oriented Business Process Execution

The development of software applications driven by business process is based on the fact that once a business process has been modelled it can be executed. However, since business process modelling notations like BPMN are not executable, a business process can be automatically transformed into an executable format, for instance BPEL (or another execution language like XML Process Definition Language, XPDL [12]), to be then executed by a BP execution engine (i.e., ActiveBPEL[9]). Nevertheless, a BP says what each task should do, but no how to perform the task. Due to that, a BP execution engine needs to invoke, in correspondence of an automatically executable task, a software component in charge to accomplish that task. This step is critical and a series of knowledge structures are needed to fill the semantics gap between the BP requirements and the existing pieces of software. The need perfectly matches the capabilities offered by the Service Oriented Architecture paradigm according to which, a business process links and sequences services in a web services orchestration. Semantic Annotation is a key aspect of this step. Using a Business Ontology, Business Processes and Web Services are connected to explicit concepts, with this knowledge, an inference engine should comprehend and match the needed services with the processes.

This binding, however, will not be probably unique during the lifecycle of the IS. BP reflects functional requirements of the IS, while Web Services are functional operations. In essence, the BP represents a workflow schema where each task is nothing more than a placeholder of a function to be executed. Consequently, if different web services provide the same needed functionality, they are all candidates for the binding. Such a situation gives high flexibility respect to hard coded

[9] http://www.activebpel.org/.

[10] For not automatically executable tasks, BPEL4People [11] extends BPEL from involvement of Web services alone to role-based human activities as well.

functions. The reason for selecting a service instead of another can depend of various reasons:

- The type of binding (early or late).
- Internet servers congestion.
- Contracts typologies between enterprises.

According to the emerging wave of the Internet of Service, the above approach will be facilitated and encouraged. The Internet of Services will take the enterprise SOA approach to the next level by making services easy to implement, consume, and trade.

Furthermore, in an open scenario like the one that is going to configure with the advent of the Internet of Services, the binding of services to business processes will more and more need of:

- Intelligent search methods for the individuation of suitable services needed for executing a certain bp.
- Interoperability solutions for allowing the coexistence of services which, spread worldwide, have not been designed to work together.

For both these aspects, emerging semantics-based solutions (i.e., WSMO [13] for search and retrieval of web services, and the Athena Semantic Reconciliation suite [14] for heterogeneous message reconciliation) certainly represent promising solutions.

From this brief description, it emerges how Service Oriented execution of business processes represents a step forward agile, flexible and non monolithic software applications. In fact, the accomplishment of each task is demanded to services which have been properly selected. Whenever the selected services are not anymore available, other suitable available services will be searched and invoked.

Rule-Based Approach to IS Maintenance and Evolution

In a dynamic enterprise, BPs need to be periodically revised and updated. Such BP evolution may be necessary for different reasons, as for instance the introduction of company policies which requires the update of non conformant BPs.

Company policies are often represented in the form of business rules (BRs). Business experts usually tend to formulate a BR in natural language (NL), but it is well-known that NL is often ambiguous and error-prone. For this reason, there are interesting proposals of using structured (controlled) natural language. Recently, OMG promoted the use of structured English in the business rules framework SBVR [16]. Another interesting proposal is ACE [17] (Attempt to Controlled English): a rich subset of standard English, designed for specification and knowledge representation.

Independently of its representation language, a BR can say, for instance: "all expenses greater than 5,000∈ require the approval of the Head of Unit." Another BR may involve the way business operations are performed, for instance: "the receiving of a quotation must precede the issuing of a purchase order."

In the context of BP evolution, a challenging problem is to automatically identify the BPs that violate at least one BR and, possibly, to make the former evolving according to the latter.

In a previous work [18], one of the authors of this paper, presented an ontological approach to BP modeling, proposing a method to verify if, given a BR, a process is consistent with it. Such a method is characterized by the concepts of BP Schema (BPS), which is a set of predicative atoms, and BP Instance (BPI) originated from the actual execution of a BPS. In order to be valid a BP Schema, all its instances must satisfy the rules. Consistency table to test coherence between BR vs. BPS, and without exploding every single instance are used.

However, independently of the specific solution, a BR-based approach appears a valid support the maintenance and evolution of business process driven applications, especially in the respect of agility and flexibility of enterprises. In fact, the possibility to express BRs in a declarative way, avoiding hard coded control procedures, makes enterprise policies more easily configurable and adaptable especially in the context of an open scenario where enterprises dynamically change and join together in virtual organizations.

Conclusions

In this paper we have focused on innovative approaches to development, execution, maintenance and evolution of enterprise software applications. In particular, a business process driven approach has been presented.

The approach is based on some characterizing features: (1) representing the business logics by means of a business process by using graphical notations; (2) service oriented execution of business processes; (3) business rules for supporting evolution and management.

References

1. Journal of Accountancy (2001). Research shows high failure rate on IT projects. Journal of Accountancy, February 2001. 24. Available at: http://www.aicpa.org/PUBS/JOFA/feb2001/news6.htm
2. The Standish Group. (2001). Extreme Chaos. Available at: http://www.smallfootprint.com/Portals/0/StandishGroupExtremeChaos2001.pdf
3. Bennett, K.H. (1996). Software Evolution: Past, Present and Future. Information and Software Technology, 38, 673–680.
4. http://www.omg.org/mda/specs.htm#MDAGuide

5. Rakesh Mohan, Mitchell A. Cohen and Josef Schiefer. A State Machine Based Approach for a Process Driven Development of Web-Applications. Book Series: Lecture Notes in Computer Science. Volume 2348/-1 / 2002
6. Thomas Andres. From Business Process to Application: Model-Driven Development of Management Software in the book AGILITY by ARIS Business Process Management, 2006
7. A.W. Scheer ARIS – Business Process Modeling, 2nd ed. Berlin: Springer 1999.
8. Smith and Whittington, Method for constructing a process-driven system, United States Patent 7171647, 01/30/2007
9. Business Process Modeling Notation, V1.1. OMG Document Number: formal/2008-01-17 Standard document URL: http://www.omg.org/spec/BPMN/1.1/PDF.
10. Andrews T., et al. Business Process Execution Language for Web Services. 5 May 2003. Document URL: http://download.boulder.ibm.com/ibmdl/pub/software/dw/specs/ws-bpel/ws-bpel.pdf.
11. T. R. Gruber. A translation approach to portable ontologies. *Knowledge Acquisition*, 5(2):199-220, 1993.
12. TC-1025-Ver 1.0 XML Process Definition Language. Web address: http://69.89.31.244/~ialprise/wfmc/index.php?option=com_login.
13. Mocan A., Cimpian E. An Ontology-Based Data Mediation Framework for SemanticEnvironments. *International Journal on Semantic Weband Information Systems*, Vol. 3, Issue 2, pp. 69-98, (2007).
14. Bagnato A., Coscia E., Missikoff M., Pondrelli L., Taglino F.. Semantic Reconciliation of Business Documents in a SOA Framework, in the *Proceeding of eChallenges 2007*, Barcelona (Spain) 15-17 October 2006.
15. Agrawal A., et al. WS-BPEL Extension for People (BPEL4People), Version 1.0. Web address: http://download.boulder.ibm.com/ibmdl/pub/software/dw/specs/ws-bpel4people/BPEL4People_v1.pdf.
16. OMG Group: Semantics of Business Vocabulary and Business Rules Specification. OMG (2006).
17. Fuchs, N.E., Kaljurand, K., Kuhn, T.: Discourse Representation Structures for ACE 6.0. Technical Report ifi-2008.02, Department of Informatics, University of Zurich (2008).
18. Lezoche M., Missikoff M., Tininini L., Business Process Evolution: a Rule-based Approach. BOMDS'08 – *9th Workshop on Business Process Modeling, Development and Support conjunction with the CAiSE'08 conference,* Montpellier, France, June 16–17 (2008).

Business Process Modelling Within the Cycle of Continuous Improvement

L. Pacicco[1], **A. Ravarini**[2], **and F. Pigni**[3]

Abstract Business Process Modelling is a much-researched field as it concerns the need to analyse and improve business process. The topic of BPM is particularly timing given the need for clarifying process structures and their improvements in the context of SOA, the service oriented architecture. However not much emphasis has been placed on the relationships among BPM methodologies, techniques and tools. In this work we propose a framework in which these three BPM elements are positioned within the cyclical process of continuous improvement. This framework suggests the adoption of different BPM techniques depending on the objective to be reached: the IT industry has developed flexible and dynamic tools for process modelling called "Business Process Management Suites" (BPMs), they are composed of different tools and adopt different methodologies and techniques for supporting all the phases of the continuous improvement.

Introduction

Business Process Modelling (BPMo) is a topic of great interest for researchers as it concerns the organizational need to analyse, improve and control business processes [1]. The Modelling of Business Process is part of the wider management approach of Business Process Management: it allows to graphically represent how operations are performed within the organization through the representation of entities, activities, enablers and relationships among them [2]. Business Process Management (BPM) is a method of efficiently aligning an organization with the requirements of clients: it is a holistic management approach that promotes business effectiveness and efficiency while striving for innovation, flexibility and

[1] Università Carlo Cattaneo – LIUC, Castellanza (VA), Italy, lpacicco@liuc.it
[2] Università Carlo Cattaneo – LIUC, Castellanza (VA), Italy, aravarini@liuc.it
[3] Università Carlo Cattaneo – LIUC, Castellanza (VA), Italy, fpigni@liuc.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_12, © Springer Physica-Verlag Berlin Heidelberg 2010

integration with technology. As organizations strive for attainment of their objectives, BPM attempts to continuously improve processes: the process to define, measure and improve processes. Business Process Improvement (BPI) is a systematic approach to help any organization optimize its underlying processes to achieve more efficient results. BPI attempts to reduce variation and/or wastage in processes, so that the desired outcome can be achieved with better utilisation of resources.

As different authors have shown in their researches, a BPMo project can have different objectives and thus can be approached with different methods and supported by different techniques and tools [3]. One of the main purposes of BPMo is, then, the improvement of the existing processes through the analysis of the “as is” situation that leads to the identification of the main inefficiencies to remove, or at least to reduce, designing the “to be” model [2,4]. The study of business processes has gained momentum over time since value-adding processes are strictly connected to the competitiveness of organizations [5]. In this scenario, the design of processes has the purpose of improving the competitiveness of the organization since it makes business processes more efficient and effective and this lead to enhance the organizational performances. Moreover, the clear definition of the organizational processes leads employees to a greater awareness of the way the organization works.

The topic of Business Process Modelling is particularly timing given the need for clarifying process structures and their improvements in the context of SOA, the service oriented architecture. The need to quickly react to the changing market conditions with adequate products and services, requires enterprises an agile organizational structure and thus to customize their own business processes “on demand”: flexibility is becoming the key principle in designing business processes [6]. This objective could be reached through “business services”: pieces of business processes that, selected and composed “on demand,” allow to define processes tailored to enterprise needs. The right composition of different business services permits to satisfy a business goal [6]. This is the main aspect at the base of SOA [7,8], the idea to support Services with the aim of bridging the gap between business and IT through a set of business-aligned IT services [9]. In this scenario, the challenge for Business Process Modelling is to provide the business architecture to link the business strategy with the application architecture.

In order to run a project of Process Improvement, a company need to adopt the most suitable solution: in this paper with the term “solution” we will refer to the set of methodologies, techniques and software applications.

Literature Review

In this work, we propose a framework in which different BPMo methodologies, techniques and tools are positioned in a cyclical process of continuous improvement. The term “Methodology” indicates a set of theoretical structures, procedures and methods underlying a certain discipline. Methodology, in this work, is referred to the principles of methods, rules, and postulates employed by the Process Modelling. The “Techniques” are a set of procedures used to accomplish a specific activity or task. In this work we refer to techniques as the set of procedures underlying process analysis, representation and modelling. Finally, the term “Tools” indicates objects that allow to carry out a certain discipline. Modelling tools are software platforms developed to simplify the utilize of modeling techniques [10–12]. We further detail the Literature concerning the different elements of the model.

In order to define the variables of the framework regarding the positioning of the methodologies, we refer to the classifications and the review proposed by Melao & Pidd [1] and Aguilar-Savéen [5]. Both the authors classify the same methodologies using different variables; these methodologies are: Static BPMo, Dynamic BPMo (both discrete and continuous) and Soft BPMo. Melao & Pidd propose a classification based on four different perspectives on business processes: Static Business Process Modelling is the methodology that best represent processes as deterministic machine; Discrete-Event Simulation and Continuous-Event Simulation are appropriate for represent processes, respectively, as complex dynamic systems and interacting feedback loops. Finally, Soft Process Modelling best interprets process as social construct. Aguilar-Savéen identifies two variables to classify business process models: the purpose of the model and its change permissiveness. The first one is related to the uses or purposes of the analysis: the author identifies four main categories represented in Fig. 1. The change model permissiveness is the capability of the model to support changes without totally remodeling the process.

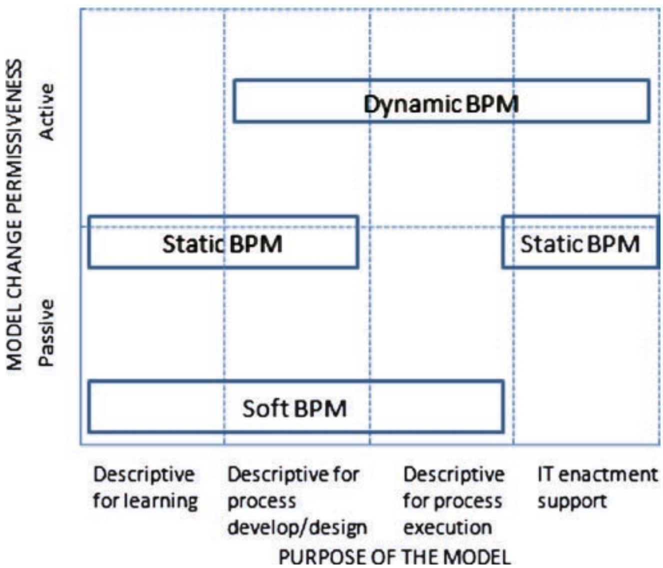


Fig. 1 Methodologies’ classification proposed by Aguilar-Savéen

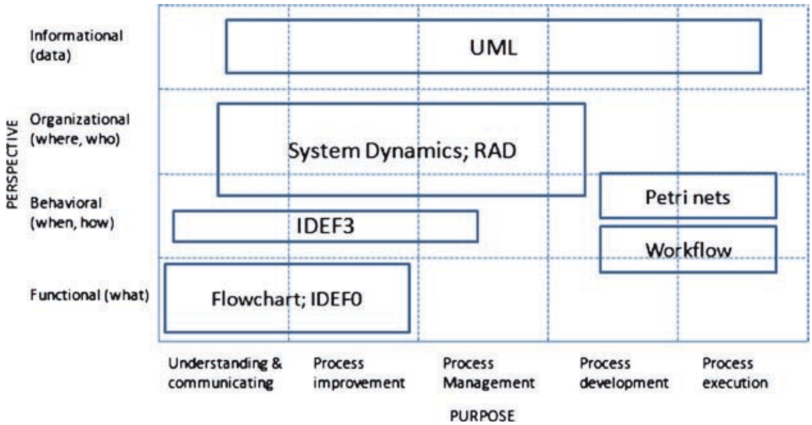


Fig. 2 Techniques' classification proposed by Giaglis

BPMo techniques are widely studied in Literature: we review the most commonly used techniques and the classifications proposed by different authors [1, 3, 5, 10]. The techniques are: Flowcharting, Role activity diagram (RAD), IDEF (IDEF0, IDEF3), Petri-net, UML, Action Workflow, System Dynamic. Giaglis proposes a matrix to classify the techniques considering two variables: the purpose of the modelling activity and the perspective on the process (Fig. 2). For each type of objective, the author indicates moreover which are the technique's features required.

Luo & Tung identify three variables to classify BPMo techniques: the objectives, the perspective on the process and the characteristics of the technique: they suggest the adoption of a general procedure for evaluating and selecting BPMo techniques. This process of selection should be a reconciliation of the three variables: the objectives of the model (communication, analysis and control of the processes) determine the perspective of the analysis and the characteristics of the modeling method. The match of these requirements leads to select the most suitable method (Fig. 3) .

The framework proposed by Aguilar-Savéen about the BPMo techniques considers the same variables of the methodologies: the purpose of the model and its change permissiveness (Fig. 4**).**

Melao & Pidd propose a classification of the techniques based on the perspective on the process: IDEF, Flowchart and RAD are adapted to represent process as deterministic machine; Petri nets, UML and Work Flow better are the techniques that best represent process as complex dynamic system. Finally, System Dynamic is the most suitable technique to represent process as interacting feedback loops.

As regards modelling tools, we refer to three recent articles that examine and classify some tools currently available on the market: Gartner Group, BPMInstitute and Forrester evaluate tools like IBM Websphere Business Modeler and ARIS Platform on the basis of two main characteristics, the flexibility and the capability to be dynamic.

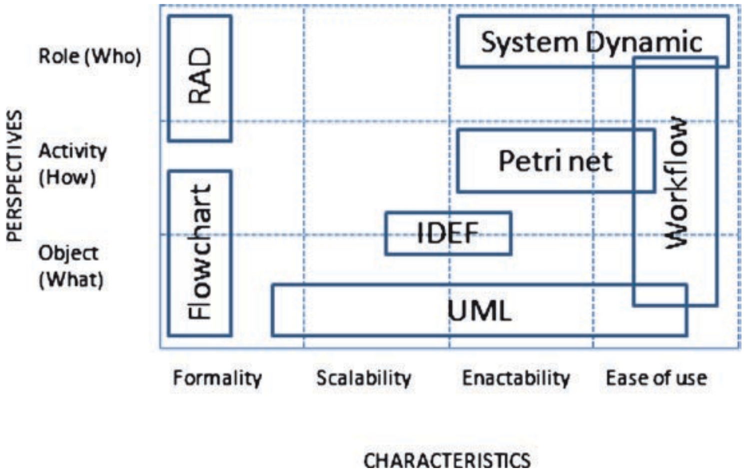


Fig. 3 Techniques' classification proposed by Luo & Tung

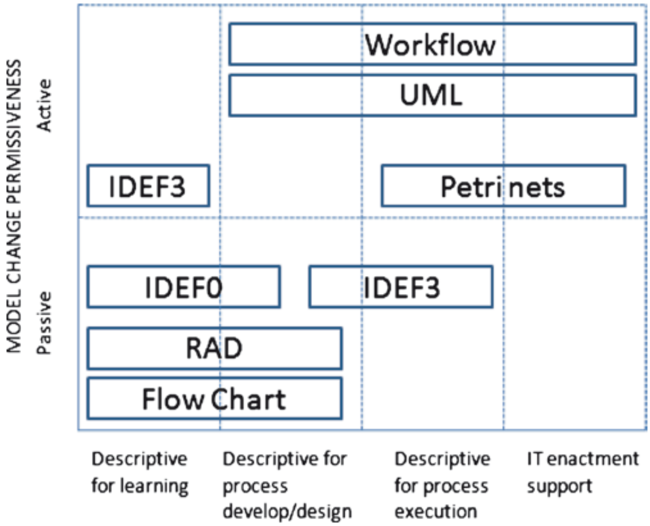


Fig. 4 Techniques' classification proposed by Aguilar-Savéen

The Proposal Framework

Matching the results mentioned above, we propose a new framework aiming at positioning BPMo methodologies, techniques and tools within the cyclical process of continuous improvement. The methodologies are classified on the basis of the perspectives on business processes and the purpose of the model (Fig. 5).

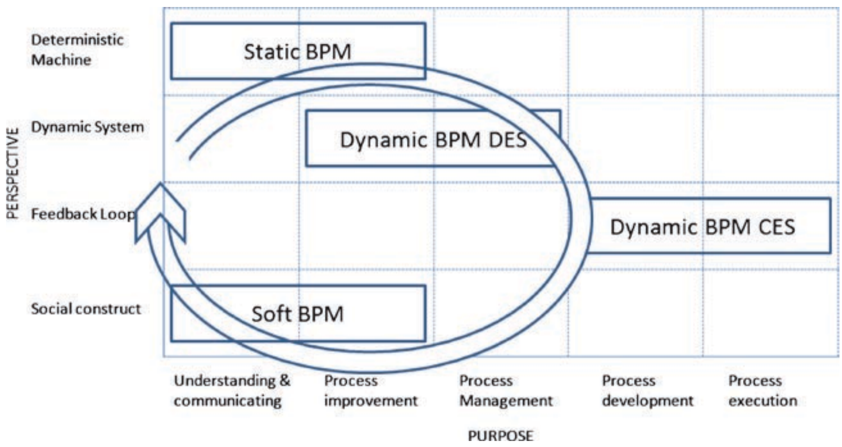


Fig. 5 BPM methodologies: the proposal framework

These methodologies of process analysis and modelling can be thus interpreted as consecutive steps to analyse, define, evaluate, implement and improve business processes, since their efficiency is strictly connected with the competitiveness of the organization. The main phases of the cyclical process of analysis and modelling support different objectives [1]:

1. AS-IS and TO-BE Analysis: it studies the automatic way of working of a process. The most suitable BPM methodology in this phase is the Static BPM: the objective of this first step is to gain understanding of the processes in order to outline possible improvements.
2. Dynamic Analysis: it studies the possible scenarios through the Dynamic BPMo methodology that allows to evaluate the improvements and to select the execution model.
3. IT Systems integration support: the Dynamic BPMo methodology allows to automate, execute and control the process.
4. Analysis of the process as social system: the Soft BPMo is the most suitable methodology in this phase as it permits to get informations from the staff about the way the new process works.

This evolutionary sequence traces the life-cycle of the Business Process Management that consists of four main phases: acquisition of knowledge about the process, change management, process automation and execution&control.

In the framework proposed in this work, BPMo techniques are classified considering two variables: the perspective on the process and the characteristic of the technique. The resulting framework from the match of methodologies and techniques classifications within the business process management life cycle is represented in Fig. 6.

This framework suggests the adoption of different techniques depending on the objective to be reached: this approach is however too theoretical because it requires much effort for training people about many and different techniques. On the other hand, it would be difficult also the implementation of a single techniques able to represent all the perspectives: this is the reason why is more realistic to evaluate

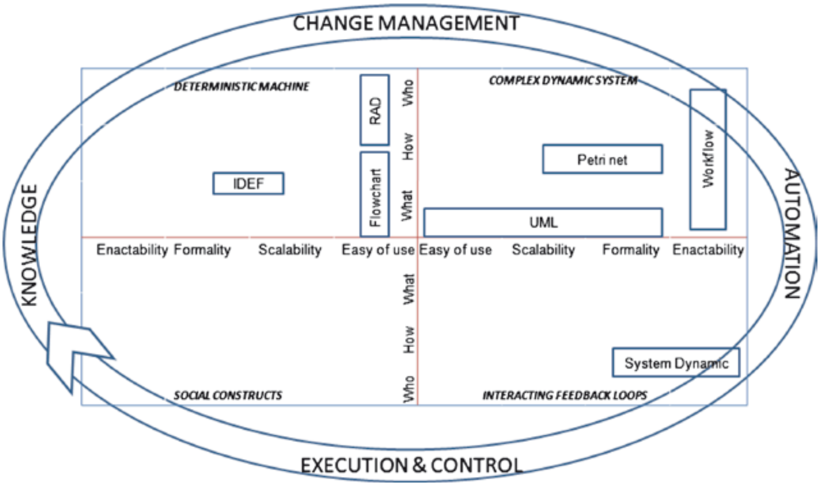


Fig. 6 BPM techniques: the proposal framework

and choose the most suitable technique to adopt. In this scenario, the IT industry has developed flexible and dynamic tools for process modelling: these tools, called "Business Process Management Suites" (BPMs), are composed of different tools and adopt different methodologies and techniques for supporting all the phases of the continuous improvement. The BPM Suite also allows a facilitated interaction with users, improving the collaboration between business and IT. The analysis developed in the articles above mentioned, shows how the BPMs support the entire process of continuous improvement. The IBM Websphere Business Modeler, for example, includes different components, each of them supports one of the objectives of the Process Management in order to manage and continuously improve business processes (Fig. 7). These components are:

- Websphere Business Modeler that supports the analysis and the graphical representation of the as-is and the to-be process. It documents the current processes and allows to perform "what if" analysis in order to evaluate different scenarios.
- Websphere Process Server that ensures the right implementation of the process.
- Websphere Business Monitor that supports the real time control of the way the process works, giving informations about process's status and advising key users on the activities to be carried out.

Conclusion

Business Process Modelling is a much-researched field but the relationships among BPM methodologies, techniques and tools has not been deepened enough. This work shows how the traditional hierarchical view on BPMo elements has turned into a new conception in which methodologies, techniques and tools are

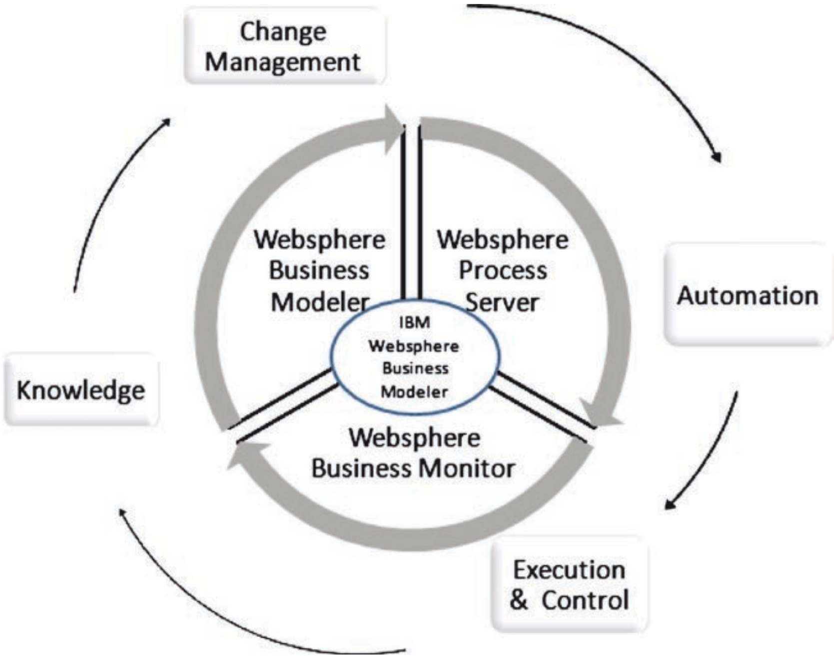


Fig. 7 WebSphere's components within the cycle of continuous improvement

linked to each other though a recursive relationship. Depending on the context in fact, it's necessary to choose the approach and the most suitable methodology, and implement them through different techniques gathered into one unique BPM Suite. We have proposed a framework that effectively position BPMo methodologies and techniques within the cyclical process of Process Improvement and also an example of BPMo tools has been expounded. However, further research is required in order to deepen these relationships and to find those variables, linked to the context, that could influence the evaluation and the adoption of methodologies and techniques.

References

1. Melão, N. and M. Pidd, *A conceptual framework for understanding business process modelling*. Info Syst J, 2000. **10**(2): p. 105–129.
2. Bandara, W., G. Gable, and M. Rosemann, *Factors and measures of business process modelling:model building through a multiple case study*. European Journal of Information Systems, 2005. **14**(4): p. 347–360.
3. Luo, W. and Y.A. Tung, *A framework for selecting business process modeling methods*. Ind Manage Data Syst, 1999. **99**: 312–319
4. Fu-Ren L., Yang, M.-C., Pai, Y.-H., *A generic structure for business process modeling*. Bus Process Manage J, 2002 8: 19–41

5. Aguilar-Savén, R.S., *Business process modelling: Review and framework*. Int J Prod Econ, 2004. **90**(2): p. 129–149.
6. Cauvet, C. and G. Guzelian. *Business Process Modeling: a Service-Oriented Approach. In 41th Hawaii International Conference on System Science*. 2008. Waikoloa, Big Island, Hawaii.
7. Erl, T., *Service-oriented architecture* : *concepts, technology, and design*. 2005, Upper Saddle River, NJ: Prentice Hall Professional Technical Reference. xxviii, 760 p.
8. Merrifield, R., J. Calhoun, and D. Stevens, The next revolution in productivity. Harv Bus Rev, 2008. **86**(6): p. 72–80.
9. Leymann, F., D. Roller, and M.-T. Schmidt, *Web services and business process management*. IBM Syst J, 2002. **41**(2): p. 198–211.
10. Giaglis, G.M., *A taxonomy of business process modeling and information systems modeling techniques*. Int J Flex Manuf Syst, 2001. **13**(2): p. 209–228.
11. Kettinger, W.J., J.T.C. Teng, and S. Guha, *Business process change: A study of methodologies, techniques, and tools* MIS Q 1997. **21**(1): p. 55–80.
12. Hoffer, J.A., J.F. Geroge, and J.S. Valacich, *Modern systems analysis and design. – 4th edn.* 2002: Pearson Education, New York

Changing Time Orientations in Organizations: A Role for ICT?

D. Isari[1] and M. De Marco[2]

Abstract Despite its importance to temporal issues, research into the temporal impacts of information technology in organizations is still limited. On the other hand, organizational culture research shows that the way time is perceived and collectively organized reflects assumptions that are an expression of the specific organizational setting, underscoring that cultural assumptions are an important contributory factor to the strength and direction of organizational change. In this contribution, we have investigated the role ICT can play in promoting changes in the temporal dimension of organizational culture, and sought to assess whether temporal assumptions can affect the way a new system is used, thus facilitating/hindering the achievement of the expected results. Our case study covered the four types of 'temporal performance' management expected to see thanks to the introduction of a workflow system and showed that, after its introduction, the temporal dimensions of the organizational culture of the departments involved showed some significant changes, which confirm hypothesis 1 of the study, but also some contradictory effects that seem to confirm hypothesis 2.

Introduction

It is generally accepted that, when implemented in organizations, information technology hugely speeds up business processes, thereby enabling the adopting organizations to save a great deal of time. Despite its significance in temporal terms, research on the time impact of information technology in organizations is still limited [1]. Empirical studies on this topic began to appear in the last decade in the journals of Organization and IS discipline [2–8]. Accelerating the pace of work processes, fostering workers' polychronicity, promoting shifts from "batch" logic to "flow" logic and improving synchronization among organizational units are just a few examples

[1]Università Cattolica del Sacro Cuore, Milano, Italy, daniela.isari@unicatt.it
[2]Università Cattolica del Sacro Cuore, Milano, Italy, marco.demarco@unicatt.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_52, © Springer Physica-Verlag Berlin Heidelberg 2010

of some key objectives pursued by firms when they adopt systems like Workflows or ERPs. Such objectives, which we will refer to as expected temporal performances, are related to potential changes in the temporal organization of processes and activities, but also to potential changes in mental attitudes and assumptions people share towards time and time use in the workplace. Organization studies have long acknowledged time as a fundamental dimension of organizational culture [9] in his seminal study, Schein [10] maintains that organizational culture has groups' dominant assumptions of time and space embedded within it and describes a variety of "assumptions on time" that characterize different organizational cultures. Schriber and Gutek [11], in their empirical research, also described rules about time as specific dimensions of organizational culture and found that these cultural features varied across organizations and working groups. It has been underscored that, in addition to being a condition for the coordination of activities and the production of organizational outputs, the temporal organization of work processes constitutes a framework that plays an essential role also as a template for organizing behavior: a cognitive and cultural framework which defines activities and routines of both people and organizational units and is used by people to make sense of actions and events in the workplace [12]. In his study of temporal patterns in the organization of activities in hospitals, Zerubavel [13] found that various types of schedules worked as "cognitive maps" used by personnel to provide a background, a "repertoire of what is expected, likely or unlikely to occur within certain temporal boundaries" [p. 125]. Temporal assumptions represent thus an expression of the specific organizational and professional culture which produces them, conveying cognitive framework and symbolic value, for the individual and the group of workers. Such assumptions can also be expression of specific sub-cultures – i.e. departmental, professional – within a firm [14, 15]. Therefore, the relevance of temporal assumptions as a cultural framework and a cognitive map can thus be considered a factor which contributes to their strength and permanence within a given organizational context. As a result, the introduction of technologies with the potential to bring changes to this domain involves a challenge to many of the cognitive orders and cultural values on which organizational actors rely. On the other side, like all other social structures, they have a provisional nature and can change over time [16, 17], also in line with technological innovations. This paper seeks to contribute to research on temporal impacts of information technology in organizations presenting a case study which investigates the role ICT can play in promoting changes in the temporal dimension of organizational culture and tests the hypothesis that temporal assumptions shared by people before a system is introduced can affect the way it is used, thus facilitating or hindering the achievement of the results the system is expected to convey.

Aim of the Study and Research Questions

Our purpose is to investigate the role ICT can play in promoting changes in the temporal dimension of organizational culture: does the introduction of a new system contribute to change shared assumptions about time and time use in the workplace?

Can ICT help transform the way people view time and the ‘appropriate’ way to collectively organize it within a given context (at organizational/ department/group level)? Can temporal assumptions affect the way a new system is used, thus facilitating/hindering the achievement of the expected ‘temporal performance’ conveyed by the system? Our investigation into these issues is based on the case of a manufacturing company where a Workflow System has been introduced in three organizational departments with the aim of improving customer service processes, and addresses two main research questions:

1. Does the introduction of the workflow system transform the temporal assumptions shared by people in organizational units, thus achieving the expected temporal performance, and, if so, to what extent?
2. Do the temporal assumptions that exist in organizational units before the introduction of the system affect the use of the system thus facilitating/hindering the achievement of the expected temporal performance?

Case Study: Research Design and Theoretical Framework

Our study was conducted in the Italian branch, employing 350 people, of a multinational manufacturing company, where a Workflow System (Lotus Notes) was introduced to improve Customer Service processes, in particular, the Complaint Management Service, the most prominent customer service activity, which requires the coordination of three different departments. As we will describe later on, the workflow system was considered critical due to its potential to achieve results related to temporal issues. The company supported the change management process by organizing an internal workshop, with the involvement of the department managers, which took place during the design phase, in order to share the objectives and optimize the fit between the features of complaint service process and the new system. The system had been introduced about 8 months before the fieldwork started in July 2007, thus the implementation stage was sufficiently advanced to enable us to measure possible changes in the temporal assumptions within the departments. The research is designed as a positivist case study [18, 19] and the units of analysis are the three departments where the system has been implemented: “Customer Point,” Storehouse and Logistics, “Orders Management” Unit (which reported to the Sales Department). The study was developed in two phases, having two different objectives: Phase 1 Investigation of the temporal performance expected by the managers adopting the system. Phase 2 Measurement and description of the temporal dimensions of culture existing in the three departments before and after the introduction of the system.

Data collection.

Data was gathered through documental analysis, semi-structured interviews with the IT and Organization manager, the department managers and the employees, questionnaires based on Likert scales addressed to both managers and employees.

The theoretical framework adopted in order to describe and measure the temporal dimensions of organizational culture is based on a set of concepts which have been operationalized and tested in previous research into the psychology of work and organizational culture [11, 16] integrated with concepts drawn from the work by Zerubavel [13] and Barley [12]. The framework includes these dimensions:

Deadlines: importance of defining and meeting deadlines, start and stop points of activities; Scheduling: perceived importance of scheduling, activity which concerns location in the temporal realm and gives organizations a framework for constructing temporal boundaries; Synchronization and coordination: perceptions about the importance of cooperating with others and working in a coordinate way or as a team; Temporal symmetry: the extent to which different groups share the same temporal order; Polychronicity: the extent to which people prefer to be engaged in two or more tasks simultaneously and believe that is the best way to do things; Sequencing of tasks: importance attributed to the order in which activities and tasks take place ; Social cycles : the regular recurrence of events and processes: the cycles in work activities experienced over time; Allocation: the amount of time devoted to a task or activity, it can be considered a measure of work overload, in that it defines the degree to which schedules seem too tight; Speed vs. Quality: rules that people follow on trade-offs between the quality of work and the speed of work over time; Work Pace : rate at which activities can be accomplished: it concerns the speed of work and people's expectation to work fast; Awareness of time use : people's awareness of how they use their time on the job and expectations that they know how long they take to perform activities; Expected temporal performance: we define "expected temporal performance" the whole of expectations expressed by managers with regard to temporal issues, such as process acceleration, changes in people's time orientations, changes in temporal dimensions of a departmental culture.

Case Study Results and Discussion

Investigation of Expected Temporal Performance

Interviews with managers showed that the main objectives inherent the introduction of the workflow system were widely shared and that expectations were highly related to temporal issues. Four expectations, relevant from the temporal viewpoint, turned out to be widely shared by all managers:

1. Speeding up the process of Complaint management.

This meant accelerating the individual activities that make up the process, like gathering documentation on the customer's order, collecting information about the specific problem encountered, monitoring the customer's "complaint dossier" and reducing the overall "lead time" of the process in order to provide faster answers to customers. “Lead time” was a very common expression used, and the cross analysis with the documentation confirmed it was one of the project’s key goals. It also meant reducing duplications and the time needed to produce physical documents: “less paper” was a common remark among mangers.

2. Reducing temporal misalignment among different departments.

Customer Point operators, who are subject to daily pressure from customers, were far more aware of the delays suffered in providing the customers with answers, compared to other departments, which had other priorities and followed their own activity cycles. The workflow system was expected to facilitate departmental “alignment” on priorities and deadlines. This kind of objective can be better explained using Zerubavel’s concept of temporal asymmetry: these departments didn’t share the same “temporal order,” each of them having its own scheduling and activity cycles, which obstructed the overall process.

3. Shifting from a “batch logic” to a “flow logic”.

The system was expected to make it easier for people to deal with issues instantly, as they arose and without waiting until they had accumulated a “pile of dossiers” on their desk. As the IT and Organization manager put it. “We want people to change their mentality, from a ‘batch logic’ to a ‘flow logic’, dealing with requests as soon as they show up.” These remarks referred to the tendency to organize the activity in recursive “cycles,” occurring in some cases merely once a week (i.e. storehouse operators were reported as checking dossiers once a week) and also to a preference to do one type of activity at a time (monochronicity). Reduction/elimination of such cycles and polychronicity represented key objectives.

4. Shifting from “indefinite urgency” to “definite deadline” assumptions.

Managers reported that the appreciation of the level of urgency of a “dossier” was left to the individual operators, who, based on their experience and willingness, judged whether a complaint case was more or less urgent. There was no sharing of common deadlines for dossier definition and responses given to both internal and external clients: this resulted in a general feeling of uncertainty, well expressed by all mangers, when they stated that “everything is urgent here,” and that “in general, there has always been a rule that any complaint must be processed within 24 h.” Managers admitted that it could take up to 10 days.

Changes in the Temporal Dimension of Organizational Culture

Data from the employee questionnaires given to the three departments were triangulated with data from ten in-depth interviews carried out with the four managers and six employees, enabling us to analyze the temporal dimensions of each department’s culture and assess the perceptions of change in these dimensions before and after the introduction of the system. For the purpose of this article we will focus on the analysis of the main changes in the temporal assumptions, following the introduction of Lotus Notes.

Data analysis showed a significant increase in three dimensions – deadlines and scheduling, synchronization and coordination and temporal symmetry among departments – after the introduction of the system. Deadlines were not perceived as so important before the introduction of the system. The respondents reported that there was a belief that "everything is urgent" and a general rule that "overall, all complaint dossiers should be opened on the day the complaint arrives." Others reported that "we didn't really think of deadlines, it was more indefinite." According to the results of the questionnaires, the value of this dimension scored very high 11 months after the introduction of the system. Respondents reported that what really made the difference was the introduction of a formalized classification of complaints based on the expected completion time and the visualization of dossiers flagged by a colored tag, which was visible to the operators of all departments, thus reminding them of the existence of a deadline and that it required alignment among departments. The introduction of this system of deadlines and of the colored tag "artifact" represented a liaison among departments: using Barley's concept of symmetry, the three units now share a common deadline system and have to meet aligned deadlines, which has increased the overlap among their different temporal orders.

The value of synchronization and cooperation among departments ranked very high in all three departments and was perceived as having increased significantly because the sense of "teamwork" among departments had also increased. Customer Point operators reported that, pre-Lotus Notes, the synchronization with other departments was very poor: other departments were reported as "having their own time," "creating bottlenecks," "being slow to give answers." All the interviewed customer service operators shared the strong conviction that this situation had improved significantly with the introduction of the workflow system because their requests are now transmitted instantly through Notes and the date and hour of the

Table 1 Changes in temporal assumptions

	Temporal assumption	Customer point	Storehouse and logistics	Orders management
1	Schedules and deadlines	+	+	+
2	Synchronization and coordination	+	+	+
3	Temporal symmetry	+	+	+
4	Polychronicity	+/=	=	+/=
5	Sequencing of tasks	=/-	=	=
6	Social cycles	+/-	+/-	=
7	Allocation	+/-	+	=
8	Speed vs. quality	=	=	=
9	Work pace	+/-	=	=
10	Awareness of time use	+	=	+

request, as well as the other department's response, are recorded. On the other hand, operators from other departments reported that the system made it "simpler and quicker to gather and send documents because the databases are now interconnected." The increase of these three dimensions confirmed also the achieving of three expected temporal performances: the lower level of misalignment among departments, the adherence to defined deadlines, and the speeding up of the customer complaint process. This kind of evidence would seem to confirm the first hypothesis of the study, that the introduction of workflow systems has the potential to transform the temporal assumptions shared by people in organizational units. Nevertheless, it is important to note that the introduction of the workflow system was combined with an internal workshop involving the managerial level and that the results we report were associated by the respondents with both the innovations introduced by the system and the effectiveness of the workshop as a change management strategy.

To the contrary, the dimensions of polychronicity and sequencing showed no significant change, while the social cycles characterizing the departments revealed contradictory patterns of change. These dimensions were associated with the achievement of the objective whereby, in performing their activities, workers would shift from a batch logic to a one-piece flow logic. Polychronicity scored low in the questionnaires gathered from all three departments. When triangulated with the interview data, the result was explained in this way: in all departments the workflow was recognized as fostering polychronicity because all data and documents were stored in a single database, making it "easier to open and close items related to different activities simultaneously, having links immediately available." On the other hand, employees pointed out that they didn't like working this way and that there wasn't yet a shared belief that this way of working was "better." High scores of time allocation dimension cross-confirmed that there was a feeling of an increasing work overload. Further, when under pressure to deal with overloads, operators shifted back to batch logic: for example, Customer Point operators during phone call peaks (twice a day) interrupted their other activities to concentrate on answering the phone, admitting that "messages in Lotus were left on stand-by." Another case was when they had a number of administrative tasks requiring high levels of concentration: they adjusted with colleagues in order to divide labor based on specialized activities and followed a monochronic logic. Interestingly enough, as far as Social Cycles are concerned, the interviews showed that, though the pressure toward a "flow logic" had increased, operators retained their previous cycles: at Customer Point, the activity is still organized around the "phone call peaks" and four main daily cycles are still in place. This influenced, as pointed out in the previous section, a use of the workflow system that is not yet thoroughly in line with the expected "flow logic." The same happened in Storehouse and Logistics, where the importance of sequencing is a key feature of the departmental culture and where monocronicity is high. Here, operators reported that there had been an adjustment between the social cycles of their activity and the need for more polychronicity: they used to follow a 5–6 day cycle in complaint management activity: i.e. the "pile of paper" here was left to grow until, finally, they dedicated one entire day to this specific, time-consuming activity. The presence of this cycle expresses the "batch logic" they followed. In addition, this created a noticeable temporal asymmetry with Customer Point operators, who were left waiting for answers for up to a week. This department is characterized by another typical cycle, the Morning/Early afternoon cycle. In the morning, ordinary activity takes place; at one p.m. afternoon planning starts, while deliveries take place through to five p.m. At present, complaint management has been re-allocated according to this second cycle: Lotus Notes is checked in the morning and, accordingly, complaints start to be checked in a more "flow oriented" logic. This allocation of the complaint management activity to the morning/early afternoon cycle has enhanced the symmetry with Customer Point. In this case, the shift to a "flow logic" has been partly obtained through an adjustment to existing social cycles and to a still strong orientation to monochronicity in departments. To summarize, our findings suggest that the persistence of two temporal dimensions of organizational culture – monochronicity and sequencing – and the strength of the social cycles existing within the departments have influenced the use of the system and the achievement of one important expected temporal performance, the shift to a flow logic. This result seems to support our second hypothesis that temporal dimensions of organizational culture can affect the use of the system, thus having an impact on and even hindering the achievement of the expected temporal performance.

Conclusions

Despite its importance to temporal issues, research into the temporal impacts of information technology in organizations is still limited. On the other hand, organizational culture research shows that the way time is perceived and collectively organized reflects cultural assumptions that are an expression of the specific organizational setting (at firm, departmental, group level), underscoring that cultural assumptions are an important contributory factor to the strength and direction of organizational change. In this contribution, we have investigated the role ICT can play in promoting changes in the temporal dimension of organizational culture, and sought to assess whether temporal assumptions can affect the way a new system is used, thus facilitating/hindering the achievement of the expected results. Our case study covered the four types of 'temporal performance' management expected to see thanks to the introduction of a workflow system and showed that, after its introduction, the temporal dimensions of the organizational culture of the departments involved showed some significant changes, which confirm hypothesis 1 of the study, but also some contradictory effects that seem to confirm hypothesis 2. Significant increases were seen in three dimensions – synchronization and coordination, temporal symmetry, deadlines and scheduling. The increase of these dimensions confirmed the achievement of the three expected temporal performances: the reduction of the misalignment among departments, the shift to definite deadlines, and the speeding up of the process. This supports the first hypothesis of the study, that the introduction of workflow systems helps transform the temporal assumptions shared by people in organizational units. It is important to remember that the system was introduced in tandem with an internal workshop involving the managerial level and that the results reported here were associated by respondents with both innovations introduced by the system and the workshop. Nevertheless, the assumptions underlying the objective that workers would shift from a 'batch logic' to a 'flow logic' in performing their activities failed to show any significant change: data analysis shows that the persistence of two temporal assumptions – monochronicity and sequencing – and the power of the social cycles existing within departments influenced the expected use of the system and the achievement of one important temporal performance, the shift to a flow logic. This supports our second hypothesis that temporal dimensions of organizational culture can affect the use of the system, thus hindering the achievement of the expected temporal performance.

References

1. Lee H. and Whitley E. (2002). Time and Information technology: temporal impacts on Individuals, organizations and society. *The Information Society* 18: 235–240
2. Sahay, S. (1998). Implementing GIS technology in India: some issues of time and space. *Accounting, Management and Information Technologies* 8: 147–188
3. Lee H. and Liebenau J. (2000). Temporal effects of Information Systems on business processes: focusing on the dimensions of temporality. *Accounting, Management and Information Technologies* 10: 157–185
4. Orlikowski W.J. and Yates J. (2002). It's about time: temporal structuring in organizations. *Organization Science*. 13(6):684–700
5. Sawyer S., Southwick R. (2002) Temporal issues in information and communication technology-enabled organizational change: evidence from an enterprise system implementation. *The Information Society* 18:263–280
6. Scott S.V., Wagner E.L. (2003). Networks, negotiations and new times: the implementation of ERP into an academic administration. *Information and Organization* 13: 285–313
7. Sarker S., Sahay S. (2004) Implications of space and time for distributed work: an interpretive study of US-Norwegian systems development teams. *European Journal of IS* 13: 3–20
8. Prasopoulou, E., Pouloudi, A, Panteli, N. (2006). Enacting new temporal boundaries: the role of mobile phones. *European Journal of IS* 15: 277–284
9. Hofstede,G. (1991). Cultures and organizations. Mc Graw Hill, London
10. Schein E.H. (1988) Organizational culture and leadership. Jossey Bass, San Francisco, CA
11. Schriber J.B., Gutek B.A. (1987) Some time dimensions of work: Measurement of an underlying aspect of organization culture. *Journal of Applied Psychology* 72(4):642–650
12. Barley S.R. (1988). On technology, time, and social order: Technically induced change in the temporal organization of radiological work. In Making Time: Ethnographies of High Technology Organizations. F.A. Dubinskas (ed.): 123–169. Temple University Press, Philadelphia
13. Zerubavel E. (1979). Patterns of time in hospital life. The University of Chicago Press, Chicago
14. Lawrence P.R., Lorsch J.W. (1967). Organization and environment:managing differentiation and integration. Harvard University Graduate School of Business Administration, Boston
15. Gherardi S., Strati A. (1988). The temporal dimension in organizational studies. *Organization Studies* 9(2): 149–164

16. Bluedorn A.C. et al. (1998) Polychronicity and the inventory of polychromic values (IVP). *Journal of managerial psychology* 14(3/4): 205–230
17. Ancona D. et al. (2001a) Time: A new research lens. AOM Review 26(4):645–663
18. Benbasat, I. et al. (1987). The Case Research Strategy in Studies of IS. *MIS Quarterly* 1(3): 369–386
19. Yin R.K. (2003). Case Study Research, Design and Methods. Sage, Thousand Oaks, CA

Checking the Consistency, Completeness and Usability of Interactive Visual Applications by Means of SR-Action Grammars

R. Cassino[1] and M. Tucci[2]

Abstract The development of interactive visual applications is a complex work, usually performed with the help of advanced visual programming environments. Starting from the GUI's visual specifications, the programming environment generates the corresponding code that implements the interface. In most cases, designers and developers have no tools to keep control over the usability and the maintainability of the resulting applications. In fact, the success of an information system depends on the accessibility and usability of its interface. The evaluation of visual environments is traditionally performed by means of expert-based evaluations or by testing with end users. In this paper, we describe a methodology to design, specify and evaluate interactive visual applications, based on the SR-Action Grammars formalism. We describe how it is possible to assess the usability metrics of consistency, completeness and user control by means of checks performed at high abstraction level of the visual language. In particular, we improve the formalism of the SR-Action Grammars (Cassino et al. (2003): SR-Task Grammars: A Formal Specification of Human Computer Interaction for Interactive Visual Languages – 2003 Symposium on Visual Languages and Formal Methods (VLFM '03) – IEEE Symposia on Human-Centric Computing Languages and Environments (HCC'03)) to specify visual languages, so to perform usability checks by the management of the production rules. TAGIVE (Cassino et al. (2006): A Methodology for Computer Supported Development of Interactive Visual Applications – WSEAS Transactions On Information Science and Applications Journal.) is the tool that allows to design interactive visual environments and to generate the related formal specification in automatic manner. Thanks to the controls performed at formal level, the system guides the designer in the correct development of the application.

[1]Università di Salerno, Salerno, Italy, rcassino@unisa.it
[2]Università di Salerno, Salerno, Italy, mtucci@unisa.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_56,

Introduction

The success of an information system is highly dependent on the accessibility and usability of its interface. The Graphical User Interfaces are interactive visual applications realized with the help of advanced visual programming environments.

The interface of a software application must allow the user to have a good awareness of the system state and the situation; during the execution it is necessary to reduce the number of the steps to transform an intention in an action and the interface must be able to evoke "what to do" and "how to do."

Most of the existing techniques for the evaluation of interactive visual applications must be manually performed and iteratively repeated at each refinement step after a rapid prototyping of the system.

In recent years, the growing use of diagrammatic representations in several application fields has motivated the study of formal methods to specify visual languages, but one of the main barriers to the practical use of these formalisms is the high cost of the parsing and the choice of an appropriate abstraction level for the specification of the system behaviour. In this perspective, several approaches to the development of graphical applications formally specified can be found.

In [1] Visual Conditional Attributed Rewriting (VCARW) systems are introduced and used to specify visual languages and to perform control mechanisms of the interaction, thus favouring the design of more reliable and usable systems.

GEDISAC [4] (Graphical Event-Driven Interface Specification And Compilation) presents an approach to GUI Development which supports the designer in modelling and code generation of the total GUI, granting its correctness and reliability and allowing cost-effective software implementation, maintenance and evolution. Nevertheless, the use of the adopted formalism is difficult to understand and therefore restricted to areas where it becomes necessary. DiaGen [5] provides an environment for the rapid development of diagram editors. In particular, the approach considers graph-like languages to describe visual languages whose diagrams consist of nodes and edges of different type. The technique just adapts to the development of interactive visual applications characterized by numerous graphic objects and specific interaction mechanisms and does not manage usability controls. Visual Automaton [6] is a finite-automaton based formalism to specify visual applications. However, the formalism provides only a description methodology and does not implement any usability controls.

In this paper, we describe a methodology to design, specify and evaluate interactive visual applications, based on the SR-Action Grammars formalism. In particular, we describe how it is possible to assess the usability metrics of consistency, completeness and user control by means of checks performed at high abstraction level of the visual language.

The paper is organized as follow. In Section "The SR-Action Grammars Formalism" the formalism of SR-Action Grammars is introduced. In Section "The Management of the Usability Controls" we describe how the usability metrics of consistency, completeness and user control are managed by the proposed formalism. Section "Conclusions" contains some concluding remarks.

The SR-Action Grammars Formalism

The SR-Action Grammars model is meant to allow designers to specify interactive visual languages, thanks to the new typology of production rules, named *action-rules*. Such productions allow us to directly specify the effect of actions performed on some component of a scene.

Whenever an action is performed on a *dynamic component* (element to which an action is associated), an associated action rule is applied, which specifies the next state of the scene or the transition to a new scene. Semantics rules are associated with each production, allowing to specify not only how the visual state of the scene is modified, but also how the system internal state may be affected by the production application.

In Fig. 1 we present a portion of a map of a simple interactive visual application and the related formal description:

At implementation level, any scene in the map is detailed in terms of static, dynamic components and layout properties. Then, at formal level this means that each non terminal symbol is specified in the form:

$$\text{Scene1} = <M_{\text{Scene1}}, R_{\text{Scene1}}, \alpha_{\text{MScene1}}>$$
$$\text{Scene2} = <M_{\text{Scene2}}, R_{\text{Scene2}}, \alpha_{\text{MScene2}}>$$

where M is a subset of the symbol occurrences; R is the subset of the spatial relation between symbols; α is the set of the actions linked to the symbols. The implementation of the transition from the Scene2 to the Scene1, performed by a *Single_Left_Click* on a button, is specified by the following production rules:

………

1: single_left_click.button$^{0,1} \rightarrow <\{S^{1,0}1\}>$

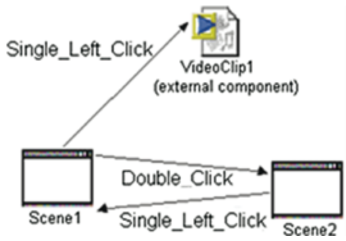
contain(side^{1,0}, button^{0,1}) $\rightarrow$ [1] ϕ

{button^{0,1}.state = 1

$S^{1,0}$1.state = 0

$S^{1,0}$1.visibility = button^{0,1}.state }

……….



VN ={Scene1, Scene2}
VT = {VideoClip1}
DELTA = {Single_Left_Click, Double_Click, Single_Left_Clic}
where VN is the set of the non terminal symbols; VT the set of the terminal symbols; DELTA is the set of the provided actions.

Fig. 1 The application map and the related formal specification where, the index 1 indicates the number of the rewriting rule, *button*^{0,1} is the symbol occurrence of a button element in the Scene2; $S^{1,0}1$ indicated the return to the Scene1. According to the semantic rule associated with action-production 1, whenever a *single_left_click* action is performed on the button appearing in the Scene2 (expressed by the s-item button^{0,1}), the state attribute of the button s-item is set to 1, and the same value is also inherited by the visibility attribute of the s-item Scene1. In other words, the effect of the action will be the transition into the new scene. Problems of formal description of a scene arise if mistakes at implementation level occur, how detailed in the next section.

The Management of the Usability Controls

In this section we describe how the SR-Action Grammars formalism is used to perform usability checks as consistency, completeness and user control.

TAGIVE [2] is a visual environment implemented to design interactive visual environments and to generate the related formal specification in automatic manner. In particular, the generation of the grammar is performed in a gradual manner corresponding to the two phases of the implementation of the system: the design level, that allows to describe the application map (see Fig. 2a); the implementation level (see Fig. 2c), by which the several scenes and the interaction mechanism are developed. Then, by a top-down methodology, all the scenes and the actions inserted in the design map must be later defined to prevent the application to be incomplete.

Starting from the application map, the set of nonterminal symbols representing scene nodes, the set of terminals representing external file nodes and the set of actions representing edges, are generated (see Fig. 2b). Moreover, the association of each edge in the map with the corresponding source and target nodes is internally stored. Such information is later exploited by TAGIVE to directly control the lower level of the construction, namely the composition of each scene (see Fig. 2c) and the management of the events occurring in it (see Fig. 2d). This allows the system, throughout the development phase, to prevent incorrectness and to check for completeness of inter-scene interactions.

As for the consistency check, the system constraints designer's choices both for the intra-scene and for the inter-scene interactions allowed at any point during the development. As an example, let us consider the Application Map shown in Fig. 2a, and let us suppose that the designer is defining the interactions starting from *Scene2*. When the designer accesses the event management functionality related to the dynamic label *Exit*, he/she is prompt by the system only of the two possible actions which can be performed starting from *Scene2*, namely *Single_L_Click* and *Double_L_Click*, which correspond to the two edges stemming out of *Scene2* in the map. Thus, he/she cannot associate wrong actions like *Single_R_Click* to the label, since only the two allowed actions are listed in the combobox. As for completeness verification, TAGIVE exploits the underlying grammar rules in order to check that

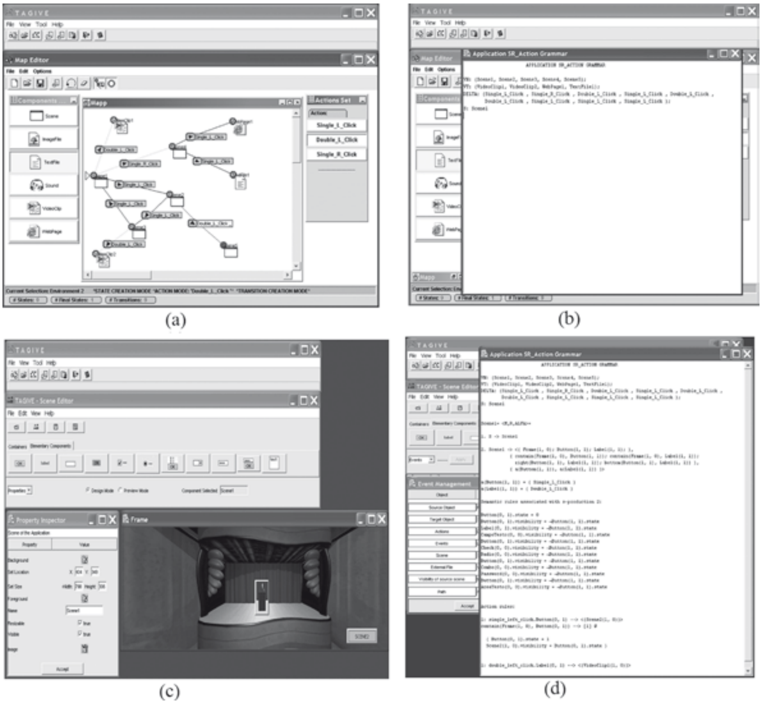


Fig. 2 The application map (**a**) and the partial specification (**b**). A scene implementation (**c**) and the related formal description (**d**)

all the scenes in the map have been defined and that each scene is made reachable. As an example, suppose the designer has defined only the first scene *Scene1* in the map of Fig. 2a and that he/she has implemented only the *Single_L_Click* transition from *Scene1* to *Scene2*. In case the designer confirms the end of the implementation, the system the system does not allow the release of the application because there are incompleteness. All the other detected incompleteness with respect to the application map would be highlighted on the map itself. In particular, all the edges representing interactions which have not been specified at the lower level would become thick and red. Similarly, all the nodes which are not reachable starting from the initial node, would be highlighted by thick red circles, as illustrated in Fig. 3.

Thus, in the example the designer would realize the following.

- The dynamic behaviour associated with the *Single_L_Click* action connecting *Scene2* to *Scene3* is missing, since the system has not found a proper action rule for it in the grammar. Similarly, the dynamic behaviour associated with the *Double_L_Click* action for the transition to *Scene2* is not specified, and similar problems occur with all the other edges in the map.

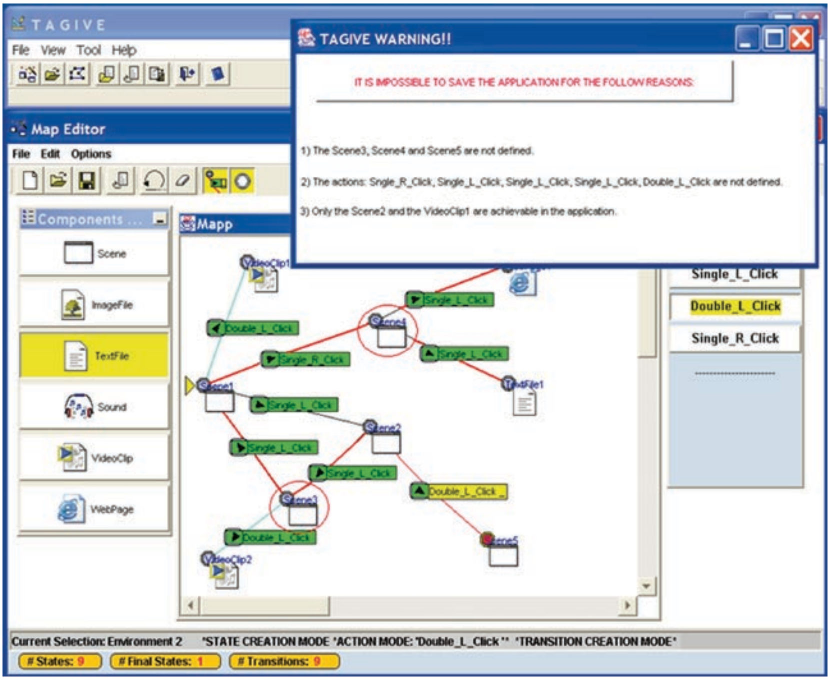


Fig. 3 The application map of Fig. 2a: nodes not reachable from the initial node are circled

- The nodes representing *Scene3*, *Scene4*, *Scene5*, and the external files *VideoClip2*, *WebPage1* and *TextFile1* are not reachable at all. As a matter of fact, no rule is found in the grammar, which has none of those s-items in its right-hand side (see Fig. 4).

It is worth noting that apparent nondeterministic situations may arise from two edges labelled by the same action which stem out of one node in the map, e.g., two *Single_L_Click* edges stemming out of the same scene node. In such a case, TAGIVE would prevent the designer from associating the same action twice with the same dynamic component in the source scene. Thus, once a *Single_L_Click* action has been associated with a button in the scene, and the corresponding event has been managed, any other attempt to associate a *Single_L_Click* action with that button would fail. Of course, the second *Single_L_Click* action may instead be associated to any other dynamic component in the scene.

The "user control" means that the user must have full control and understand what he is doing during the interaction with the application. In the proposed approach, we tried to manage any aspects of this usability metric at formal level. In particular, the system checks if in a scene there are some dynamic symbols linked to an action to return at the start point; to undo at the last task; to return at the last selected point and, accordingly, if the production rules and the related attributes are generated.

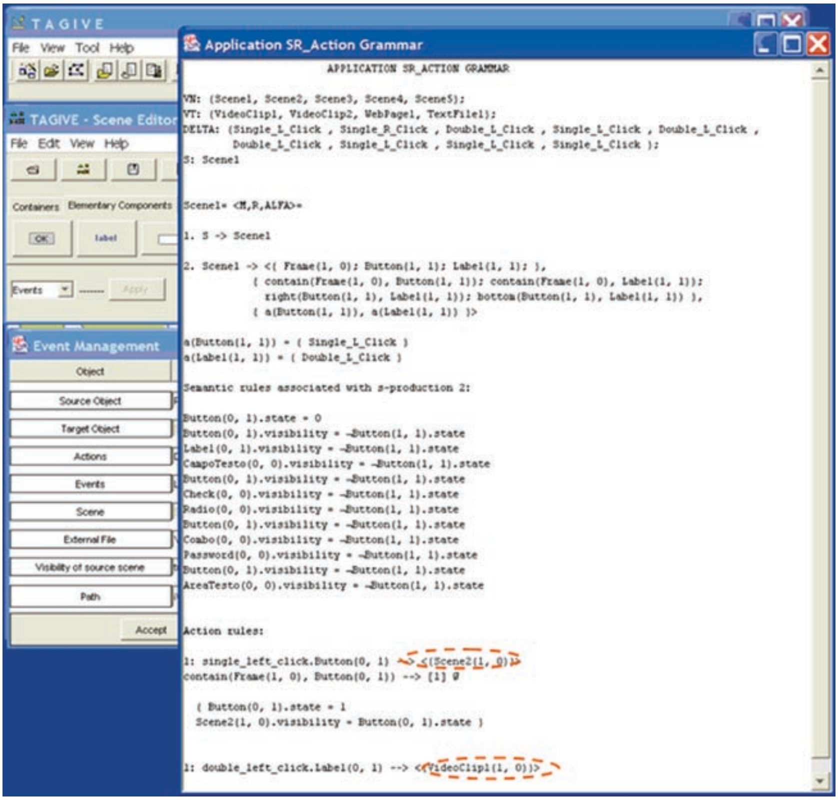


Fig. 4 The management of the incompleteness errors

Conclusions

In this paper, we have described an alternative approach to specify interactive visual applications and to perform usability controls by at a high abstraction level of the generated visual language. In fact, the interface of a software application must allow the user to have a good awareness of the system state and the situation; during the execution it is necessary to reduce the number of the steps to transform an intention in an action and the interface must be able to evoke “what to do” and “how to do.” The methodology is based on the SR-Action Grammars formalism and shows how it is possible to use a formalism to try practical aid in the development of visual applications in terms of control of consistency, completeness and user control of the developed system. The generation of the grammar is performed in a gradual manner corresponding to the two phases of the implementation of the system: the design level, that allows to describe the application map; the implementation level, by which the several scenes and the interaction mechanisms are developed. As a matter of fact, by a top-down methodology, all the scenes and the actions inserted in the design map must be later defined to prevent the application to be incomplete. Thanks to the controls performed at formal level, the system guides the designer in the correct development of the application. The described approach is still work in progress and it is developed in parallel to a usability evaluation approach of graphical environments that tends to realize an automatic evaluation process based on computable algorithms to achieve quantitatively measurable parameters. Further work will be done to show the efficiency of the described usability evaluation process in a wider range of desktop and mobile applications and in comparing the results with those reported by other types of usability evaluation methods.

References

1. Bottoni, P., Costabile, M.F., Mussio, P. (1999): Specification and Dialogue Control of Visual Interaction through Visual Rewriting Systems, *ACM TOPLAS*. **21**(6) 1077–1136.
2. Cassino, R., Tortora, G., Tucci, M., Vitiello G. (2003): SR-Task Grammars: A Formal Specification of Human Computer Interaction for Interactive Visual Languages – 2003 Symposium on Visual Languages and Formal Methods (VLFM '03) – *IEEE Symposia on Human-Centric Computing Languages and Environments (HCC'03)*
3. Cassino, R., Tortora, G., Tucci, M., Vitiello G. (2006): A Methodology for Computer Supported Development of Interactive Visual Applications – *WSEAS Transactions On Information Science and Applications Journal*.
4. GEDISAC – An innovative approach to the development of Graphical User Interfaces" - http://www.txtgroup.com/newsletter/attachment/gedisac_leaflet.pdf.
5. Minas, M. (2002): Specifying Graph-like Diagrams with Dia Gen – Electronic Notes in Theoretical Computer Science", Volume 72, Issue 2, November 2002, Pages 102–111.
6. Della Penna, G., Intrigila, B., Orefice, S. (2001): Generating graphical applications from state-transition visual specifications - *International Journal of Human Computer Studies 55* 861–880.

Compliance Management is Becoming a Major Issue in IS Design

R. Bonazzi[1], L. Hussami[2], and Y. Pigneur[3]

Abstract This article aims at improving the information systems management support to Risk and Compliance Management process, i.e. the management of all compliance imperatives that impact an organization, including both legal and strategically self-imposed imperatives. We propose a process to achieve such regulatory compliance by aligning the Governance activities with the Risk Management ones, and we suggest Compliance should be considered as a requirement for the Risk Management platform. We will propose a framework to align law and IT compliance requirements and we will use it to underline possible directions of investigation resumed in our discussion section. This work is based on an extensive review of the existing literature and on the results of a four-month internship done within the IT compliance team of a major financial institution in Switzerland, which has legal entities situated in different countries.

Introduction

In this article we suggest that compliance requires a multifaceted alignment, which should be treated in the early steps of Information Systems (IS) engineering at a higher level than the applicative one, to assure the flexibility required to deal with the evolution of laws.

Addressing risk and compliance management means acknowledging the larger re-regulation movement, started in the 1990s. Observing this evolution with concern, several industry experts warn about the negative consequences of the "regulatory overload" or "regulatory burden." One of the main reasons compliance with regulation is considered as being a burden is its cost (e.g. [1] shows how compliance

[1]HEC Lausanne, Lausanne, Switzerland riccardo.bonazzi@unil.ch
[2]HEC Lausanne, Lausanne, Switzerland, lotfi.hussami@unil.ch
[3]HEC Lausanne, Lausanne, Switzerland, yves.pigneur@unil.ch

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_45,

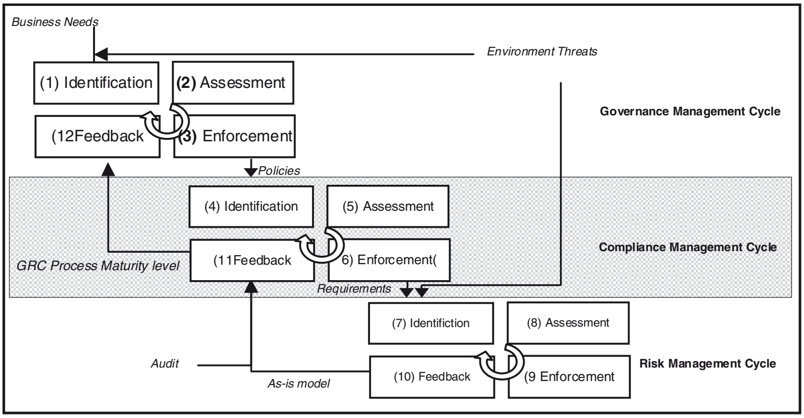


Fig. 1 IT GRC process

performances affect enterprise costs). Top cost drivers in the area of risk and compliance management are IT systems, i.e. data processing and corresponding software.

The trouble comes from the implementation approaches selected by most of the companies, which continue to meet compliance requirements "with one-off, best-of-breed solutions that address today's immediate need" [2], without an integrative architectural approach. All experts observe that an integrated compliance management approach is required for complying with multi-source, evolving and complex regulations (e.g. [3, 4, 5]). A global or holistic compliance requires a "Governance, Risk and Compliance" approach, which we applied in proposing a so called "IT GRC process" illustrated in Fig. 1 and composed of steps in three loops, which turns at different speed and that we associate at two watches (Governance and risk management loop) and one coordination system (Compliance management loop). The time of the watches is the IT GRC proces maturity level required.

Each loop has four steps: the first one identifies the threats, the second one assesses them and decides which ones to address. The third one puts into place artifacts to enforce the decisions taken in the previous steps. The fourth step gives feedback to the identification step.

More in details, the first three steps shown in Fig. 1 belong to the Governance loop, i.e. "the act of establishing IT decision structures, processes, and communication mechanisms in support of the business objectives and tracking progress against fulfilling business obligations efficiently and consistently," according to [6]. Steps 4, 5 and 6 belong to a coordination loop and deal with compliance, "the act of adhering to, and demonstrating adherence to, external laws and regulations as well as corporate policies and procedures," according to [7]. Steps 7, 8, and 9 belong to the risk management loop, "a coordinated set of activities to not only manage the adverse impacts of IT on business operations but to also realize the opportunities that IT brings to increase business value," according to [6]. Steps 10, 11 and 12 are the feedback steps of each loop.

The article proceeds in the following way. Section "IT Compliance Framework" presents a framework to perform the alignments required by compliance. Section "Different Alignments Between Domains" describes in details each alignment by citing existing example in the IS literature and underlining zones that are not fully covered yet. Section "Discussions and Further Work" concludes with discussion and further works.

IT Compliance Framework

For our IT GRC process model we combined the concept of a risk management cycle [8] and the ones of quality management [1] together with the previous works of Giblin et al. [9] of IBM, Sheth [10] from Semagix and El Kharbili et al. [11], who proposed a compliance process life-cycle and described the process steps. El Kharbili et al. [11] described a possible holistic solution, yet it seems that the compliance problem has two dimensions – *Legal Dimension* and *IT Dimension*-, while there are two kinds of sources of regulations to comply with: *External* and *Internal*.

We propose the regulation/IT alignment framework illustrated in Fig. 2 This is aimed to recall the strategic alignment model of Henderson and Venkatraman [14] and it has four domains, as the product between dimensions and sources of regulations. For the sake of clarity, Fig. 2 presents a real example taken from practice, concerning requirement engineering for document retention compliance with SEC 17a-4. Comparing Fig. 2 with Fig. 1, one can notice that the Governance steps of the IT GRC process generate the policies in the Organizational Infrastructure, while the Compliance steps deliver the IT Compliance Risk Management infrastructure.

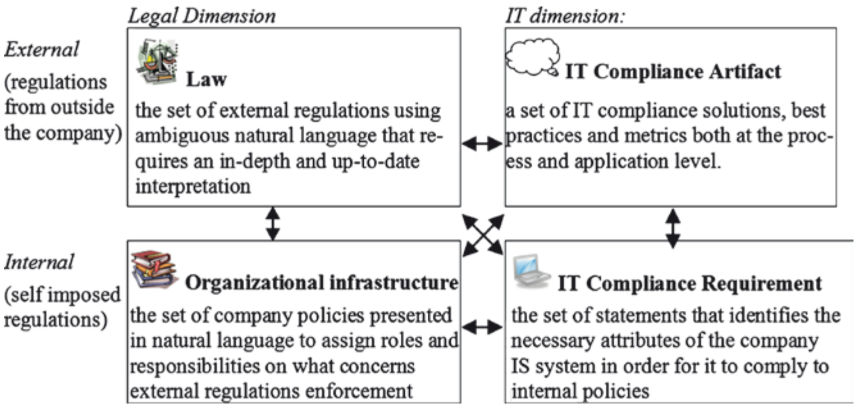


Fig. 2 Regulation / IT alignment

Different Alignments between Domains

This section describes the different alignments in the framework presented in Fig. 2, under the assumption that an arrow in the picture corresponds to two alignments in opposite directions. Each alignment refers to a brief review of articles both from the academic journals and from research groups like Forrester Research, Inc. and Gartner, Inc.

The alignments between the Law domain and the Organizational Infrastructure domain. We named the effort aimed at aligning the Organizational Infrastructure with the Law as contextualization. It concerns the first three steps of the IT GRC process and it is the subject of frameworks like COSO [15] for what concerns enforcement strategies. A support tool for the identification and assessment parts is proposed by Lau et al. [16], i.e. a hierarchical taxonomy of regulations using a XML structure, coupled with a reasoner as a compliance checking assistant that asks to the user a set of questions in order to define whether he is compliant with the law.

On the other direction of the arrow we named the effort aimed at aligning the Law with the Organizational Infrastructure as Contracting, which concerns steps 12 of the IT GRC process and is mostly the subject of journals for compliance officers (e.g. [17]). For this activity we did not find any IT support artifact.

The alignments between the Organizational Infrastructure domain and IT Compliance requirement domain. We named the act of defining the IT compliance requirements starting from the company policies as To-be analysis, since it involves the design of the new IS. This can be treated in different ways, depending if one sees it as a set of controls to put into place (e.g. CobiT [18]) or as a number of IT risks to adress (e.g. ISO 17799). We defined three kinds of design solutions:

Ex-post solutions to design an artifact to assess the level of compliance. Rifaut [19] proposed a Goal-Oriented Requirement Engineering (GORE) framework based on the ISO 15504 standard for process assessment to ease the checking task and define the maturity level of a process. Governatori et al. [20] considered the problem of checking the conformity of a business process execution against the terms of a contract, by adopting for both a common event-based formalism. Lezoche et al. [21] studied the problem of checking the conformity of the process models rather than the instances, by testing these models against a set of business rules. Note that this practice provides as well assistance for business process compliant design; thus one could also see it as an ex-ante solution.

On going solutions to design an artifact that could assure a real time internal control. Namiri and Stojanovic [22] from SAP proposed the implementation of the Internal Control process as semantic layer above business processes, called Semantic mirror, which contains the rules under which the business process can be executed, and are derived from the risk assessment of the business process. A related work is Agrawal et al. [23] from IBM, who proposed to see the internal control processes as in an organization as “a set of workflows, each containing required control activities" to obtain business process modeling, rules enforcement, and auditing.

Ex-ante solutions to design an artifact aimed at avoiding actions that are not compliant. Zur Muehlen and Rosemann [24] proposed an approach to design and model business processes by considering the risks they are exposed too. The result is a business process model that encompasses the risks, by means of three elements: a risk taxonomy, a taxonomy of the business process elements exposed to risk and a set of risk handling strategies.

On the other direction of the arrow, in order to align the Organizational infrastructure with the IT compliance requirements one could find inspiration from the authors grouped in the "ex-post solutions" (i.e. [19, 20,21,22,23]) to perform an as-is analysis of the existing IT capacities before listing the actions required. This is why we decided to name this alignment as As-is analysis.

The alignments between the IT artifacts domain and IT Compliance requirement domain. The act of defining the IT compliance requirements starting from the existing IT artifacts is here named as Artifact Choice. The support artifact could be under the shape of studies from Universities or of vendors/products comparisons offered by research centres, as well as strategic advices coming from an external consultant. On the application level the new compliance demand yields the thinking and the design of different types of applications to support compliance and risk management (Heiser et al. [25] offered a list of the most important in 2008). Assuming that information is the cornerstone of any effective risk & compliance process, Sheth [10] argued that semantic technologies are a good support for compliance applications.

On the other direction of the arrow the effort aimed at aligning IT artifact with the IT Compliance requirements of companies could be named as Trends Analysis and it might lead either to a case study (e.g. [4]), to a set of best practices (e.g. [6]) or to a new version of an IT application.

The alignments between the Law domain and the IT artifact domain. The act of aligning IT artifact with the Law could be called Artifact Creation. Most of this effort is still under the shape of tacit knowledge and we could only find effort aimed at formalizing the law, which is the first step in order to develop an artifact according to [9, 10, 11]. Gangemi et al. [26] built a Core Legal Ontology (CLO) above an extension of their previous work DOLCE. Another considerable effort has been made by Hoekstra et al. [27] of the Leibniz center for Law who built the LKIF ontology for describing legal concepts over 3 layers (abstract, basic and legal).

In the other direction we found only few authors who treated the alignment between Law and the existing IT artifacts (e.g. Gasser's analysis of *dynamization of the law* [5] or Skinner's idea of *forensically evolving regulations* [28]). We decided to call this alignment Awareness.

The diagonal alignments. Even if many authors (i.e. [1, 3, 6, 9, 10, 11]) have already envisaged an alignment of IT requirements with the Law yet these applications are to come. On the opposite direction of the arrow, nothing has been found on the alignment of law with the solutions implemented in companies.

We did not find much concerning the IT artifact/Organizational Infrastructure alignment, even if one could suppose to use the framework from Hevner et al. [29] to obtain rigor (Support choice alignment) and Relevance (Assessment). On the other direction of the alignment (Organizational Infrastructure/ IT artifact) one could suppose an artifact that would allow a company to define the policies by being aware of the existing IT artifacts.

Discussions and Further Works

Based on an analysis of the state of art, we can notice that several alignments efforts have been done separately without a holistic view [3, 4]); we propose these research axes:

1. *A holistic system:* as we mentioned, one could think about bringing all the isolated efforts together. Considerable work was achieved for legal ontologies (CLO, LKIF); we can go further by putting them in the context of a compliance management system. The efforts by [22, 23, 24] at the business process level form a package and need to be integrated together. A coupling with a risk assessment tool [22] is needed for a GRC process, and then the whole should be linked with a legal assistance tool. In a first moment a common formalism that aligns the legal, business and IT concepts should be elaborated. This will give the compliance dimension for an organization business model where we would see the impact trace of a regulation on the business, process and application levels. This model would be of high usefulness to support decision making and auditing. Finally the system should achieve a high flexibility to assure constant evolution. Different layers of abstractions are then needed and we suggest an investigation on the combination of ontologies and the Model-Driven Architecture paradigm.
2. *Support to alignment decisions*: the different alignments required by compliance need an approach that goes beyond solving classical ambiguity or contradictions handling between actors involved. The specificity of the legal context involves more or less voluntary asymmetry of information between parties interested. Starting from the idea of an artifacts aimed at solving classical ambiguity or contradictions handling (e.g. the legal use cases proposed by Gangemi [30]) one could study different cases of "coopetition," in which actors have interest of cooperate and compete at the same time, to determine the effect asymmetry of information on the perception of risk and the amount of wrong estimations done. Then, assuming that a common language for alignment is available, it would be interesting to see the different usages of such language that each actor does, according to his specific goals. This would help designing a support system for group decisions, which would implement the holistic system features described in the previous point.

References

1. IT Policy Compliance Group (2008) 2008 Annual Report: IT Governance, Risk and Compliance Improving Business Results and Mitigating Financial Risk. Retrieved May20, 2008 from http://www.itpolicycompliance.com/research_reports/it_governance/
2. Purdy, R. M. (2006) Compliance Initiatives Can Yield IT Opportunities. U.S. Banker. Retrieved from http://www.americanbanker.com/article.html?id=20060601WEM27QCJ&queryid=189565628&hitnum=1
3. Volonino, L., Gessner, G.H., Kermis, G.F. (2004) Holistic Compliance with Sarbanes-Oxley. Communications of the Association for Information Systems. 14(11): 219–233.
4. Rasmussen, M (2005) Seven habit of highly effective compliance programs. Retrieved from http://www.forrester.com/Research/PDF/0,5110,37240,00.pdf.
5. Gasser, U., Hausermann, D. M. (2007) E-compliance: Towards A Roadmap For Effective Risk Management. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=971848.
6. Kark, K., Othersen, M. & McClean, C. (2007) Defining IT GRC. Retrieved from http://www.forrester.com/Research/PDF/0,5110,43341,00.pdf.
7. McClean, C., Rasmussen, M. (2007). Topic Overview: Governance, Risk, And Compliance. Retrieved from http://www.forrester.com/Research/PDF/0,5110,39611,00.pdf.
8. Her Majesty Treasury (2004). The Orange Book. Management of Risk – Principles and Concepts. Retrieved from http://www.hm-treasury.gov.uk/media/3/5/FE66035B-BCDC-D4B3-11057A7707D2521F.pdf.
9. Giblin, C., Liu, A. Y., Müller, S., Pfitzmann, B., & Zhou, X. (2005) Regulations Expressed As Logical Models (REALM). *18th Annual Conference on Legal Knowledge and Information Systems (JURIX 2005)*, IOS Press, Amsterdam.
10. Sheth, A. (2005) Enterprise Applications of Semantic Web: The Sweet Spot of Risk and Compliance. *IFIP International Conference on Industrial Applications of Semantic Web (IASW2005)*, Jyvaskyla, Finland.
11. El Kharbili, M., Stein, S., Markovic, I., Pulvermueller, E. (2008) Towards a Framework for Semantic Business Process Compliance Management. GRCIS'08 Workshop at 20th *International Conference, CAISE 2008*, Montpellier, France.
12. Security And Exchange Commission (1993) Reporting Requirements for Brokers or Dealers under the Security Exchange Act of 1934. Retrieved from http://www.sec.gov/rules/final/34-38245.txt.
13. Federal Rules of Civil Procedure (2007) Rule 34 (a) Retrieved from http://www.law.cornell.edu/rules/frcp/Rule34.htm.
14. Henderson, J. C., Venkatraman, H. (1993) "Strategic alignment: Leveraging information technology for transforming organizations." *IBM Systems Journal* 32(1): 472–484.
15. COSO (2004) Enterprise Risk Management Integrated Framework- Executive Summary.. Retrieved from www.coso.org/documents/COSO_ERM_ExecutiveSummary.pdf.
16. Lau, G. T., Kerrigan, S., Law, K. H. & Wiederhold, G. (2004) An E-Government Information Architecture for Regulation Analysis and Compliance Assistance. *6th International Conference on Electronic Commerce (ICEC)*, Delft, The Netherlands.
17. Maher, M. M. (2005) "Tips for Managing Relationship with Regulators." ABA Bank Compliance 26(3): 24-28.
18. ISACA (2007) Control Objectives for Information and related Technology (COBIT) 4.1. Retrieved from http://www.isaca.org.
19. Rifaut, A. (2005) Goal-Driven Requirements Engineering for Supporting the ISO 15504 Assessment Process. Software Process Improvement, *12th European Conference, EuroSPI* 2005, Budapest, Hungary, Springer.
20. Governatori, G., Milosevic, Z., Sadiq, S: (2006) Compliance Checking between Business Processes and Business Contracts. *10th IEEE Conference on Enterprise Distributed Object Computing*.

21. Lezoche, M., Missikoff, M., Tininini, L. (2008) Business Process Evolution: a Rule-based Approach. *20th International Conference, CAISE 2008, Montpellier*, France.
22. Namiri, K., Stojanovic, N. (2007) A Semantic-based Approach for Compliance Management of Internal Controls in Business Processes. CAiSE Forum 2007.
23. Agrawal, R., Johnson, C., Kiernan, J., Leymann, F. (2006) Taming Compliance with Sarbanes-Oxley Internal Controls Using Database Technology. *22nd international Conference on Data Engineering*., Washington, DC, USA, IEEE Computer Society.
24. Zur Muehlen, M., Rosemann, M. (2005) Integrating Risks in Business Process Models. *Australasian Conference on Information Systems (ACIS 2005)*, Manly, Sydney, Australia.
25. Heiser, J., Perkins, E., Witty, R.J., Williams, B., Miklovic, D., De Lotto, R.J., Vining, J., Van Decker, J.E., Colville, R.J., Nicolett, M., Stevens, L., McKibben, D., Furlonger, D., Caldwell, F., Proctor, P.E., Chin, K., Logan, D., Ouellet, E., Wheatman, J., DiCenzo, C., McDonald, N., Bace, J., Knox, R.E., Noakesfix, K., Allan, A., Eld, T., Kreizman, C., Brittain, K., McNee, S (2008) "Hype Cycle for Governance, Risk and Compliance Technologies, 2008.". Retrieved from Gartner, Inc.
26. Gangemi, A., Prisco, A., Sagri, M.T., Steve, G., Tiscornia, D. (2003) Some ontological tools to support legal regulatory compliance, with a case study. *Workshop on Regulatory Ontologies and the Modeling of Complaint Regulations (WORM CoRe 2003)*, Catania, Italy, Springer LNCS Catania.
27. Hoekstra, R., Breuker, J., Di Bello, M. & Boer, A. (2007) The LKIF Core ontology of basic legal concepts. *Workshop on Legal Ontologies and Artificial Intelligence Techniques (LOAIT 2007)*.
28. Skinner, C. (2008) Forensically evolving regulations. Retrieved from http://www.thefinanser.co.uk/2008/09/forensically-ev.html.
29. Hevner, A., March, S., Park J., Ram, S. (2004) "Design Science in Information Systems Research," *MIS Quarterly*, Vol. 28 No. 1, pp. 75-105.
30. Gangemi A. (2007). Design Patterns for Legal Ontology Construction. In P. Casanovas, P. Noriega, D. Bourcier, F. Galindo (Ed.), Trends in Legal Knowledge: The Semantic Web and the Regulation of Electronic Social Systems. European Press Academic publishing.

Concern-Oriented and Ontology-Based Analysis of Information Systems

C. Bogdan[1] **and L.D. Serbanati**[2]

Abstract To manage the complexity of the development of an Information System (IS) a systematic partitioning of its models is needed. In particular, the system conceptual domain construction requires a structured approach. Our research on conceptual modelling in software engineering conducted us to propose a concern-oriented analysis approach aimed to construct the domain model of an information system as a composition of multi-facetted views. The method uses the concerns of various stakeholders of an IS for partitioning the system conceptual domain in stakeholder-oriented sub-domains. For each concern a high level description includes both the problem associated with it and the role of the stakeholder who manifests the concern. Mental representations descriptions of stakeholders' beliefs and knowledge related to each concern are identified and on their basis a domain ontology is created. We propose the creation of UML ontological models based on this ontology. Such a model is constructed from the IS ontology preserving the semantics of involved concepts. Then facets of the future IS are created by composing UML ontological models of the stakeholder's beliefs and knowledge. We applied this in the case of an IS that provides the registration of a new trading company using the services provided by the public administration institutions.

Introduction

Motivation

Any IS is constructed with the aim to bring some benefits to its stakeholders. Satisfying the stakeholders' needs is a challenging task which requires extensive costs, time, and resources, and deals with problems as inconsistencies, incorrectness, incompleteness or inaccuracy of the system requirements especially when the system is a complex one.

[1]Ovidius University, Constanta, Romania, cbogdan@univ-ovidius.ro
[2]Politehnica University, Bucharest, Romania, luca@serbanati.com

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_29, © Springer Physica-Verlag Berlin Heidelberg 2010

To manage the system complexity the developer systematically uses models to describe the system structure and behavior. As Easterbrook and Nuseibeh pointed out in [1], the challenge of the requirements engineering phase is a three dimensional one: (1) to understand stakeholders' problems expressed as beliefs and knowledge, and the language in which they communicate the domain concepts; (2) to achieve the stakeholders' agreement (by sharing the same ontology), and (3) to build systems that meet their concerns, needs, interests, or preoccupations.

Our research on conceptual modeling in the early phases of the software process conducted us to propose a concern-oriented analysis approach aimed to construct the domain model of an IS as a composition of multi-facetted views. The facets in a view are models constructed on the basis of the domain ontology.

Concerns

We define the stakeholder's concern in our approach as a problem-originated care of one or more stakeholders involved in the construction or evolution of an IS in its natural environment [2]. The care of a stakeholder may derive from his/her: (1) interest or responsibility in the construction or evolution of the IS in its environment, (2) wish to improve or modify something in the world for better matching his/her expectations, or (3) worrying about something wrong or undesired could occur.

Understanding the concerns means to be able to describe them, too. In our approach, the high-level specification of a concern that a stakeholder tries to solve is an association of the concern problem specification with the role the stakeholder plays in the system (see the example C5). For the concern problem specification we uses a pair composed from two descriptions: (1) the initial state description of the current situation, as the stakeholder perceives it, and (2) the final state description of the situation that matches expectations, interests, or desires of the stakeholder. These two elements are, respectively, considered as hypothesis and conclusion of the problem specification.

Multifaceted Information Systems

According to our approach, we consider an IS as an aggregation of views that are themselves created by composing facets. These facets can be explicitly constructed on the basis of the ontological UML models of the stakeholders' beliefs and knowledge.

We consider a belief as a state of mind about a mental representation[3] of an element perceived in the real world.

[3] In the cognitive psychology, a mental representation is defined as a psychological mechanism that allows the reflection and the knowledge of an entity, phenomenon, or of a state of affairs in its absence [3].

There is a strong relation between knowledge and beliefs: a credible belief accepted by all people who are interested in, it's a piece of knowledge. Nevertheless, we do not consider all the beliefs and knowledge of a stakeholder, but only those which compose the motivations of the origin of his/her concerns when the stakeholder plays his/her role. We called semantic rationale such a concern motivation.

In order to obtain an ontology we use the semantic rationales of the stakeholders' concerns to firstly identify their vocabularies, and then capture and describe their intended meaning.

A vocabulary is a set of intensional (conceptual) relations on a domain space [4]. The conceptual relations can be unary (they are called concepts), binary, ternary, and so on.

In [2,5] we proposed a concern-oriented approach to IS analysis in the following 11 steps: (1) identification of stakeholders; (2) identification of concerns; (3) concern classification; (4) identification of relations between concerns; (5) priority of concerns solving; (6) identification of the semantic rationales; (7) identification of the concepts used in the semantic rationales; (8) ontological analysis of the intension of the concepts; (9) choosing a foundational (top-level) ontology to be extended by the new ontology; (10) classification of the concepts conforming the foundational ontology; (11) construction of the ontology.

The approach also includes other four steps for construction of informational views on the IS under study from the previously obtained domain ontology: (12) construction of the UML ontological model of each piece of knowledge or belief; (13) construction of facets for each concern rationale; (14) analysis of the independence degree of the facets; and (15) construction of the informational view by grouping facets of some related concerns. This paper is focused on these four steps of the method.

Constructing an Ontology

In this section we briefly present the first 11 steps of our approach.

The mental representations of stakeholders' knowledge and beliefs contain information that refer instances of concepts belonging to three conceptual categories: (1) physical entities and their relations in the real world, (2) ad hoc conceptualizations resulted from the stakeholder's experience, and (3) abstract (non-physical or social) entities that were produced and are shared by various communities. All concepts we use to refer concrete and abstract entities in the domain of interest as well as relations between them belong to the ontology vocabulary. In our approach we use the vocabulary for solving the problem associated to the concern.

To identify the concepts in the vocabulary we use the semantic rationales: from each concern rationale the participating concepts are gathered in the vocabulary. This activity is repeated until the whole conceptual domain of the problems associated to the stakeholders' concerns is obtained.

At this point a foundational ontology should be chosen. In our research we used the top-level ontology DOLCE [6] and one of its modules D&S [7]. Other top-level ontologies might be used.

Subsequently the conceptualization of foundational ontology should be carried out, that is a taxonomy is created by subsuming the existing concepts in the foundational ontology taxonomy with the concepts in the vocabulary. Then, the domain ontology is created by formally describing the intension of each concept and their intensional relations.

Views and Facets

In our approach a view is a model of a IS related to a particular, logically homogeneous set of concerns that emerge from a particular perspective: social, functional, informational, or technological [2] to the IS development. Therefore, depending on the used perspective, we can obtain social, functional, informational, or technological views. A view is a model of the IS that results from a projection of the system into a large area of concerns belonging to one or more stakeholder roles interested in that particular perspective. In this paper, we consider only informational views. Such a view usually includes structural models of the system where the system entities are transformed in information structures and any transfer of substance or energy is transformed in an information flow. To represent such a model we used UML class diagrams [8].

We consider an informational view as a cluster of facets. Each facet [9] is a simplified model of the informational view and conceptually represents a concern-driven abstraction of the informational view according to a stakeholder's paradigm. Technically, the facet structure is represented as a UML class diagram containing concepts as classes and the semantic relations as they appear in the concern domain ontology. In the facet structure are removed the concepts that belong to the top-level ontology (see the Fig. 3).

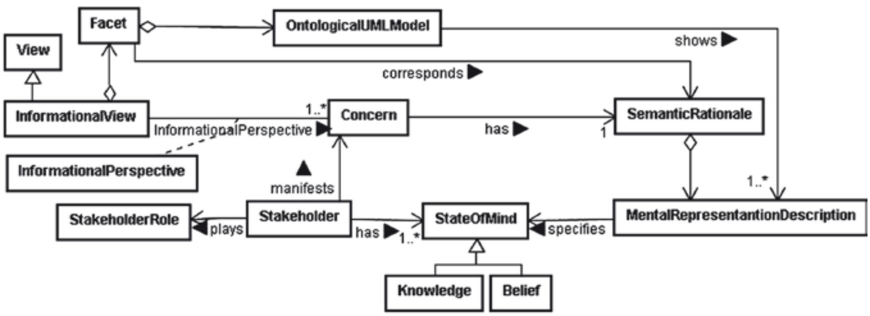


Fig. 1 Concepts involved in the construction of informational views

Projection mechanisms as views and perspectives are not new. For instance, Nuseibeh et al. [10] propose the framework ViewPoints in which each ViewPoint encapsulates partial representation knowledge, development process knowledge and specification knowledge, about a system and its domain.

UML Ontological Models

An UML ontological model is a UML class diagram that semi-formally defines the semantic of a piece of knowledge or belief of a concern's rationale. Such model is constructed from the IS domain ontology. It uses UML concepts like class, association, and so on [8]. We find that the correspondence between these concepts and the categories and conceptual relations of the domain ontology (constructed using the DOLCE+D&S ontology) can be expressed in the following rules:

1. All categories of the domain ontology, excepting the abstracts and formal roles, are mapped to classes; for instance, in Figs. 2 and 3, all the categories in the domain ontology are represented by classes.
2. The material roles are eventually mapped to association classes and the formal ones are eventually mapped to association roles.
3. The categories subsumed by abstract category are eventually mapped to the data type UML concept [8].
4. All ontological relations, excepting parthood, constitution, and subsumption are mapped to associations [8] in UML ontological models.
5. Temporal and temporary parthood, as well as constitution relations are mapped into UML aggregation relations. When the aggregate class has the responsibility to manage its parts, the aggregation relation becomes a composition one [8].
6. The subsumption relation is mapped into the UML generalization/specialization relation.

In order to construct the UML ontological model of the mental representation description for a piece of knowledge or belief, our approach proposes the application of the following set of rules:

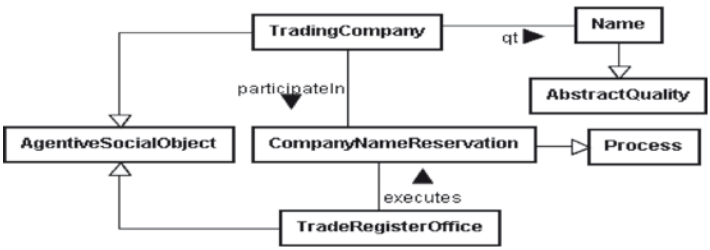


Fig. 2 The UML ontological model for the knowledge K5

1. If a concept from the mental representation corresponds to a category belonging to the domain ontology, we map this category and the categories from the foundational ontology that subsume it into UML classes or data types.
2. If a concept corresponds to a quality belonging to the foundational or domain ontology, the model will contain the corresponding class and, in addition, the class or classes that are mapped by the category or categories in which the quality inheres in. We inferred this rule from the fact that, according to DOLCE, each quality is specifically, and constantly dependent on the entity it inheres in [6].
3. In the case of a relation between two concepts, we check if it is an ontological relation. If so, we transform the relation into a UML one, according to the rules 4–6 above enumerated.
4. If the relation between two concepts, excepting the causality one, is not an ontological relation, the domain ontology is traversed following the subsumption relation of the corresponding categories in order to search the ontological relation which has the same meaning with the initial relation. The matching of the two relations is based on the reasoning supplied by the ontology.
5. The causal relation between two concepts is described in the model by the dependence relation.

The above set of rules describes an abstraction mechanism we can use for information extraction from ontology and creation of UML ontological models.

We conclude this section with the class diagram of the concepts and their relations necessary for construction of the informational views (Fig. 1).

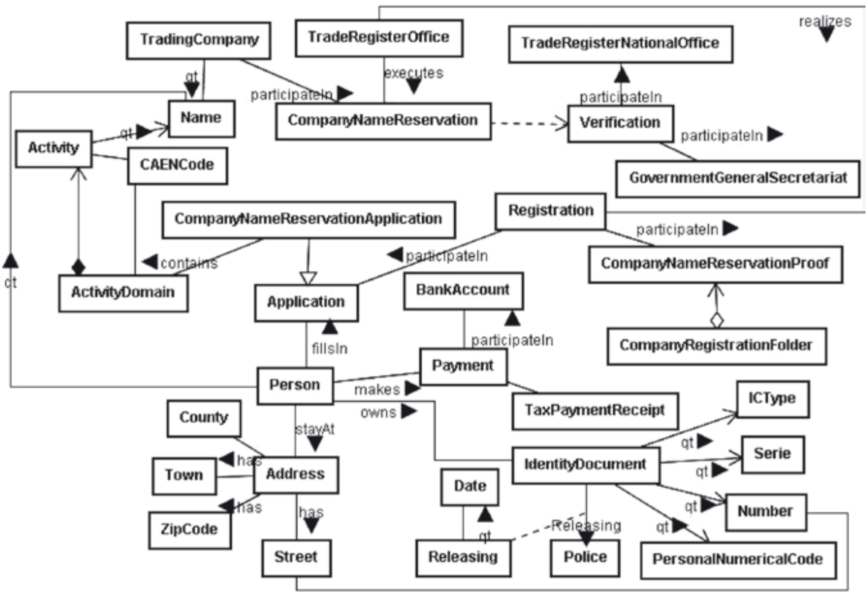


Fig. 3 The facet associated to the concern C5

Case Study

Our approach is applied to the information system of the Romanian Public Administration (short, RPA). The RPA includes public institutions like the Trade Register Office (short, TRO), the Public Finance Administration, the Labor Safety and Social Insurances Agency, the Official Gazette Agency, etc.

The RPA also provides services to companies belonging to the business environment or to private entrepreneurs who want to establish their own company. For this the founder has to register his/her company at the TRO in the city where the company headquarters will be located. TRO issues a registration certificate that authorizes the legal operation of the company.

Identification of Concerns

As the first step, we identified the stakeholders who have a legitimate interest in the IS under study. They are applicants such as founders, administrators, legal representatives, and clerks, jurists, judges, or service providers like public institutions and banks.

In the second step, we identified the concerns of the stakeholders, more precisely 31 concerns. The description of a founder's concern is presented below.

C5	Name: Care to state the new trading company's name	
	Problem	Hypothesis: The founder has to choose at least three Romanian names. These names will be verified by the TRO.
		Conclusion: What name will the new trading company have?
	Stakeholders: Founder	

The next two steps consist in the analysis of the concerns with the aim to identify pieces of knowledge and beliefs. For instance, in the table below two samples of knowledge of the concern C5 are presented.

Code	Mental representation description in natural language
K5	The names of all trading companies are reserved by the TRO.
K55	The name of a trading company cannot contain the words: "scientific", "academy", "university", "collegiate", "school", "school-boy", or their derivatives.

From the founded concerns analysis we derived 264 beliefs and knowledge.

Facet Construction

As it is stated in the section "UML Ontological Models", an UML ontological model of the semantic rationale of a concern is an UML class diagram that describes the semantics of a knowledge or belief that belongs to this rationale. We construct such a model by applying the rules 1–6 given in the section "UML Ontological Models" on the domain ontology. For example, the UML ontological model for the knowledge K5 is presented in Fig. 2.

After the construction of the UML ontological models of all pieces of knowledge and beliefs of the semantic rationale associated to a concern, we can create the concern facet. For this, we apply the abstraction mechanism on the UML ontological models and select the classes that belong to the future domain model and the ontological relations between them. Next a new filtering of the classes is needed: some classes that are mapped by the top-level ontological categories should be removed from the UML ontological models. The removal is done only if it does not eliminate relations belonging to the facet semantics. Figure 3 presents the facet that we obtained applying our approach to the concern C5.

Conclusions

An approach based on a concern-oriented analysis aimed to construct an IS as a composition of multi-facetted views was presented. A case study regarding the construction of the domain model of an IS for new trading company registration was included. We also intend to apply our approach in an IS for longitudinal health care records management.

References

1. Nuseibeh, B., Easterbrook, S. (2000) Requirements Engineering: A Roadmap. In: A. Finkelstein, editor: *The Future of Software Engineering*, A. ACM Press, New York, 35–46.
2. Bogdan, C., Serbanati, L. D. (2006) Toward a Concern-Oriented Analysis Method for Enterprise Information Systems. In *Proceedings of the IEEE International Multi-Conference on Computing in the Global Information Technology*, IEEE Computer Society.
3. Zlate, M. (2004) *Psihologia Mecanismelor Cognitive*, Polirom.
4. Guarino, N. (1998) Formal Ontology and Information System. In *Proceedings of FOIS'98*, Trento, Italy, IOS Press.
5. Bogdan, C., Luzi, D., Ricci, F.L., Serbanati, L.D. (2007) Towards an Ontology using a Concern-Oriented Approach for Information Systems Analysis, *Enterprise Interoperability II, New Challenges and Approaches*, Springer-Verlag.
6. Masolo, C., Borgo, S., Gangemi, A., Guarino, N., Oltramari, A. (2003) WonderWeb Deliverable D18. Ontology Library. IST Project 2001-33052 WonderWeb: Ontology Infrastructure for the Semantic Web.

7. Gangemi, A., Mika, P. (2003) Understanding the Semantic Web through Descriptions and Situations. In *Proceedings of the International Conference ODBASE03*, Italy, Springer.
8. OMG (2003) Unified Modelling Language Superstructure, version 2.0, ptc/03-0802.
9. Serbanati, L. D. (1992) *Integrating Tools for Software Development*, Yourdon Press Computing Series, Prentice Hall.
10. Nuseibeh, B., Kramer, J., Finkelstein, A. (1994) A Framework for Expressing the Relationships Between Multiple Views in Requirements Specification, *IEEE Transactions on Software Engineering*, vol. 20, nr. 10, 760–773

Crisis! What Crisis?

P.M. Bednar[1,2] and C. Welch[3]

Abstract There is a crisis discussed in the discipline of Information Systems. Those who perceive such a crisis to exist are by no means agreed, as to its nature and origins. Our inquiry shows that there are a three distinct "crises" being debated. The first of these relates to the substance and boundaries of the discipline itself and if it is even a discipline at all. Another "crisis" relates to higher education and a fall in demand for IS courses from new students. Commentators perceive this to threaten the existence of IS departments in Universities, and to have potentially serious consequences for both research strategies and career paths of academics. Thirdly, there is perception of a crisis in the wider world, characterised by fewer vacancies in IS-relevant occupations whilst, at the same time, employers complain of a shortage of suitably skilled applicants for the vacancies available. This paper examines evidence for the three "crises," real or imagined, suggested above, in the Information Systems field.

Introduction

There is supposedly a crisis in the IS (Information Systems) field [1]. Areas of focus for this "crisis" can be used to differentiate between three distinct types (Table 1): (1) lack of agreement as to the nature and boundaries of the IS discipline; (2) fewer students wishing to read IS-related subjects at Universities; (3) too few job opportunities for IS professionals. But what does this mean, from what point of view and for whom? In response to queries relating to whether or not "IS" is a discipline, we can point to a number of eminent, core thinkers whom we would firmly place within a recognisable IS field – Borje Langefors [2]; Enid Mumford [3]; Peter Checkland [4]; Hans-Erik Nissen [5]; Claudio Ciborra [6]; Heinz Klein [7], to name a few. Another response to the IS identity debate may be seen in the development of the Informing Science trans-discipline [8]. Is this simply a reaction to perceived ambiguity of the term "IS" or is it something different in nature?

[1]Lund University, Lund, Sweden, peter.bednar@ics.lu.se
[2]University of Portsmouth, Portsmouth, UK, peter.bednar@port.ac.uk
[3]Portsmouth Business School, Portsmouth, UK, christine.welch@port.ac.uk

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_41, © Springer Physica-Verlag Berlin Heidelberg 2010

Table 1 Crises and their focus

Crisis	Focus
Discipline	Evolution, development and research in IS and its identity as a subject
Education	Falling demand for the traditional offerings of Computing / IT in HE education
Employment	(a) Lack of available appropriately skilled staff (b) Lack of employment opportunities for IT professionals

A panel session at ECIS 2008 discussed evidence of differences in approach discernable in journal and conference papers authored in different countries [1]. An analysis of papers submitted to the conference over the past 10 years is revealing when considering the extent of citations of social theorists (Table 2).

Table 2 Extent of citations of social theorists in ECIS for the past ten years

Country of origin of principal author	% citing social theorists
Sweden	46
United Kingdom	33
Denmark	31
France	28
Australia	27
Netherlands	26
Germany	19
USA	17

What are the professional boundaries of the IS discipline? In Europe, it is probable that employment opportunities in IT are decreasing with the growing tendency for work to be outsourced to Asian labour markets [9–11]. However, there are signs of expansion in IS occupations and specific business sectors such as banking, healthcare or government [10]. In the example of Skandia routine IT maintenance and development tasks were recently off-shored so that investment could be made in a tenfold expansion of employment of business analysts to develop IS capability [12]. This shows that it is important to consider where boundaries are drawn in deciding whether "IS" is in crisis. The Matthew Jones index of social citation density (the sum of the number of distinct social theorists cited by each paper, divided by the number of papers published) reveals a score of 0.53 for the first 10 years of ECIS, in contrast to the IFIP WG 8.2 which had an index of 2.1 and the US-based journals *MIS Quarterly* and *Journal of Management Information Systems* both of which had 0.05 [1]. These numbers (Table 3) suggest to us that different authors who are addressing a supposedly common themes of IS have nevertheless interpreted the boundaries of these in very different ways.

When looking at definitions offered to students in textbooks we find examples describing "IS" as something that "consists of all the components that work together to process data and produce information." Furthermore this explanation is "clarified" with: "a computer-based set of hardware, software and telecommunications components, supported by people and procedures, to process data and turn it into useful information."[13]. While such a "clarification" is confusing it is not

Table 3 Mathew Jones index of social citation density

Forum for IS research	Social citation density (over a 10 year period)
IFIP WG 8.2	2.1
ECIS	0.53
MIS Quarterly	0.05
Journal of MIS	0.05

unusual. Nor is this type of confusion limited to the realm of student texts but includes leading subject tracks at top academic conferences such as the ICIS 2008 conference. In the whole preamble to the suggested topics relating to development of IS [14], we find no evidence of recognition of socio-cultural or phenomenological dimensions of IS development. Where, for example, is the link to examine the "human existence in everyday working life" highlighted by, e.g. Langefors [15], Ciborra [16], Mumford [17] or Nissen [18]? This human dimension is missing completely from the description. When researchers do take the socio-cultural and phenomenological dimension into account, IS research becomes a critically-informed inquiry [19, 20]. Critically-informed research goes beyond that which is merely interpretive. Klein and Myers highlight three "stages" that can be useful in identifying research work with a critical dimension [20]. The first is an interpretive stage, concerned with gaining insight into social phenomena. A second stage goes beyond interpretations to embrace critique, through examination of social practices lying behind them. A third stage, unique to work in critical social theory, has its focus on achieving understandings with potential to enable beneficial change in social arrangements. In IS research, such as that by Checkland [4, 21] or Mumford [17, 22] we find evidence of engagement with phenomenological perspectives. Checkland [21], for example, in his later work, has taken steps to distance himself from naïve interpretations of his *Soft Systems Methodology* which attempt to view it as a "recipe" for carrying out inquiry. He makes a point of distinguishing two systems constructs within his work: that of a serving system and a system to be served [21]. Mumford's *ETHICS* methodology was described as "Effective Technical and Human Implementation of Computerised Systems" [22]. However, she gave explicit recognition to the importance of the domain of human experience. "ETHICS is intended to provide users with the means to contribute in a practical way to the design of new work systems, especially those which incorporate new technical applications" [17, p. 273].

Crises: Subjects or Objects?

Is there a crisis in IS or is it simply miasma? What does the word "crisis" in this context imply? Commonly the word is used as a vehicle to increase the dramatic atmosphere surrounding news stories. Originating in the Greek krinein – to decide – its modern English usage denotes "a time when a difficult or important decision must be made" [23]. In the current rhetoric surrounding IS and IT, it is possible to trace this meaning, coupled with both a sense of urgency and a confusion about the way forward. The first of our three observed "crises" comes from understanding of IS as a subject. Is it a distinctive discipline or is it an aspect of Computing or IT, etc.? Questioning the existence of an IS discipline mainly because the focus and definitions of the area are disputed reveals a naivety, apparently based in a belief that there is such a thing as an undisputed core in any discipline. For example in the natural sciences, disciplines as we know them today have gone through evolutionary and revolutionary processes drawing upon different schools of meta-science [7, 24, 25]. This can also be recognized when reflecting over issues such as chemistry related to alchemy; relevance of Newtonian and Einsteinian physics to "real world" engineering problems, e.g. ageing of Rolls Royce jet engines; sci-fi inspired technology in Formula 1 Ferrari micro-surface. It is clear that scientific disciplines have boundaries which are still "fuzzy." The second "crisis" comes from the Higher Education arena [26, 27]. It is perceived that fewer applicants are coming forward to study the courses traditionally offered by HE institutions under titles such as Computer Science, Computing, IS and IT. A perceived corollary of this decline in numbers is a decline in prestige for the related disciplines in terms of funding, support for research and opportunities for employment among academics. In an effort to attain a new equilibrium and halt the perceived decline, academic and professional organizations have convened working parties and conferences, and commissioned reports from professional market researchers [28, 29]. The aim has been to investigate the elusive causes of the perceived decline and draw up fresh strategies to turn around negative trends. The third "crisis" is highlighted by organizations in industry and commerce who are the employers of IT and computing professionals. Surveys have suggested that a "skills gap" exists in which vacancies are left unfilled or filled by staff whose capabilities are inadequate to the work demanded of them. This shortage is pointed to as a factor inhibiting growth in productive capacity, efficiency and potential to innovate in many sectors of industry. A variety of reasons for this shortage have been put forward, e.g. failure of schools to interest children in ICTs and computing; failure of the HE sector to produce sufficient graduates or graduates with the right skills [27, 28, 30, 31]; inadequacy of staff development opportunities so that current employees do not update their skills in a cost effective and timely way. A typical comment on the situation is: "Those complaining of skills shortages … increasingly want maths, physics and computer science graduates who can hold extreme complexity in their heads … or those who can mix business and technical skills to deliver systems that meet user needs" [32]. Concern continues to focus upon initial qualification, with the result, that "The shortage of those capable of supporting computational intensive industries threatens the continuance of the UK as a major location for leading edge research, let alone product development and support, in pharmaceuticals, aerospace and multi-media content production and publishing."[33]. A different face of this "third" crisis is coming from the perspective of those seeking employment in IT-related fields. The number of vacancies for IT and computing-related occupations appears to have fallen in recent years, so that, for instance, a large proportion of graduates of courses in this area had failed to find relevant employment 1 year after graduation [34]. Over this period, the median salary in the field had risen with 4.2% [9]. This apparent contradiction derives from a shift in patterns of employment – there are fewer vacancies for intermediate level staff, whereas vacancies for highly skilled professionals remain unfilled, bidding up the associated salaries. It is reported that: “Employers “believe the answer to the skills and knowledge shortage is to focus on the development of elites rather than on widening graduate participation”. In other words, IT skills are still very much in demand – so long as they are in reality “IT-plus”. Employers now want IT generalists: individuals with a good grounding in different aspects of IT – and with the ability to think outside the box as well. Whether this is quite what the UK educational system is now producing is a question for another day” [30]. Undoubtedly, off-shoring is a factor in the reduction in employment opportunities in Europe: “The growth in offshore outsourcing is naturally of concern to IT professionals in the UK, especially now that the IT job market is at a low point. Ovum Holway has forecast that between 20,000 and 25,000 jobs may be lost in the UK IT industry over the next few years as a direct result of work moving offshore.”[29]. It seems obvious that, if current University courses equip graduates only with mediocre skills, or with skills that can be provided more cost-effectively elsewhere, then those graduates will not be in demand. Companies are looking for a premium, for understanding of business imperatives, for problem-solving abilities, etc. A further comment states that: “The IT recruitment market is in a very fragile position. It is essential that the UK retains a strong and highly qualified IT base. Fundamental to the technical skills is the requirement for sound business and communication skills. IT people in the UK that can achieve this and remain up to date with the latest technology will always be in demand and hopefully help to reverse some of the outsourcing due to take place over the next few years”[11]. However, how far do these concerns translate into a crisis within the IS discipline?

Crisis in the Information Systems Field

Already in 1998, Claudio Ciborra highlighted a “crisis in the academic field of Information Systems” [16] that he regarded as not new but having occurred “a while ago” (p. 6). In his view, the academic field was in the throes of both crisis and success simultaneously. The source of this paradox lay in an expansion of IT applications in industry and commerce, resulting in increased demand for academic resources, which he perceived to be at odds with the “contents, directions, trends and main characteristics of the IT/IS discipline itself.” As an example, Ciborra cites a mismatch between the academic focus of research into “strategic applications,” focusing on development of AI to support complex, strategic decision-making, and the way in which industry was generating strategic advantage by tinkering with applications already existing at operational levels. Drawing upon Husserl’s 1934 lectures on the “Crisis of European Sciences and Transcendental Phenomenology” [35], Ciborra highlights crises as a phenomenon of separation – of “scientific objectivity" on the one hand, and life as it is lived on the other. He reminds us of Husserl's view that, in effect, it is possible to become enrapt with scientism so that we forget that the origins of science are subjective in nature. The ascendancy of methodologies in IS research and practice over many decades is a case in point: "Systems design methods may be the most diffused methodology on Earth accompanying the introduction of a new technology, but they work only in part. There are various signs in this respect … major failures of systems, in which the methodology has not been able to rescue the project; long delays and sky rocketing costs of many applications, despite the use of methodologies …"[16, p.7]. He points out that those who focus on empirical measurement in examining issues tend to overlook situatedness in IS-related problems. "One key element gets to be neglected: human existence, which represents the essential ingredient of what information is, of how the life world gets encountered, defined and described" [16, p. 9]. We believe that one source of the separation highlighted by Ciborra lies in the interpretation of the nature and scope of IS, both as phenomena and as a discipline. A definition of IS preferred by the authors of this paper is "… systems where information technique is used for information treatment, which aims to transfer 'messages' in time and space" [36]. Our preference for this approach lies in a need to emphasize that information is created by living human beings, who interpret data in ways influenced by context and life experience. Thus, information cannot be delivered from one person to another. However, messages can be exchanged that contain data, and possibly incorporate metadata, for interpretation by a recipient who thus creates "information." Elements within organizations are related and co-ordinated through interconnected units of "information" [15, p. 53]. We support two possible interpretations of the term "Information Systems," "IS1" and "IS2" [36, 37]. "IS1" refers to individual people, and their use of hardware and software. When we include their range of inter-individual communicative activities, an expanded definition emerges labelled "IS2." An organization is comprised of individual people, in interacting, social, communicative networks. This means that actors adhering to "IS1" could find their efforts failing due to lack of synergy. The close connection between organizational and informational/communicative issues inherent in "IS2" requires that perspectives grounded in "IS2" are given consideration prior to any initiatives grounded in "IS1" within the same organizational context. When viewed in the context of "IS2," systems analysis and design activity must be seen as a special case of purposeful change, involving individual and collective organizational learning as a processes over time. Support for contextually-relevant individual and collective learning is needed in order to avoid the artificial separation of theory, e.g. standard methodologies, from practice – organizational life as it is lived [16, 18]. A large proportion of IS development projects initiated in business organizations are perceived by those who manage them to be failing to deliver expected value [38]. We suggest the source of this "failure" to lie in a focus on problem definition within an "IS1" paradigm, while "IS2" is overlooked or neglected. This forgotten "situatedness" is of great importance throughout the history of IS research. Neglect of "situatedness" can be a reason why "IS" is not always recognized as a discipline, and this would explain the crisis perceived by many commentators.

References

1. Galliers, R., Baskerville, R., Lyytinen, K., Urquart, C. and Fitzgerald, B. (2008). *Cricket or Baseball?* Panel session. *European Conference on Information Systems* 2008. from: http://www.ecis2008.ie/ 30 June 2008.
2. Langefors, B. (1966). *Theoretical Analysis of Information Systems*. Studentlitteratur, Lund
3. Mumford E. (1983). *Designing Human Systems for New Technology: the ETHICS Method*. Manchester Business School, London
4. Checkland P. and Scholes J. (1990). *Soft Systems Methodology in Action*. Chichester, Wiley.
5. Nissen H-E. (1984). 'Acquiring knowledge of Information Systems – Research in a Methodological Quagmire,' in E. Mumford et al, editors (1984), *Research Methods in Information Systems. Proceedings of IFIP WG 8.2 Colloquium, Manchester*, 39–52. North Holland
6. Ciborra, C. (2002). *The Labyrinths of Information*. Oxford, Oxford University Press
7. Klein, H. (2004). 'Seeking the new and the critical in critical realism: déjà vu?' *Information and Organization*, 14, 123–144
8. Cohen, E. (1999). Reconceptualizing information systems as a field of the transdiscipline of informing science. *Journal of Computing and Information Technology*, 7(3), 213–219
9. AGR (2008). Graduate Recruitment Survey 2008 - Summer Review. From: http://www.agr.org.uk/publicationlibrary/view_survey_summary/id.109.html 10 September
10. IT Jobs Watch UK (2008). Report. From: http://www.itjobswatch.co.uk/ 10 September.
11. Molyneaux G. (2008). Commentary; Salary Services Ltd. Salary Survey Commentary for July. From: http://www.jobadswatch.co.uk/commentary
12. Grant, I. (2007). 'India deal clears Skandia's app maintenance backlog,' *Computer Weekly*, 6 November 2007, p.4.
13. Oz, E and Jones, A. (2006). *Management Information Systems*. Cengage Learning.
14. Avison, D. and Siau, K. (2008). *Alternative Systems Development*, Preamble to track call for papers *International Conference on Information Systems* 2008, from: http://www.icis2008.org.htm 30 June 2008.
15. Langefors, B and Dahlbom, B (editor) (1995), *Essays on Infology*, Studentlitteratur, Lund.
16. Ciborra, C.U. (1998). 'Crisis and Foundations: an inquiry into the nature and limits of models and methods in the information systems discipline', *Journal of Strategic Information Systems*, 7, 5–16
17. Mumford, E. (2003). *Redesigning Human Systems*. Hershey, IRM Press.
18. Nissen, H-E. (2007). Using Double Helix Relationships to Understand and Change Informing Systems, *Monograph of Informing Science: the International Journal of an Emerging Transdiscipline*, 10, 21–62
19. Klein, H.K. (2007). *4th Leverhulme Lecture*, January 12 2007, Salford Business School, UK.
20. Klein H.K. and Myers M. (2008). *A set of principles for conducting and evaluating critical field studies in information systems*. Working Paper.
21. Checkland, P. and Holwell, S. (1998). Information, Systems and Information System. Wiley, New York.
22. Mumford, E. and Weir, M. (1979). *Computer systems in work design – the ETHICS method*. New York, Wiley
23. Soanes, C. and Stevenson, A., editors (2005). *The Oxford Dictionary of English*, 2nd edition. Oxford, Oxford University Press.
24. Kuhn, T.S. (1996). *The Structure of Scientific Revolutions*, University of Chicago Press, Chicago
25. Radnitzky, G. (1973). *Contemporary Schools of Metascience*, 3rd edition. Henry Regnery, Chicago
26. Van der Vyver, G.L. and Lane, M.S. (2006). 'Are Universities to Blame for the IT Careers Crisis?', *Issues in Informing Science and Information Technology*, 3, 679–686.

27. MacKinnon L. & Bacon L. (2008). Oil and Vinegar – why we must spice up ICT education. *ComputerWeekly.com*; July 8, http://www.computerweekly.com/blogs/when-it-meets-politics/2008/07/
28. Lovegrove, G. and Round, A. (2006). 'A report on HEFCE-funded initiative *"Increasing the supply of students in higher education in IT and Computing"*, British Computer Society.
29. Research Insight Ltd (2008). *'A study on the IT labour market in the UK'* commissioned by The Council of Professors and Heads of Computing, viewed at http://www.cphc.ac.uk/docs/reports/cphc-itlabourmarket.pdf 16 September 2008
30. Ozimek, J. (2008). 'IT career virgins need a cherry on top: Oversubscribed employers demand overqualified workers'. 31st July *The Register*, From: http://www.theregister.co.uk/2008/07/31/it_jobs_good_or_bad/
31. e-skills (2008). *Technology Counts: IT and Telecoms Insights 2008*. From: http://www.e-skills.com/Research-and-policy/Insights-2008/2179 10 September 2008.
32. Virgo, P. (2008a). 'A crisis of quality not quantity', *ComputerWeekly*. July 22. From: http://www.computerweekly.com/blogs/when-it-meets-politics/2008/07/
33. Virgo, P. (2008b). 'Deskilling Britain - the accelerating UK ICT crisis'. *ComputerWeekly.com*. June 10, From: http://www.computerweekly.com/blogs/when-it-meets-politics/2008/06/
34. HESA (2008). SFR 124: Destinations of leavers from higher education in the United Kingdom 2006/07; from: http://www.hesa.ac.uk/index.php/content/view/1237/161/ 3 July 2008.
35. Biemel, W. editor (1954). The crisis of European science, and transcendental phenomenology]. Husserliana, Vol. VI (in German). The Hague: Martinus Nijhoff.
36. Bednar, P.M. (1999). *'Informatics – a working chaos for individuals and organizations'* (in Swedish). Dept. of Information & Computer Sciences, Lund University, Sweden
37. Bednar, P.M. and Welch, C. (2005). 'IS, Process and Organisational Change', Proceedings of *13th European Conference on Information Systems*, University of Regensburg, Germany, May 2005.
38. Williams, P. (2007). 'Make sure you get a positive return,' *Computer Weekly*, 13 Nov 2007.

Designing Flexible User Interfaces

L. Parasiliti Provenza[1] and A. Piccinno[2]

Abstract In the design of computer systems, human diversity and their specific needs have been neglected in the past, possibly because engineers were developing products for end users who were very much like themselves. The large impact that computer systems have nowadays on the increasing number of different users brings to consider traditional Human-Computer Interaction topics, such as user-centered design, usability engineering, accessibility, information visualization, very important also for Information Systems, since they influence technology usage in business, managerial, organizational and cultural contexts. People would like computer systems that can be tailored to their individual needs and working practices. To this aim, systems must be developed whose user interfaces is flexible, i.e., it permits end users to modify or add new functionalities, still being simple and easy to use, not requiring any programming knowledge. In this paper, we discuss an approach that gives end users the possibility to tailor presentation as well as functionalities of the system they use, thus supporting users to participate in the design of their tools.

Introduction

One of the reasons why many high-tech products, including computer-based systems as well as electronic equipment and every day appliances, are so difficult to use is that, during the development of a product, the emphasis and focus have been on the system, not on the people who will be the ultimate end users. Maybe developers counted on the fact that humans can more easily adapt to the machine than vice versa. Human diversity and their specific needs have been neglected in the past also because engineers were developing products for end users who were very much like themselves. With the large spreading of computers everywhere, the target audience has changed dramatically and keeps changing every day. What has

[1] Università di Milano, Milano, Italy, parasiliti@dico.unimi.it
[2] Università di Bari, Bari, Italy, piccinno@di.uniba.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_62,

been done in the past does not work for today's users and technology [7]. One of the main requirements of the information technology society is to design for "universal access," i.e., computer systems must be accessible by any kind of users. Moreover, computer systems should allow end users to focus on the task at hand and not on the means for doing that task.

One of the main objectives of the Information Society in the last years is the elimination of the so called *digital divide*. Recent studies show that, in the use of computer systems, there is still a difference depending on the cultural level of people that use such systems. HCI topics, such as user-centered design, usability engineering, accessibility, information visualization are very important in information systems, since they influence technology usage in business, managerial, organizational and cultural contexts. Markets, companies, people are not static and evolve in time, thus forcing to update computer systems to new requirements and information needs. Methods and techniques must be developed to help designers creating products that are adequate to end users cultural level, skills and needs, but are designed to be easily evolved, permitting end users to have a more active role than being only consumers of software products, i.e., end users should be able to modify or add new functions, without requiring any programming knowledge.

This paper illustrates a methodology for designing computer systems that gives end users the possibility to tailor presentation as well as functionalities of the system they use [2], [3], i.e., to perform activities of End-User Development [6], [10]. The methodology is described through its application to the Web user interface of a knowledge base in a territorial domain.

A Case Study

User interfaces of current computer systems, such as web portals, are often full of functionalities, thus generating disorientation and cognitive overhead on each user, who is usually interested in a subset of functionalities. The approach presented in this paper aims at designing user interfaces, for Web applications as well as for any computer system, that are flexible, i.e., they are customized to specific types of users and also allow users to further tailoring them in order to better adapt the interface to their needs.

The case study refers to the development of an information system, accessible via web, as required by a consortium of towns in a Northern Italy region. The goal is to create and manage a knowledge base about tourism, cultural, economic, and geological aspects of this region.

In this territorial context, three different types of end users are primarily involved in creating and managing new knowledge related to the territorial domain:

- *Visitors*, whose goal is to access the documents they are interested in and to annotate and record their comments and observations about a specific resource of interest, for their personal or public use.

- *Experts*, i.e., specialists in different fields like history, geology, etc., whose main task is to generate new contents about the territorial district relative to their own expertise, guaranteeing their consistency and correctness.
- *Publishers*, whose task is to control how the knowledge base evolve by validating and publishing new contents, generated by either experts or visitors; if the new contents are relevant and socially acceptable, the publisher can make them available to the whole community.

Although the three types of end users access the same knowledge base, each of them has different interests, responsibilities, skills, and needs to perform different activities on the information. There is thus the need to develop a computer system that provides visitors, experts and publishers with flexible interfaces through which they can easily access and manipulate the common knowledge base according to their different goals and needs.

Additionally, among visitors, experts and publishers, different communities of end users can be identified each of them characterized by a specific culture, language and system of signs [4]. Specifically, the community of visitors is highly heterogeneous. People from any place in the world – characterized by different cultures and languages – may wish to visit the system and access the knowledge base to gain the information they need or to enrich it with new contents or useful observations.

However, cultures as diverse as, for instance, the Italian and Japanese ones, use different textual signs as well as icon and diagrammatic signs to express the same concepts and feelings [8]. Hence, the shared knowledge, and the whole system as well, should be presented to each community according to its specific culture, background and system of signs, thus facilitating their understanding of the knowledge and the tasks to be performed.

Applying the SSW Methodology

The SSW design methodology described in [1], [2] has been applied to our case study. The key point of this methodology is to let end users work with a software environment designed as a virtual workshop, in which they find a set of tools whose shape, behavior and management are familiar to them. The methodology thus prescribes to design and develop computer systems as a net of virtual workshops, each one customized to the needs and culture of a type of users; some workshops are developed to support end users in performing the tasks of their working practice, some others are developed to support the participatory design [9], development and maintenance of the whole computer system. Indeed, the design team is composed at least by software engineers, HCI experts and end user representatives, who collaborate bringing their own knowledge and expertise to create and, later, evolve the overall system. Each workshop devoted to end users is the result of this participatory and cooperative design.

Each environment is called "workshop," since it exploits the metaphor of the artisan workshop, where an artisan finds all and only those tools necessary to carry out her/his activities and properly shape various materials (wood, iron, etc.) into usable products, with tools shaped in accordance with the artisan's needs. For example, the blacksmith's hammer is shaped for heavy work, and has different features and weight than the shoemaker's hammer, which is shaped for different tasks. By analogy, people in their software shaping workshop find all and only those tools necessary to carry out their activities and achieve their goals. The software tools, in turn, are shaped and manageable by the designated users in a natural way (natural for them, not for a computer scientist!).

In other words, each workshop is customized to the culture and skills of the people to whom it is addressed. Moreover, the network is organized so that it reflects the working organization of the application domain and of the member of the team.

Workshops that support end users in performing their daily working activities are called application workshops; while workshops used by the design team to design and develop the application workshops are referred to as system workshops.

The SSW Network

Figure 1 shows the SSW network developed for the case study. It is organized on three different levels based on the different types of activities the workshops are devoted to. The *meta-design level* includes the system workshop for software engineers W-SE, which allows to generate and maintain all the workshops in the network. In particular they create system workshops for HCI experts (W-HCI) and for representatives of end users at the lower level (W-ReprGeologist, W-ReprHistorian, W-ReprPublisher and W-ReprVisitor). The *design level* includes system work-

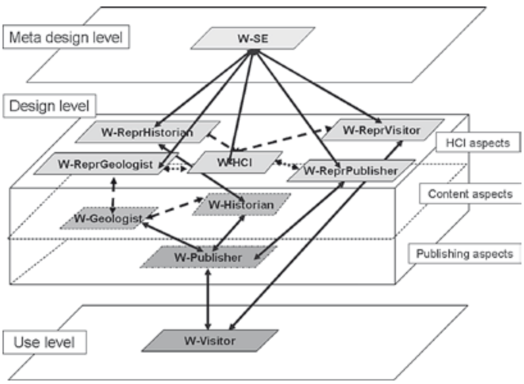


Fig. 1 The SSW network for the application described

shops for designing and adapting the application workshops in accordance with the evolving knowledge and user needs. At this level, representative visitors, experts (e.g., historian, geologist) and publishers collaborate, through their own system workshops, with HCI experts – and, if necessary, with software engineers – to produce, through simple direct manipulation activities (see [3] for some examples), workshops customized for the community they belong to (W-Visitor, W-Historian and W-Geologist for historian and geologist experts, and W-Publisher). End-user participation in the design team permits to build the correct views on the system under design based on the specific end-user interests, skills, and needs. It also permits to organize and display the common knowledge as well as the user interface according to end-user language, notation and system of signs [5].

W-Geologist and W-Historian (Fig. 1) are workshops for designing content aspects and each of them is customized to a community of specialists in the specific field, i.e., Geology and History. These workshops allow expert users to access the shared knowledge base and to enrich it by designing and evolving new certified contents.

W-Publisher, on the contrary, permits publishers to control how the knowledge base evolves by validating the consistency and quality of the new contents generated by experts and/or visitors; if the new contents are relevant and socially acceptable, the publisher can add them to the shared knowledge base and make them available to the whole community. Both expert and publisher workshops are system workshops – at different layers of the design level – since they enable not only the generation of new contents but also the design of adequate tools for accessing and using such contents.

Finally, the visitor workshop, W-Visitor, at the *use level* in the SSW network, allows visitors to access tourist documents from the shared knowledge base, to navigate among their linked resources and to record their private comments and observations, which can be submitted to the publisher to become public.

Overall, the network of software shaping workshops permits each stakeholder involved in the design, management and use of the system – visitors, experts, publishers, human-computer interaction (HCI) experts and software engineers – to participate and collaborate in the application workshops' design, implementation and use, through workshops specifically customized to them. They can perform their tasks using their own system of signs and collaborate with each other by adopting their language and jargon through communication paths (denoted in Fig. 1 through *dashed and full arrows*) [2].

SSWs for Visitors and for Publishers

The visitor workshop (presented to its users through web pages) includes only the tools for creating and navigating through private and public annotations, with tools shaped to the visitor's culture, language and system of signs. Figure 2 shows the visitor workshop, W-Visitor, shaped for an Italian visitor. It supports a visitor in

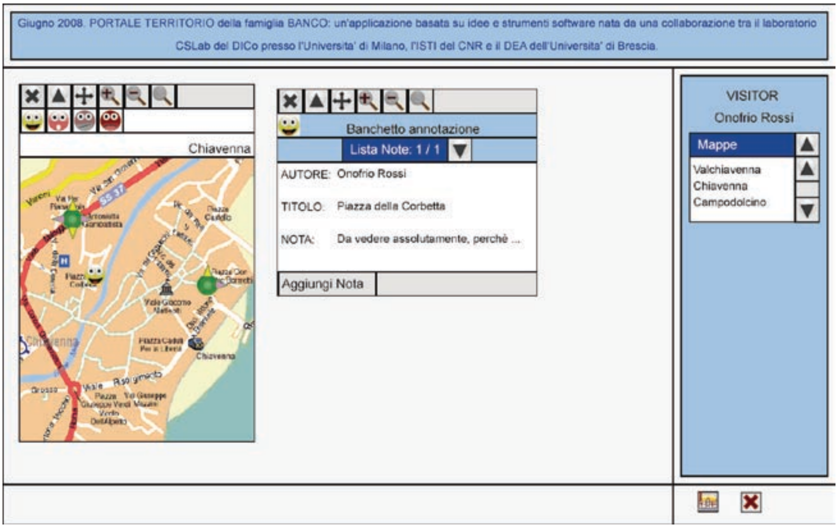


Fig. 2 A visitor uses workshop W-Visitor to add an appreciation annotation about a town square ("piazza")

accessing tourist documents, navigating through them and inserting or updating her/his personal annotations. Once the Italian visitor "*Onofrio Rossi*" clicked on the "Chiavenna" item in the menu on the right side, a bench containing a map of the considered area is displayed (Fig. 2). The top of the bench includes a bar for managing both the bench and the map, together with an annotation bar for managing personal annotations. The annotation bar contains four emoticon buttons, each one denoting a different emotion, (appreciation, surprise, disappointment or sense of danger) according to the colors and facial expressions belonging to the Italian culture and conventions. For a different culture as the Japanese one, the system will provide a Japanese customization of the visitor workshop. Through their system workshop (W-ReprVisitor), representatives of Japanese visitors will be able to collaborate with the design team to develop a customized interface of the visitor workshop. Figure 3 shows the visitor workshop illustrated in Fig. 2 customized for a Japanese visitor. The layout of the web page is the same, but the page for Japanese is not a mere textual translation, all the widgets are customized to the Japanese culture; specifically, the emoticons are visualized by using colors and graphical signs adopted by the Japanese culture to visually represent the same emotions. In this way, the interface will maintain the correct affordance and firstness of icons thus avoiding even dangerous misunderstanding.

Publisher workshops for content publishing activities will contain only the basic tools for navigating through the knowledge base and those tools for publishing new relevant contents. Figure 4 shows a screenshot of the publisher workshop, W-Publisher, while a publisher called "Mario Bianchi" is publishing a new certified content by associating it with a point of the map. Once the publisher clicked on the "Chiavenna" item in the menu at the top right, a bench containing the

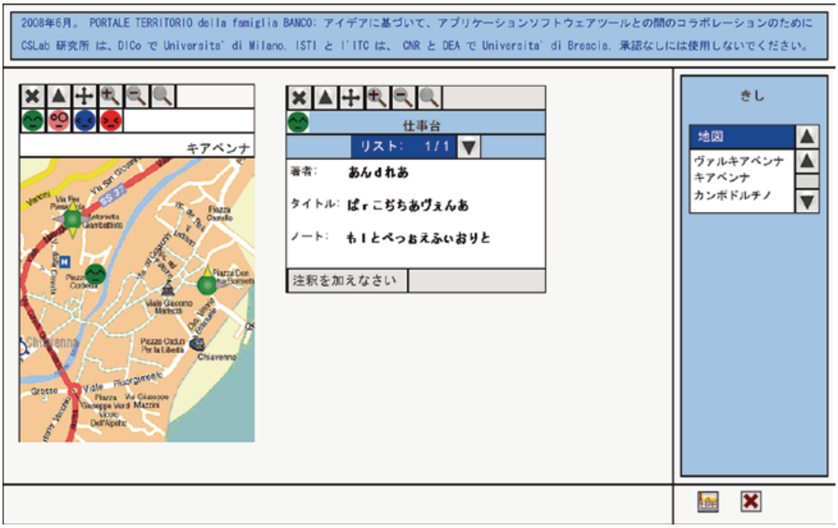


Fig. 3 A Japanese visitor accesses the appreciation annotation (denoted now by an emoticon customized to Japanese culture)

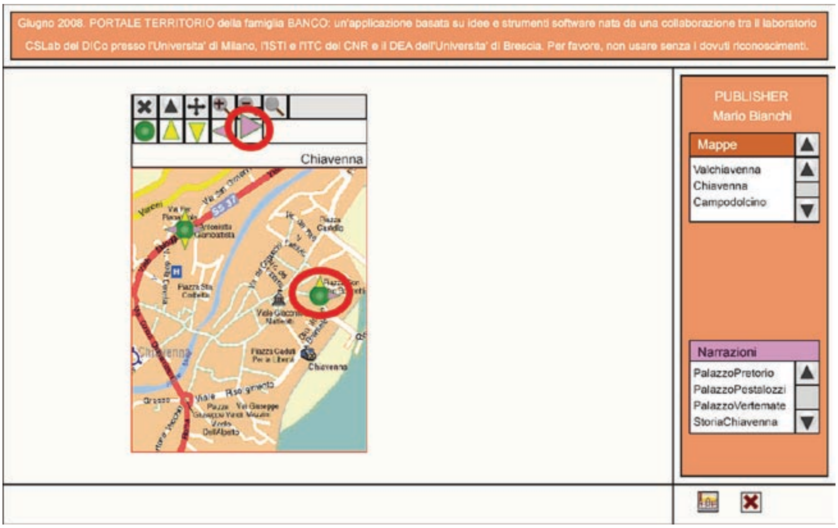


Fig. 4 A publisher is adding a narration as a component of a star operator he is creating in W-Publisher

selected map together with all and only those tools the publisher needs for publishing new information is visualized. As we can see, the organization of the window is similar to the visitor workshop, but the toolbar on top of the bench is different since it contains the widgets composing the operator, i.e., the *star operator*, for publishing new contents. The star operator is a visual link – associated with a point on a map – that consists of a (green) spot and of four (optional) triangular widgets, which link the map's point at hand to related information (the "Chiavenna" map shown in Figs. 2 and 3 is equipped with 2 star operators).

A publisher can enrich the shared knowledge base by publishing: (1) descriptions as specialized textual information the publisher inserts on a specific resource of interest when s/he creates the spot components of the star operators; (2) multimedia descriptions and (3) narrations, i.e., multimedia annotations enriched with a set of metadata to dynamically obtain links to related (even external) resources, with the aim of describing different aspects of the considered situation, activity or general argument, e.g., wine production, history of the place, etc.. Both multimedia descriptions and narrations are generated by some experts, which the publisher links to the inserted spot by creating or updating the triangular widgets of the star operator (the up and down yellow triangular components of the star operator permit to access multimedia descriptions, while the right and left pink ones are linked to narrations). As an example, in Fig. 4 the publisher is adding to an existing star operator a pink triangular widget to publish new certified information, i.e., a narration selected from the Narration menu at the bottom right. As a future work, publisher and visitor users will evaluate the star operator to understand if the new operator for publishing and accessing new certified contents, as designed so far, meets their different needs and expectations. If not, both publisher and visitor users can collaborate, through the SSW network, with their representatives to change the components visualization, and if necessary, the whole operator by interacting also with the software engineers.

Conclusions

This paper has illustrated an approach to designing flexible user interfaces that permit end users to modify or add new functionalities, and described its application to a web-based system in a territorial domain. The approach requires that an interactive system is designed as a network of software environments, called Software Shaping Workshops, each for a specific community of users, through which users collaborate in the design and the evolution of the network of environments and to carry out activities of interest in their application domain.

Each environment is customized to the work context, experience, and skills of the end user community; it makes available to end users all and only those tools needed to perform their activities. In this way, people are not overloaded with too many not necessary tools and features. The environment is also tailorable by end users at runtime in order to better adapt them to preferences, habits and specific work situations. The proposed approach fosters collaboration among communities of end users, domain experts and designers, and let users work with system prototypes in real settings, so that they are able to provide valuable feedback in order to build successful systems that satisfy end user expectations [1].

Acknowledgments This work was partially funded by University of Milan (Italy) FIRST grant 12-1-5244001-25009 and by the Italian MIUR, EU and Regione Puglia under grant DIPIS.

References

1. Buono P, Simeone AL (2008) An Experience about User Involvement for Successful Design. In this book
2. Costabile MF, Fogli D, Mussio P, Piccinno A (2006) End-User Development: the Software Shaping Workshop Approach. In: Lieberman H, Paternò F, Wulf V (eds) End User Development. Springer, Dordrecht, The Netherlands
3. Costabile MF, Fogli D, Mussio P, Piccinno A (2007) Visual Interactive Systems for End-User Development: a Model-based Design Methodology. *IEEE T Syst Man CY A* 37(6):1029–1046
4. De Souza CS, Barbosa SDJ (2006) A Semiotic Framing for End-User Development. In: Lieberman H, Paternò F, Wulf V (eds) End User Development. Springer, Dordrecht, The Netherlands
5. Iverson KE (1980) Notation as a tool of thought. *Commun. ACM* 23(8):444–465
6. Lieberman H, Paternò F, Wulf V (eds.) (2006) End User Development. Springer, Dordrecht, The Netherlands
7. Norman DA (2005) Human-centered design considered harmful. *Interactions* 12(4):14–19
8. O'Hagan M, Ashworth D (2002) Translation-mediated Communication in a Digital World - Facing the Challenges of Globalization and Localization. Multilingual Matters
9. Schuler D, Namioka A (1993) Participatory Design: Principles and Practices. Lawrence Erlbaum Associates, Inc.
10. Sutcliffe A, Mehandjiev N (2004) Introduction. *Commun ACM* 47(9):31–32

Digital Forensic Investigations: A New Frontier for Informing Systems

P.M. Bednar[1,2] **and V. Katos**[3]

Abstract Digital forensic investigators experience a need for support in their everyday struggle to overcome boundary problems associated with cyber crime investigations. Traditional methods are socio-culturally and physically localised and dependent on strict and historically prescriptive political management. The new internet-worked cyber-world creates unprecedented difficulties for digital forensic investigations. This is directly linked with the inherently complex uncertainties and ambiguities related to a constant need for framing and re-framing of problem spaces under investigation. As such, in this paper we propose the recruitment of the discipline of Informing Systems in the context of digital discovery. Early findings of such an exercise indicate that informing systems approaches can assist the investigation process by offering means for structuring uncertainty. As it is accepted that uncertainty is an inherent element in a crime scene, not least in a cyber crime scene, we consider the contribution of Informing Systems vital for the effectiveness of digital forensic investigation practices.

Introduction

Digital forensic investigations present a new international frontier for Informing Systems research and practice. This is due to the inherent, complex uncertainties involved in boundary setting and framing of an investigatory problem space [1]. Informing Systems (Information Systems which incorporate Human Activity Systems) intended to support digital forensic investigations are often discussed in relation to generic problem of large and complex investigations. However, very little research seems to be available focusing on support for cyber crime investigations. For example, in the UK, successive versions of Home Office Large Major

[1]Lund University, Lund, Sweden, peter.bednar@ics.lu.se
[2]University of Portsmouth, Portsmouth, UK, peter.bednar@port.ac.uk
[3]Democritus University of Thrace, Xanthi, Greece, vkatos@ee.duth.gr

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_42, © Springer Physica-Verlag Berlin Heidelberg 2010

Enquiry Systems (HOLMES), for managing and processing data in complex investigations, date back to 1986 [2]. While use of such systems could be productive in pursuing an inquiry, it does not help investigators as they struggle to overcome boundary problems associated with cyber crime [3, 4]. Research into relationships between new technology forensic experts and traditional investigators has tended to focus primarily on the difficulties of managing large quantities of material (e.g. forensic images, extracts, non-computer evidence rendered into digital form, metadata, etc.). Further challenges in this context have included retention of documents and management of relevant digital evidence that must be served to the opposing legal team before a trial [3–7]. This body of research does not in any way address the difficulties an investigator may face in (re)framing relevant problem spaces for investigation, with their inherent ambiguities and uncertainties [8]. This paper presents an approach to an issue that has been researched very little: the difficulties posed by decision-making among investigators attempting to collaborate in cases of digital, cyber or electronic crime.

The authors show how the framework for Strategic Systemic Thinking (SST), which is a valuable tool for contextual inquiry, can be applied to the specific context of digital forensics [1, 9, 10]. This is especially relevant where the organization of investigatory practice needs to adapt and "reinvent" itself, e.g. through innovation and communication across organizational and national borders. In these cases, SST could be applied as a means to identify and support individual engagement and to facilitate interaction/communication, especially in socio-cultural systems of high complexity. The authors demonstrate the usefulness of this approach for decision-making in the context of digital investigations. Some suggestions for putting this approach into practice are put forward. An internationally, recognized Electronic Discovery Reference Model (EDRM) is used as an example [11]. The difference in scope between HOLMES and EDRM is shown in Fig. 1. The SST framework is integrated with the first two stages of EDRM (Information Management and Identification) to show how it could contribute to overcoming the inherent limitations and difficulties of boundary setting and scoping of cyber crime investigations.

However, efforts to combine the EDRM model with the SST framework are by no means straightforward. The EDRM model is a systematic, structured model whereas SST is a context-aware, systemic approach. These are significant differences, not only of character but of epistemological perspective. The authors discuss and elaborate upon ways in which these two complementary approaches could be combined successfully, despite their differing philosophical foundations. The main focus of this paper is on collaborative decision-making activities and processes in cyber crime investigation. An effort is made to apply SST in order to provide support in cyber crime investigation practice. This is complemented with some clarification on ways in which SST could be applied in such an investigation, and efforts to integrate SST with EDRM are described. This is explored through an elaboration of requirements for a collaborative decision support system for digital forensics, always keeping in view the need to deal with the inherent uncertainties that prevail in a digital crime scene.

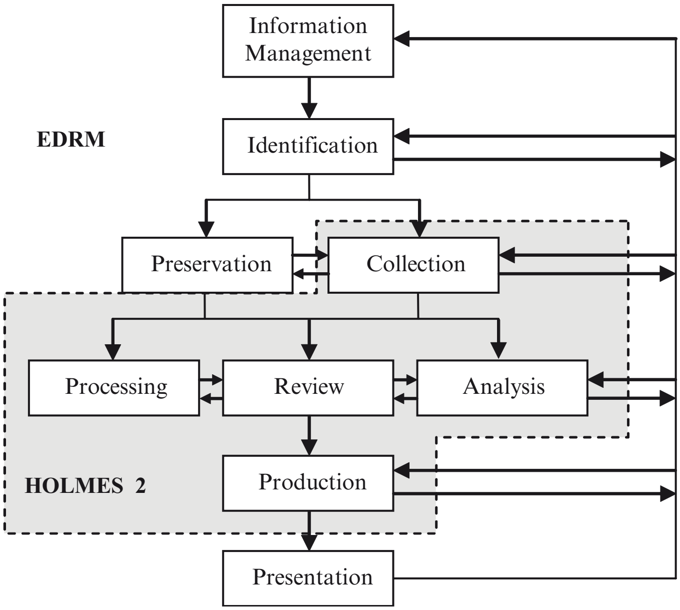


Fig. 1 Scope of HOLMES within the EDRM

A New Frontier

In their professional life, digital forensic investigators may be confounded by the complexity and uncertainty they experience in twenty-first century cyber-crime investigations. This human experience of uncertainty has been described with the help of a metaphor of an information frontier: "Why a frontier metaphor? Because it aptly captures recent experience: a decades-long period of progressive and lasting change, rich with opportunity and fraught with uncertainty. Frontiers are new terrains in which people roam, settle, and create value. Frontiers fundamentally alter not only what we do, but also how we see the world around us… By their nature, frontiers are confusing, volatile and – above all – unpredictable" [12, p. 6]. In this context models for systematic and robust decision making are promoted for the purpose to support rigour and eliminate uncertainties (e.g. the EDRM project). Then people often appear to think that a natural step follows – just invoke the power of combining a robust decision making with an IT project (e.g. the HOLMES project) and suddenly the failing digital forensic investigations will thrive, the difficult decisions will resolve themselves and the digital forensic practices will meet with success. It appears that people are looking for solutions to help them reduce complexity to simplicity and uncertainty to predictability. Leaders turn to projects in the expectations of finding a solution to life at the frontier. There appears to be a widespread fallacy that suggests rigorous practice of the "correct" procedures with the "right" IT system will automatically lead to delivery of value for an investigation.

Unfortunately, in digital forensic practice, it is only when decision making and IT systems are utilised in conjunction with embedded competencies of analysts and investigators that genuine progress is made. It could be argued that: "a critical weakness of these approaches is that they assume that the investigator is the consumer of methods and services, failing to acknowledge the value derived is not only co-created but also context dependent." [13, p. 338].

Ciborra pointed out how situated perspectives in information systems research call for methods of inquiry which capture the inner life of the actor: mind and heart [14]. Knowledge creation has been described as: "complex responsive processes, and processes of reproduction and transformation of identity, … an understanding of the processes of interaction of which we are a part"[15, p. 98]. This description puts the emphasis on the immersion of individuals in the business of everyday living. Ciborra [16, 17], drawing on Heidegger [18], highlights the experiences of everyday life as it is lived (Heidegger's "Befindlichkeit") and contrasts these with the formalised models and methodologies promoted in management literature. He suggest that, in organisations we: "listen to practitioners and we participate in their dealings with puzzles and riddles; on the other hand we do not confer any particular relevance on words like 'strategy', 'processes', 'data', or 'system'. In so doing, and in putting aside the models and methods of management science, we come closer to the everyday life of the manager, which is made up of frustrations, accomplishments, gossip, confusion, tinkering, joy, and desperation" [17, p.19]. The success of the Internet, for Ciborra, is due to the strategic importance of the ordinary, e.g. bricolage, heuristics, serendipity, make-do – rather than scientific 'ideals'. This improvisation, as a de facto knowledge management system, supports knowledge creation, sharing, capture and exploitation. Such modes of operating occur at the "boundary between competence and incompetence," and require an element of licence, or even play, to be available to actors in order to be achievable within their communities of practice [19, 20]. Activities that are situated, close to 'the dance' [16], tend also to be invisible, marginalised by management since they are difficult to control or to replicate outside of the immediate context within which a (local) community of practice resides. Improvisation when seen as a special, privileged case of cognition is reserved for spur of the moment or emergency decision making, to which normal considerations do not apply. However emergencies can be viewed as an extreme example of *life as it is lived* (Befintlichkeit). A cognitive view would be that quick thinking is involved in dealing with a situation (situated action). When asking politely in German "Wie ist Ihre Befindlichkeit" (How are you), a person is really inquiring into another's existential situation – "How do you feel?" [16]. Some views of situated action (e.g. AI) see an individual person as a kind of cognitive automaton. However, Ciborra suggests that appeals to situated/embodied knowledge need to take into account of the whole person who is *in the stream of living* – "moods, feelings, affections, and fundamental attunement with the action" [17, p. 32]. As we encounter the world, certain aspects of it will matter to us – people, things, conditions. This possibility is grounded in how a person is affected, and this affectedness discloses the world in an intrinsically social way: as a threat, as a source of boredom, or as a thrill perhaps. As Ciborra says: "If we are able to accept the messiness of the everyday world's routines and surprises without panicking, we may encounter business phenomena that deeply enrich the current 'objective' and reified models of organization and technology. We can then start to build a new vocabulary around notions closer to human existence and experience." [17, p. 19]. Ciborra emphasises the importance of mood throughout his later work. Concepts like "hospitality" are used to emphasise the affective domain. He makes use of the metaphor of treating new technology as a stranger, needing hospitality within the organization. This metaphor emphasises tolerance, welcome, being receptive, i.e. human feelings. Being a Luddite is, of course, also an emotional response to a perceived threat.

From HOLMES to EDRM

Since 1986 the Home Office Large Major Enquiry System (HOLMES) project (Fig. 1) has been employed in order to support the UK police with their investigations. This system was primarily used to support investigations in major incidents including serial murders, multi-million pound fraud cases and major disasters [2]. HOLMES2, the current version of the investigation support system, is an operational level system with document management and context of inquiry dependent analysis tools. HOLMES2 has shown to have effectively supported crime solving through the systematic application of investigation procedures at a national level. As such, it can be argued that the discovery process can benefit from a system like HOLMES when it comes to investigating conventional crimes.

In its essence, HOLMES2 is a collection of applications comprised mainly of a database and a type of a fulfilment centre performing the automated processing such as indexing. The following three applications have been deployed [21]:

1. *Casualty Bureau:* is used for assisting forces' coordination when dealing with the aftermath of major disasters.
2. *Incident Room:* is an application for capturing the information provided by the public (i.e. from witnesses).
3. *National Mutual Aid Telephony:* is used for the distribution of the telephone calls, between the host police force and the members of the public and other police units.

The user interface is mainly a collection of web forms. The end users who contribute with the user requirements are not surprisingly members of the UK Police Community [21]. However, when it comes to cyber crime investigations the key differences between the cyber-crime scene and the conventional crime scene may render a system like HOLMES unsuitable for the former type of investigations. More specifically, the trans-national flavour of a cyber crime where an offender may be in a different country or jurisdiction framework than that of the victim may increase the underlying communications complexity. Furthermore, the definition of crime, or boundary setting of a cyber crime scene, is a non-trivial exercise. The assessment of problem scope regarding inquiries into digital evidence and other electronic activities may involve not only disparate IT systems, but also engage across different socio-cultural environments, norms and legal frameworks. An attempt to respond to the pitfalls presented above was made by the Electronic Discovery Reference Model [11]. EDRM, being a model rather than an application, was developed at an abstraction level much higher than that of HOLMES in order to capture the electronic discovery processes and complexities. The EDRM is currently comprised of nine distinct stages which are fitted to the generic "preserve-acquire-analyse-report" crime scene management cycle. As such, the HOLMES system would cover the stages of Collection, Processing, Review, Analysis and Production of the EDRM model as shown in Fig. 1. The first two stages, namely Information Management and Identification is of a particular interest to this paper because of the inherent focus on uncertain and complex problem spaces.

As the stages of Information Management and Identification relate to the recognition of the problem space, it is of paramount importance to ensure that these stages acknowledge the existence and influence of uncertainty. A closer look at these stages as specified by the reference model reveals that the inquiry process proposed makes assumptions that could lead to a degenerated problem space with an "event singularity" that would not necessarily be the answer. The adoption of the famous Sherlock Holmes paradigm "…when you have eliminated all which is impossible, then whatever remains, however improbable, must be the truth" is not necessarily applicable in modern complex crime problem space, since *all* events cannot be enumerated in principle. Therefore any model that subscribes to Mr. Sherlock Holmes's paradigm is handicapped, as it is presented below [22] for the case of the first two stages of EDRM.

According to EDRM, Information Management focuses on effective record management and documentation. The reference model adopts a direction of rational inquiry focusing on a rigorous investigation protocol. For instance, a representative set of guidelines includes the following:

"1. Ensure that all needed business records are retained.
2. Ensure that all records that are required to be retained by stature, regulation, or contract are retained for the appropriate and approved period of time.
3. …" [11].

It can be seen from the previous excerpt, that the directions of the guidance explicitly highlight the importance of a protocol, whereas the actual feasibility is not challenged. For example, the first point requires that all needed business records are retained. Rather than facilitating, this point ignores the problem of determining the scope of the relevant context. In other words, it is suggested that the investigator has a priori knowledge of the problem space boundary (e.g. scope and relevance).

The Identification stage consists of four steps, Initiate, Interview, Assess, Document (Fig. 2). The model describes an ideal scenario by assuming that these four steps are sequential. This constraint is a direct consequence of the a priori knowledge assumption as described above. This mindset is followed up in the

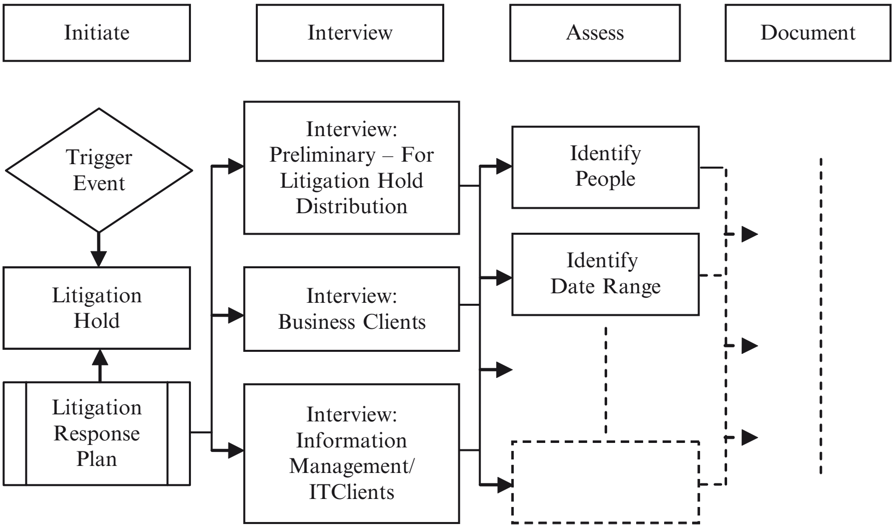


Fig. 2 The identification stage (adapted from: [11])

Interview step: by definition the concept of interview assumes that one person – typically the interviewer – leads the inquiry by knowing which questions to ask. Furthermore, the nature of an interview as an example of asymmetric communication, excludes by definition a more fully developed symmetric engagement. It cannot be expected to deliver an inquiry based on asymmetric communication when the scope is unknown (if we don't know what we are looking for, how do we know what questions to ask?). The EDRM guidelines suggest in the Interview stage, that there is a need to seek advice when determining the scope of the problem space. This shows an admission that the problem scope is unknown to the investigator. Consequently, if this is the case, it would be necessary to admit that the focus of the investigation is also unknown.

In any case, knowing what questions to ask implicitly assumes that the answer exists in the perceived problem space. In essence, such an assumption leads to exclusion of uncertainty within the investigation process. This can be illustrated by showing that in the case of the EDRM analysis approach, classic probability is sufficient to be used as the underlying analysis primitives. More specifically, if the answer exists within the original scope (prior to any reduction activity), the forensic investigator may at the very least invoke a non-deterministic process to find the answer; if the answer is not found, the scope is reduced by excluding the wrong assumption. It can be trivially shown that if the answer did not exist within the original scope, then any reductions would be pointless. An equivalent statement would be to consider that the investigator adopted a closed system view.

On the contrary, if the investigator accepts uncertainty with respect to the inclusion of the answer to the problem under investigation (i.e. adopts an open system view), then it can be seen that Probability Theory would be handicapped in modelling the reasoning and analysis of the investigator, whereas primitives that allow uncertainty such as Dempster-Shafer's Theory of Evidence [23] would be the appropriate choice.

A Framework for Digital Forensic Investigations

The SST framework is specifically suited to support the Information Management and the Identification stages. In these stages the complexity and uncertainty is not only due to a requirement to support investigators in finding the correct answers to relevant questions, but also dealing with the problem of not knowing what are the relevant questions to ask. On one hand it is about not knowing what is an appropriate definition of a problem and on the other hand it is about appreciating that the inquiry is about not even knowing what the problem "space" might be. The purpose with using the SST framework is to support the capacity of a human activity system in processing the information created by the different members of the investigatory team in such a way that [1, 9, 10]:

1. *Complement*, conflicting or incompatible ideas will not be mutually cancelled or demoted.
2. *Communication,* can take place on different orders of weltanschauung, between individuals, groups and super-groups.
3. *Socio-cultural,* dependent policy and legal constraints could be incorporated as part of the process.
4. *Expansion,* of understandings of different viewpoints is supported and not unnecessarily pre-constrained.

In the context of a Digital Forensic Investigation the SST framework can provide systemic support for dealing with complex inquiries with the following features:

"Intra-analysis" is focused on exploration and creation of individual investigators perspectives [1, 9, 10]. Each investigator has the opportunity to develop and consolidate descriptions and narratives of the problem space from their own unique perspectives. They do so by systematically using tools and methods such as brainstorming, mind maps and rich pictures, etc. As each individual makes efforts to develop their own understanding about relevant problem spaces, several hypotheses may be created. Each individual may have not only several but also often incompatible narratives. The relationships between the different narratives can be elaborated upon through the creation of diversity networks drawing upon multivalued logic, etc. While any one human expert may create narratives which can be incompatible with each other they can still be individually justifiable. This is due to situated-ness, contextual dependencies, complexity and uncertainties in general. The narratives are used as a foundation for further elaboration, story-making and self-reflection.

"Inter-analysis" is focused on group sharing, communication and development of perspectives [1, 9, 10]. Each investigator has the opportunity to describe, explain and exchange each others descriptions and narratives. Each of the narratives created are inquired into and re-created. This can be done by using walk-throughs drawing upon the same tools and methods as the intra-analysis but now in collaboration with others. The inter-analysis is supporting each individual analyst in their creation of an understanding of other investigators narratives. The vehicles for this are language games and co-creation of new narratives. The analysis is supported through the co-creation of diversity networks as part of the systematic and systemic inquiry into each and every narrative presented.

"Value-analysis" is focused upon validation and prioritization from socio-cultural perspectives [1, 9, 10]. Each investigator attempts to develop and share their understandings of the specific conditions under which each unique narrative can be acknowledged as valid or acceptable. The rationalization and classification in the value analysis is supported through the same tools and methods as the other intra- and inter-analysis. This classification exercise is based on negotiation regarding what characterizes each narrative.

"Multi-valued logic" is used and may incorporate alternatives such as: compatible, incompatible, complementary or unidentified [24–28]. It can also include concerns related to values such as: correctness (true), incorrectness (false), uncertainty (information deficit) and structured uncertainty (information overload). The use of multi-valued and inconsistent logic supports analysts and investigators in their sense-making efforts and supports them in their creation of diversity networks, etc. It also makes it possible to deal with a multitude of relationships between different narratives describing complex problem spaces and still having some kind of overview.

"Spirality" is used to bring order into reflections over complex and uncertain problem spaces [29, 30]. It is important to break away from a prescriptive process as described in the EDRM. It is necessary to treat the Information Management and the Identification stages as intertwined and recursive when approaching a complex and uncertain problem space as part of an ongoing inquiring process.

Conclusions and Outlook

When it comes to digital forensic investigations, it appears that research and practice in the area of Informing Systems can be called upon to support the investigation process. This is due to the long history of Informing Systems study of structuring uncertainty. Furthermore, just like any application of systems, research in decision support systems for digital investigations is required to consider systems' challenges in order to avoid missed opportunities. As such, interdisciplinary research between systems and digital forensics would not only promote Informing Systems, but is of paramount importance to the viability of the electronic discovery processes, due to the explosion of the complexity of the problem spaces which underlie a digital crime scene.

References

1. Katos V. and Bednar P. M. (2008) A cyber-crime Investigation Framework. *Computer Standards and Interfaces*, 30(4): 223–228.
2. Unisys (2007). What is HOLMES 2? From: http://www.holmes2.com/holmes2/whatish2/ (September 2008).
3. Valier C. (1998). True Crime Stories: Scientific Methods of Criminal Investigations, Criminology and Historiography. *British Journal of Criminology*, 38(1), 88–105.
4. Broadhurst R. (2006). Developments in the Global Law Enforcement of Cyber-Crime. *Policing: An International Journal of Police Strategies and Management* 29(3), 408–433
5. Karyda M. and Mitrou L. (2007). Internet Forensics: Legal and Technical Issues. Proceedings of the 2nd International Annual Workshop on Digital Forensics and Incident Analysis. Preneel B., Kokolakis S. and Tryfonas T. (eds.), IEEE Computer Society Press, Prague, Czech
6. Yar M. (2005). The Novelty of 'Cybercrime': An assessment in the Light of Routinge Activity Theory. *European Journal of Criminology*, 4(2), 407–427.
7. Mitropoulos S., Patsos D., Douligeris C. (2007). Incident Response Requirements for Distributed Security Informatino Management Systems. *Information Management and Computer Security*, 15(3), 226–240.
8. Jahankhani H. (2006). Waking Up to the Threat of Cyber Crime. *Information Security*, 2006.
9. Bednar P. M. (2000) A Contextual Integration of Individual and Organizational Learning Perspectives as Part of IS Analysis. *Informing Science*., 3(3): 145–156.
10. Bednar P. M., Katos V. and Hennell C. (2008) Cyber-Crime Investigations: Complex Collaborative Decision Making. Proceedings of the *Third International Annual Workshop on Digital Forensics and Incident Analysis*. Tryfonas, T. (ed), IEEE Computer Society Press, Prague, Czech.
11. EDRM (2008) *EDRM: Electronic Discovery Reference Model*. From: http://edrm.net/ (June, 2008).
12. Benko C. and McFarlan W. (2003). *Connecting the Dots*. Harvard Business School Press, Boston: MA.
13. Peppard J. (2007). The Conundrum of IT Management. *European Journal of Information Systems* 16: 336–345.
14. Ciborra C. U. and Willcocks L. (2006). The mind or the heart? *Journal of Information Technology* 21(3): 129–139.
15. Stacey R. and Griffin D. (2005). *A Complexity Perspective on Researching Organizations*. Sage, Thousand Oaks, CA
16. Ciborra C. U. (2002). *The Labyrinths of Information*. Oxford University Press, Oxford.
17. Ciborra C. U. (2004). Encountering information systems as a phenomenon. In C. Avgerou C. Ciborra and F. Land (eds.), *The Social Study of Information and Communication Technology*. Oxford University Press, Oxford.
18. Heidegger M. (1962). *Being in Time*. Harper and Row, New York.
19. Brown J. S. and Duguid P. (2002). *The Social Life of Information*. Harvard Business School Press, Boston, MA
20. McDermott R. (1999). Why Information Technology Inspired but Cannot Deliver Knowledge Management. *California Management Review*. 41(4): 103–117.
21. NPIA, National Policing Improvement Agency. (2008). HOLMES 2 overview. From: http://www.npia.police.uk/en/5962.htm (September 2008).
22. Bednar, P., Katos, V., Hennell, C. 2008. Cyber-Crime Investigations: Complex Collaborative Decision Making. *Workshop on Digital Forensics and Incident Analysis*, IEEE CS Press, Malaga, Spain, 10 October:3–11.
23. Shafer, G. (1976) *A Mathematical Theory of Evidence*. Princeton University Press, Princeton.
24. Bednar, P.M., Anderson, D. and Welch, C. (2005). 'Knowledge Creation and Sharing – Complex Methods of Inquiry and Inconsistent Theory'. *ECKM 2005*. Proceedings. Limerick, 8-9 September.

25. Bednar P., Welch C., and Katos V. (2006). ‘Four valued logic: supporting complexity in knowledge sharing processes,’ *ECKM 2006*. Proceedings, Budapest, Hungary, 4-5 Sept.
26. Bednar P., Welch C. and Katos V. (2008). Innovation Management Through the use of Diversity Networks. *International Journal of Knowledge and Learning*, (in press)
27. Bednar P., Welch C. and Katos V. (2007). ‘Dealing with Complexity in Knowledge Sharing Processes’. *ECKM 2007*, Proceedings. Barcelona, Spain, 6-7 September.
28. Bednar P., Katos V. and Welch C. (2007). ‘Systems analysis: exploring the spectrum of diversity’, ECIS 2007. Proceedings *Information Systems: Rigorous Relevance – Relevant Rigour*, St Gallen, Switzerland, 7-9 June 2007.
29. Bednar, P. and Welch, C. (2007). ‘A Double Helix Metaphor for Use and Usefulness in Informing Systems’. *Informing Science* 10, 273–295.
30. Nissen H-E. (2007). Using Double Helix Relationships to Understand and Change Informing Systems, Monograph of *Informing Science*, 10, 21–62.

Do Business Intelligence Systems Enforce Organizational Coordination Mechanisms?

A. Ferrari[1] and C. Rossignoli[2]

Abstract Please Coordination is intended as managing dependencies between activities such as, in particular, decision-making support, decisional decentralization and reduced centralization of information power, internal communication and collaboration and sharing and divulgation of knowledge. By improving all these activities, enterprises are able to create efficient and effective coordination mechanisms and consequently reduce costs and organizational complexity. The research question of this study aims at verifying if Business Intelligence Systems (BISs) are actually able to strengthen the existing coordination mechanisms, i.e., make them more efficient and less costly. The research method is an empirical research of 30 cases of enterprises with a large number of users of a BIS. Early findings reveal that BISs are mainly considered as technological tools, with little relevance being attributed to their potential in terms of facilitators of coordination mechanisms between actors.

Introduction

Coordination is intended as managing dependencies between activities such as, in particular, decision-making support, decisional decentralization and reduced centralization of information power, internal communication and collaboration and sharing and divulgation of knowledge. By improving all these activities, enterprises are able to create efficient and effective coordination mechanisms and consequently reduce costs and organizational complexity.

The research question of this study aims at verifying if Business Intelligence Systems (BISs) are actually able to strengthen the existing coordination mechanisms, i.e., make them more efficient and less costly.

[1] Università di Verona, Verona, Italy, antonella.ferrari@univr.it
[2] Università di Verona, Verona, Italy, Cecilia.rossignoli@univr.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_50,

The research method is an empirical research of 30 cases of enterprises with a large number of users of a BIS. Early findings reveal that BISs are mainly considered as technological tools, with little relevance being attributed to their potential in terms of facilitators of coordination mechanisms between actors.

This paper is structured in the following way: firstly a theoretical framework is presented; then the Business Intelligent System issue and its impact on coordination mechanisms are introduced; the research question and methodology are explained; finally, early findings and conclusions are highlighted.

Coordination: A Theoretical Framework Proposal

The extended use of ICT systems exerts an increasingly stronger influence on the best practices and positive government criteria of each enterprise. This phenomenon has created a growing need for coordination systems capable of managing the complexity caused by it. In literature, the subject of how the activities of complex systems can be coordinated has been considered by several organization theorists [1–6, 8]. Many different definitions of the concept of coordination have been given. Malone and Crowston [8] have published a list of definitions that have been proposed for this word. Among these, the most appropriate one for the purpose of this work is the following: coordination is managing dependencies between activities.

Several scholars have given their contribution analyzing the impact of ICT on the organizational changes simply caused by a growing use of information systems [2, 3, 9–13].

As a consequence, it is necessary to control the cost of coordination. In this sense, different approaches can be considered to reduce these types of cost: human coordination can be substituted with ICT systems; the greater complexity resulting from the use of ICT systems requires increasingly more coordination; hence, in order to reduce coordination costs, a large number of intensive coordination structures might be needed [8].

Coordination can be achieved by several methods, which in turn affect and change the organizational solutions adopted by the enterprises.

Coordination may play a key role in the harmonization process of the various activities set up by a given company.

In this work the focus is on the following activities: (1) Decision-making support; (2) Decisional decentralization and reduced centralization of information power; (3) Internal communication and collaboration; (4) Sharing and divulgation of knowledge. The process of improving all these activities implies the ability on the part of the organizations to create efficient and effective coordination mechanisms, which allow them to reach their objective and better operate in a competitive context. These assumptions form the basis of the theoretical framework proposed in this paper: efficiency and effectiveness of coordination mechanisms can be reached by improving the activities defined above. This causes reduction in

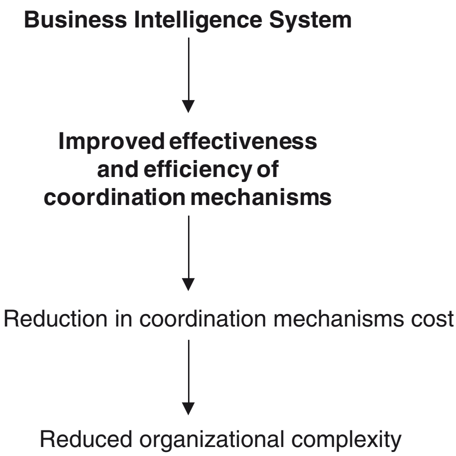


Fig. 1 The proposed theoretical framework

coordination mechanisms cost, consequently reducing organizational complexity (Fig. 1).

Coordination and organizational integration processes are critical for knowledge sharing and divulgation. This subject has been dealt with by numerous authors in literature, in relation to which Nonaka and Takeuchi have given a contribution of historical importance [14]. These authors have formulated a theory on organizational knowledge and on the methods to generate and divulge it within the organizations, considering it a fundamental resource behind innovation processes.

Furthermore, it is necessary to keep in mind that even collaboration is a knowledge-based process and, therefore, collaboration is a process that is led by knowledge, makes use of knowledge and has a knowledge-rich outcome [15]. Therefore, peculiar skills such as acquiring, selecting, internalizing, generating and externalizing knowledge are essentials [16, 17]. Computer-based systems aim exactly at allowing and facilitating these types of activities [18].

However, according to the perspective emerging in the current of studies dealing with the relation between ICT and organizational implications, it is fair to say that ICT is able to affect and modify organizations even though the human factor cannot be ignored altogether. In fact, it is the people who use the technology that have the power to confirm, change or reject/annul the whole of its potential [6, 18].

Business Intelligence Systems

This paper focuses on the role played by ICT, in particular Business Intelligent Systems (BISs), in supporting coordination mechanisms as the proposed theoretical framework (Fig. 2).

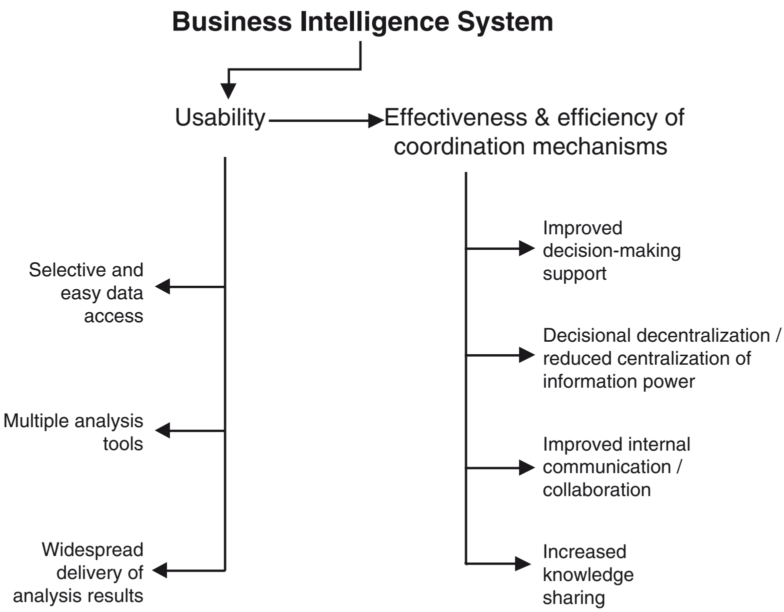


Fig. 2 Business intelligence systems and coordination mechanisms

A few authors [20–22] denote BISs as integrated infrastructures that support all managerial levels – down to the operational, real-time steering of business processes. Davenport [23] points out that BISs encompass a wide array of processes and software used to collect, analyze and disseminate data, all in the interest of better decision-making. Arnott and Pervan [24] use Business Intelligence (BI) as the contemporary term for both model-oriented and data-oriented Decision Support Systems (DSSs) focusing on management reporting, that is, BI is a contemporary term for EIS (Executive Information Systems). According to Thomsen [25], BI is a term that replaces Decision Support, Executive Support and Management Information Systems. For Moss and Atre [26] BI is understood to encompass all components of the integrated management support infrastructures of an enterprise.

The main purpose of a BI system is to improve the processes of: decision-making, decisional decentralization, internal communication and collaboration, sharing and divulgation of knowledge.

Thanks to the pervasiveness of BISs, given their typical features of usability at all company levels, such as selective and easy data access, multiple analysis tools and widespread delivery of analysis results, it is possible to reach this objective.

Organizations succeed in understanding and using BISs, which are now taking on a strategic role in the enterprises. However, from an in-depth analysis of organizational implications, a misalignment is being observed between the potential offered by these systems and their actual use, especially in order to set in motion processes of knowledge sharing and divulgation.

To remain competitive in the market, today's enterprises need to implement innovation processes based on exclusive internal knowledge that can be hardly reproduced or replaced by other companies. Hence, the need emerges to enhance and externalize the tacit knowledge of organizational actors, which plays a critical role in decision-making support and improvement of internal communication and collaboration. Organizational actors sometimes cannot grasp the importance of shared organizational knowledge as opposed to personal knowledge to facilitate coordination mechanisms within an enterprise.

Even though organizations are equipped with tools able to foster the sharing and creation of organizational knowledge, individuals are not yet fully aware of the systems' potential to ease such processes.

The Research Question and Methodology

The question of this research aims at verifying if such awareness is disappearing and therefore if BI systems are actually able to strengthen the existing coordination mechanisms, i.e., make them more efficient and less costly, since they reduce company complexity.

The research method is a survey (empirical research) carried out on a sample of 30 North Italian enterprises characterized by a large number of users of a BI system (from top management to operational levels).

The reference scenario of the investigation is represented by 180 enterprises, which have been selected based on a criterion of industry and size heterogeneity in order to detect any differences and/or organizational dynamics in the use of BI systems in relation to specific industry sectors.

The investigation started in January 2007, when the study object and the qualified subjects for interviews have been identified. Subsequently, the companies have been contacted in the period between early March 2007 and late July 2008.

Out of 180 companies contacted on the phone, 83 of these have agreed to be interviewed (46% of the sample).

The survey was carried out by means of a telephone interview with Information Systems Managers and based on a questionnaire. The purpose of the first question was the identification of the companies that had been using a BIS for at least a year. The rest of the analysis was exclusively conducted on these enterprises, which were 30 in number (36% of total sample).

Despite the low number, these enterprises in any case are heterogeneous in terms of industry and size. As regards the industry sector, the sample comprises the following: 8 in manufacturing, 5 in services, 4 in commerce and distribution, 3 in the chemical and pharmaceutical, 3 in food, 2 in textile and clothing, 2 in healthcare, 2 in automobile and 1in the public administration. The size is expressed by the 2006 turnover (37% achieved a turnover of over 500 mln Euros, 10% a turnover of 251–500 mln Euros, 23% a turnover of 101–250 mln Euros, 13% a turnover of 51–100 mln Euros, 7% a turnover of 11–50 mln Euros).

The questionnaire used for the survey included questions related to the following variables:

- Time length of use of the BIS (1–3 years, 3–5 years, over 5 years).

- Technical/application functions connected to the usability of the system by users at all levels in the organization (selective and easy data access, multiple analysis tools, widespread delivery of analysis results).
- Factors producing effects on coordination in terms of collaboration, which in turn is a prerequisite for greater knowledge sharing: improved decision-making support, decentralization of decisional power, reduced centralization of information power, improved communication.

Responses to items in the questionnaire were given using a Likert scale, in which 1 equals the minimum and 5 the maximum, in order to guarantee a certain degree of homogeneity and easy interpretation and analysis of the questionnaires.

A univariate analysis (descriptive statistics) was then carried out.

For each variable the following has been calculated:

- Position indicators (mean, mode and average).
- Variation indicators (standard deviation and variation coefficients).
- Percentiles.
- Frequencies.

Two non-parametric tests have been executed, considering the time length of the BI system use as a grouping variable, specifically the Kruskal-Wallis test and the median test, in order to identify the statistical significance of the potential connections between the analyzed variables.

Early Findings

The answers given to the questions on usability of the system on the part of users at all levels revealed no differences related to the time of use of the system. The opinions expressed on the technical/application aspects able to the ease the use of the system on the part of a large pool of users within an organization are almost unanimous (variation coefficient values are minimal) and of great value (greater than 4, in the range of 4.14–4.51). The technological potentials of the BI system are therefore recognized. The answers to the questions relative to the factors producing effects on coordination show average values (weighed average) oscillating around 3 and with variation coefficients of about 0.3. The answers do not show the same unanimity found in relation to the technical/application aspects. However the acknowledgement of positive effects on coordination overall is less relevant. Furthermore, based on the Kruskal–Wallis and median tests, it has emerged that relations with a statistical relevance useful to provide valid answers to the research question have been found only in relation to a few analyzed variables. Kruskal–Wallis test[3] three variables out of the 22 individually considered and four grouped variables show a statistically significant value (lower than 0.05), while other three

[3] This test allows to compare two or more groups of cases based on a variable.

[4] The median test is an alternative to the Kruskal–Wallis test.

are only marginally significant (higher than 0.05, and lower than 0.1). Median test[4] two variables are significant and five show marginal values.

Both tests confirm the same results: a relationship between the technical/ application aspects, concerning the immediate availability of data, and the effects on decisional decentralization, improved decision-making support and improved internal communication have been found.

Conclusion

The early results of the research show that the systems are mainly considered as technological tools, with little relevance being attributed to their potential in terms of facilitators of coordination mechanisms between actors. The peculiarities of the system, such as usability at all company levels, have been recognized as factors enabling data access and analysis, especially in terms of speed. However expressing a positive opinion on strictly technological aspects does not mean expressing a positive evaluation regarding more effective and efficient coordination mechanisms. The use of the system generates effects on organizational coordination mechanisms, such as greater decisional decentralization and improved decisional support and internal communication. However, these influences are not particularly significant. The system does not contribute to enhance knowledge sharing and divulgation, despite early expectations.

Therefore we can see that the system users fail to grasp the ample opportunities offered by the technology in terms of improved collaboration through knowledge sharing, spurred by the results of data processing carried out by the various available analysis tools. However we are aware of the limitation of this empirical research. It is necessary to expand the sample of enterprises and introduce other variables that are more related to the soft components of the organization, since the role of users is always critical for the purpose of a successful use of a ICT-based system.

References

1. Barnard, C.I. (1964) The Functions of Executive. Harvard University, Cambridge.
2. Thompson, J. (1967) Organization in Action. Mc Graw Hill, New York.
3. Galbraith, J.R. (1977) Organization Design. Addison Wesley, Reading, Mass.
4. Williamson, O.E. (1975) Markets and Hierarchies. McMillan, New York, USA.
5. Williamson, O.E. (1985) The Economic Institutions of Capitalism. The Free Press, New York.
6. Ciborra, C., Avgerou, C., and Land, F. (2004) *The Social Study of Information and Communication Technology*. Oxford University Press, New York.
7. Malone T.W. and Crowston, K. (1994) The Interdisciplinary Study of Coordination. *ACM Computing Surveys* 26(1):87–119
8. Mintzberg, H. (1979) The Structuring of Organizations. Prentice-Hall, Englewood Cliffs, NJ.

9. Markus, M.L. and Robey, D. (1988) Information Technology and Organizational Change: Causal Structure in Theory and Research. Management Science, Vol 34, No 5, pp 583–598.
10. Zubov, S. (1988) In the Age of the Smart Machine. Basic Books, New York.
11. Rockart, J.F. and Short, J.E. (1989) IT and the networked organizations: Toward more effective management of interdependence Iin Management in the 1990s Research Program Final Report. Massachusetts Institute of Technology, MA.
12. Orlikowski, W.J. (1992) The Duality of Technology: Rethinking the Concept of Technology in Organizations. *Organization Science*, 3(3):398–427.
13. Nonaka, I. and Takeuchi, H. (1995) The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation. New York, Oxford University Press.
14. Simonin, B.L. (1997) The Importance of Collaborative Know-How: An Empirical Test of the Learning Organization. *Academy of Management Journal*, 40(5):1150–1174.
15. Holsapple, C.W. and Joshi, K.D. (2002) Knowledge Manipulation Activities: Results of a Delphi Study. *Information and Management*, 39(6):477–490.
16. Hartono, E. and Holsapple, C. (2004) Theoretical foundations for collaborative commerce research and practice. *Information Systems and E-business Management*, Springer-Verlag, Vol 2, pp 1–30.
17. Tsui, E, (2003) Tracking the role and evolution of commercial knowledge management. software In Holsapple CW (ed) *Handbook on Knowledge Management*: Volume 2 Berlin: Springer, 2003 pp 5–27.
18. Leidner, D.E. and Kayworth, T. (2006) A review of culture in information system research: toward a theory of information technology culture conflict. *MIS Quarterly*, 30 (2):357–399.
19. Kemper, H. and Baars, H. (2006) Business Intelligence und Competitive Intelligence – IT – basierte Managementunterst tzung und markt-/wettbewerbsorientierte Anwendungen In: Kemper, H., Heilmann, H. and Baars, H. (2006) *Business and Competitive Intelligence*, Dpunkt, Heidelberg.
20. Negas, S. and Gray, P. (2003) Business Intelligence. *Proceedings of the Ninth American Conference on Information Systems*. Tampa, Florida.
21. Eckerson, W.W. (2006) Performance Dashboards. Wiley, Hoboken, NJ.
22. Davenport, T. D. (2006) Competing on Analytics. *Harward Business Review*.
23. Arnott, D. and Pervan G. (2005) A Critical Analysis of Decision Support Systems Research. *Journal of Information Technology*, 20(2): 67–87.
24. Thomsen, E. (2003) BI's Promised Land. *Intelligent Enterprise*, Vol 6 4:21–25.
25. Moss, L.T. and Atre, S. (2003) Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications. Addison-Wesley, Boston, MA.

Don Ihde's 'Soft' Technological Determinism and Capabilities for IS Organizational Learning. The Case of a Competence Center

P. Depaoli[1]

Abstract There is a not yet resolved, ongoing debate concerning the character of technology. After synthesizing the main strands in this theoretical contention, the paper draws on Don Ihde's 'soft' technological determinism to discuss appropriate strategies of organizational learning on the part of IS vendors. A case is presented concerning the design and evolution of the competence center of the financial division of a large Italian software house. The description and discussion show that an early, persistent, and extensive involvement of human resources in the project, the lean structure of the center, and its promotion of knowledge exchanges both within the division and with clients, suppliers, and regulatory bodies allowed for improved division capabilities. An interorganizational 'learning ladder' was thus established so that technologies and contexts could be more flexibly and effectively addressed and managed.

Introduction

Within the Information Technology (IT) domain several models concerning technology acceptance by individuals have been proposed, discussed, and used widely. Venkatesh examined eight models to formulate a unified one [1] successfully seeking to improve explanatory performance. 'Facilitating conditions' (guidance, specialized instruction, and assistance provided by the organization to the users) are one relevant set of the direct determinants of acceptance that findings show in the unified model. Such conditions appear to be significant in predicting usage behavior [1, p. 461], especially when users are older and more experienced. But what happens, for example, when the "acceptance problem" is embedded in different cultural backgrounds (let's say North America *versus* the Far East)? Is it possible

[1]Università di Urbino, Urbino, Italy, paolo.depaoli@uniurb.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,

DOI 10.1007/978-3-7908-2148-2_32,

to just ‘extend’ one of the current models to include cultural elements [2], or is it necessary to broaden the research span? In more general terms, to what extent is the word ‘acceptance’ appropriate when considering ‘technology’? What are the consequences for researchers and practitioners?

In the first section following this introduction, the theoretical background of the ‘technology issue’ is explored and a specific approach (defined by Don Ihde ‘soft’ technological determinism [3]) is introduced. In the following section, a case is presented showing how an IS vendor can effectively “combine” (through an organizational learning strategy) user organizations needs with hardware and software basic technologies (thus acting as an ‘external facilitating condition’ in IS technology management of an organization). In the final section outcomes of the preceding work are commented and conclusions drawn.

The Theoretical Background

In their account of the possible advantages for IS research to utilize concepts and approaches which belong to the social shaping of technology, the authors [4] describe the two main theoretical areas developed as a reaction to technological determinism: the social construction of technology (SCOT) and the actor-network theory. In spite of the useful suggestions coming from the two approaches (especially their contribution to “describing techno-economic networks in detail”), when they sum up their comments, they conclude (citing Orlikowski [5] to support their close) that the relationship between organization and technology remains unclear so that disputes concerning social and technical distinctions are bound to continue. In fact, Orlikowski in her 1992 article does say that the technology literature had been not only “ambiguous and conflicting” [5, p. 398] but also either “overly deterministic or unduly voluntaristic” [5, p. 403]. Thus her drawing on Giddens’ work to propose a ‘structurational model of technology’ was a needed attempt to reformulate the relationship between technology and organizations. However, in 2004 [6] she reappraises her preceding contributions concluding that “[w]hile acknowledging the importance of technology’s material properties [her] treatment of such materiality remains underdeveloped” [6, p. 319].

So the dispute on SCOT continues: Latour [7] is vehemently opposed to ‘social constructivism’ (“the maker, the creator, the constructor has to *share* its agency with a sea of actants over which they have neither control nor mastery”, p. 32) but he favors ‘constructivism’ along with the relevant concepts he has been using in his work: “actant, mediation, obligatory passage point, translation, delegation”. The discussion, then, opens on Latour’s ‘actant’ which Ihde [8], for example, considers a provocation since the word indicates that humans and nonhumans are merged in a symmetrical mutual modification: “I can’t quite bring myself to the level of ‘socializing’ the artifacts. They may be *inter*actants, but they are not quite *actants*” [8, p. 139].

This, however sketchy, account indicates that, concerning technology, some basic conceptions are encountered and the issues at stake are essential. So that different implications are entailed by different ways of conceiving technology. In fact, Ihde in his *Bodies in Technology* [3], mentions some instances of philosophers (in fact they could be considered "science studies experts" – SSE) having been invited to take part as consultants in important programs: he mentions, for example, Dreyfus and the RAND Corporation for artificial intelligence. Since, in his opinion, philosophers' participation in technology development teams is increasing, Don Ihde deals with the "predictive problems in technological development" [3, p. 104]. The question concerns how it is possible to manage technology since "*all technologies display ambiguous, multistable possibilities*" [3, p. 107, emphasis by author]. On the one hand, a philosopher's contribution is limited to applied ethics if s/he intervenes in an after development situation whereby s/he plays an endgame role typical of the ambulance corps in a battlefield (this is the metaphor the author uses). On the other hand, yet unable to achieve full prognosis on a new technology, a different and more pro-active role (which he calls "R and D") allows for the exploration of possible effects, of unforeseen and unintended uses, within "partially determined *trajectories*". Not surprisingly Ihde claims his technological inclination to proximate a "'soft' determinism or direction" [3, p. 132]. So, the closer the sources of an innovative endeavor, the more effective the effort to manage ambiguity and complexity inherent to technology development (through SSE). And vice versa.

With respect to this issue, some questions can be posed, for example: what degrees of freedom are there (what 'trajectories' can be envisaged) when moving away from primary sources of innovation? How and when and who are the actors to involve in exploring innovation trajectories in an organization? What is the profile of an "organizational" SSE?

The Case: A Competence Center as an Intersect of Experiences and an Interpretive Actor of Both Strategy and Operations and a 'Facilitating Condition' at Industry Level

The case addresses the above mentioned questions at micro (firm and interfirm) level by showing the design process and launch of a competence center of a division in a large Italian software house. In fact, the pursuit of appropriate strategies of organizational learning (OL) on the part of information systems (IS) vendors ('output takers', with respect to basic hardware and software producers, and 'input makers', with respect to user organizations) can lead to the development of 'external facilitating conditions' (a role similar to the SSE) in orienting and managing technology in a given industry.

Characteristics of the vendor. The Finance Division (FD) of the third (for revenues) Italian software house was launched in 1991 to conquer an emerging market produced by a deep change in regulations in the banking industry. A change that would bear significant consequences on the financial services business. By the year 2000 FD (200 people) had become the fastest growing division in the company. FD specific units had been established in the mid nineties: Training, Strategic Development (in charge of setting key client programs), and R&D (responsible for exploring new inputs from potential suppliers) The growth rate of the division had been tumultuous, riding high the market expansion. The technical strength was based on the possibility of integrating all processes (trading, settlement, corporate actions, reporting) in one infrastructure; other vendors' offerings, instead, were based on separate application systems. The organizational strength derived from the business and normative knowledge of the processes – in a few years FD clients dispensed with the financial BPR projects of international consulting firms since FD became a better and cheaper domain expert.

Emerging problems. Some concerns engaged FD top management: (1) the financial services market probably would not keep growing at the current pace; (2) explorations of opportunities on other European markets were necessary; (3) maintenance of the core product was becoming increasingly complex. Furthermore: (4) the training unit was running "on its own", not really integrated with the rest of the division; (5) Strategic Development Unit people were intensively employed in project management; (6) R&D Unit people were involved in maintaining the core product.

Setting the organizational learning program through extensive and early involvement of people: exploring the present learning environment. At the end of 2000, consultants were hired to work with the head of the training center (a former FD project manager) who was going to be in charge of the Finance Division Competence Center (FDCC), the backbone of the OL strategy. The main objective was to identify the 'capabilities' that had been critical for achieving the FD current success and the possible ways to keep them updated and able to sustain its evolution. Thus, the mode of functioning of the Competence Center should ensure both the 'embedment' of the Center within the FD and the monitoring of emerging techniques and technologies by promoting connections with the FD environment: for example, suppliers (e.g.: data base vendors), regulators, clients, and business associations relevant for the financial services industry. The objectives to be achieved were complex since the FDCC was supposed to support both operations and research and development activities.

To guarantee the necessary early and full involvement of human resources, the organizational learning program included a 'setting' phase (which lasted two months) dedicated to collate and organize the contributions of 53 people (ranging from the managing director of the FD to senior analysts) on key issues (clients, projects, the current human resources management systems, communication and knowledge development) by means of in-depth individual interviews and discussions (from one to two hours long).

Outlining the possible learning environments: finding the interconnections and designing the basic features. On the basis of an interim report, four in-house teams worked to outline the 'services' to be provided by FDCC (with consultants, including the author of this paper, acting as facilitators).

One team addressed the process of assessing 'competences' needed to perform different roles in the FD. Step one was to draw a list of capabilities to best articulate and describe the FD know-how (a way of making it as explicit and shared as possible):187 financial, technical, and managerial competences were thus specified. Then the descriptions of the 28 FD roles were revised so that they would: (1) be less prescriptive and consequently more interpretable and used by people; (2) contain a profile of capabilities considered to be important to handle each position. This team also gave a first appraisal of the existing competence gaps per each unit. Within an interorganizational learning perspective, particularly valuable was the decision to define the competences that clients were expected to have to best interact with the FD. Next, development actions were defined; they included, but were not limited to class-room work; in fact, they also comprised small informal interest groups, 'didactic' participation to projects, a 'hot-line' with in-house experts and other initiatives (top-down or bottom-up proposals) that would be coordinated by the FDCC.

The second team worked on 'communication' within the Division. The FDCC would help circulate lessons learned during field project work among project teams; the idea was both to organize meetings and to prepare information, documents and data that could be accessed from one's desk, or from client premises (via the web). This aspect was critical in facilitating product sub-systems improvement as a result of problems encountered in the delivery phase.

The third team examined the ways through which FD could keep its capabilities updated by means of the Competence Center. A list of 'knowledge sources' was compiled (e.g.: suppliers known for their state of the art offering, universities, regulatory institutions) and matched with a list of in-house experts (the more experienced project and product managers together with the members of the R&D and Strategic Development Units). Thus innovation could be monitored and distributed. The role of the FDCC was to facilitate this ongoing process by searching for contacts and exploring first opportunities of collaboration.

The fourth team analyzed the contribution of FDCC to promotion and sales: the material collated for knowledge management purposes could be used for market analyses and for preparing presentations. Early FDCC involvement in projects was recommended so that possible problems (sometimes underestimated by sales people) or opportunities could be better evaluated. Furthermore, on the basis of the capabilities that client project teams should detain in order to interact effectively with the FD teams (for analysis and parametrization of the 'product'), seminars were to be organized with the support of the 'knowledge partners'.

Outcomes. The fundamental features of the FDCC were: (1) a light unit (the head plus two full time persons) involved in FD 'product' promotion and project work besides FDCC activities, so that 'grip' with operational issues would be maintained (the unit would not be "encapsulated"); (2) its staff was not supposed to be permanent (even though the Center was considered to be a valuable step in the FD professional career); (3) a "diffused" structure in that it employed in its own projects (training, knowledge management tools, etc.) the communities of practice of the Division; (4) an intersection, a crossroads of the experiences of the Division and a primary interpretive actor connecting strategic management and operations (and, within operations, enhancing dialogue between 'Project' and 'Product' units);

(5) a support to top management for exploring opportunities on European markets; (6) certainly not a profit center, even though the revenues from seminars were going to be appreciated and considered to be a sign of effectiveness.

By 2002, one and a half years after its start: (1) the FDCC had organized the self-assessment of individual competence profiles of all employees (who discussed them with their supervisors); (2) it had been deeply involved in the evaluation of the attractivity of a European foreign market and in searching for a possible local technical partner for the FD (using as a basis for mutual understanding and discussion the list of FD capabilities that had been prepared); (3) it had collated information concerning critical issues in projects and edited them so that they could be accessed on line by teams engaged in field work (besides being used by product managers for product implementations); (4) the revenues from seminars exceeded FDCC direct costs.

Discussion and Conclusion

The discussion is developed through three comments and a concluding remark.

Comment 1. Don Ihde's 'soft' technological determinism belongs to the phenomenological strand which claims to overcome the dichotomy subject-object by stressing the mutual interrelation between humans and the world [9, p. 110]. The consequence is that a technology does not exist in itself but it is context dependent: it has different identities, dependently from its uses. Don Ihde calls this characteristic of technology 'multistability'. Thus, on the one hand, Ihde alerts us to be cautious in adopting the very concept of 'technology acceptance': "… technologies may be variantly embedded; the 'same' technology in another cultural context becomes quite a 'different' technology." [10, p. 144]. On the other hand, artifacts do exist and mediate how people relate to their worlds. The consequence is that an artifact (an IT/IS, for example) used in another context is a different artifact and, at the same time, people in that other context, by using that artifact, forge an experience which is different from the one they would have achieved without such artifact. Therefore, it is hardly possible to achieve a conclusive knowledge on how a certain technology will perform in different contexts unless one assumes that such contexts are (almost) identical. The focus then should be on managing the evolution of context-artifact-experience (and this is the role of philosophers-SSE according to Ihde) rather than counting on an ex ante knowledge of artifact-impacts-control-acceptance.

Comment 2. Since information systems are particularly context sensitive, one of the crucial points in their adoption is the appropriate management of their evolving use in a certain context-organization. Given the division of labor among firms (producers of basic hardware and software, IS vendors, and IS buyers) technologies and techniques developed far up-stream become black boxes for down-stream users. Vendors are able to mediate between artifacts and users by dynamically monitoring contexts (producers and buyers' strategies, knowledge domains, core competencies and other context significant traits), provided they are well equipped in terms of (inter)organizational learning . Thus they can become the equivalent of an SSE at the industry level: an 'organizational facilitating condition' for the IT/IS management in user organizations.

Comment 3. The case has shown one example of nurturing such (inter)organizational learning(OL). There is a large number of definitions of OL [11], possibly because the two words both intercept two multifaceted concepts and serve different purposes (research and practice). The concept of 'learning ladder' seems to best serve this discussion since it involves

> "… three main loops. One basic loop routinizes work practices and indirectly routines, while using resources; a second one combines work practices and organizational routines to form capabilities; and the third loop gives meaning to capabilities in the context of the firm's competitive environment and business mission thus allowing the selection and elicitation of core capabilities" [12, p. 578]

As it was shown, the FDCC was designed (and operated) to weave together routines (concerning both 'projects' and 'product'), individual competencies to form FD capabilities, and to harness FD core capabilities by reinforcing internal knowledge through its exposure to state of the art stimuli (from suppliers, international consulting firms, the Italian central bank).

Furthermore, the competence center was important in sustaining an interorganizational 'learning ladder' since the division did not act as a mere intermediary, an entity reducing communication to embedded knowledge (present in standardized services). It developed, instead, relationships with its clients similar to alliances that occur in joint ventures or in acquisitions where exchange, knowledge integration, and learning are possible and favored [12]. In the FD case this amounted to a mitigation of the effects that ICT 'black boxes' base technologies (developed upstream) could produce in less flexible and receptive vendor-client environments. FDCC can therefore be considered an 'external facilitating condition' capable of prompting effective IS adoption and management.

Concluding remarks. The case has shown that the capabilities for choosing and managing the mix of available techniques that best suit differently situated user needs can be spurred by *ad hoc* organizational solutions, if they are centered on timely and persistent involvement of actors who circulate and interpret experiences, practice and knowledge. By means of such a "collective learning facilitator", the 'multistability' of technology can be more effectively addressed and managed.

In sum, first level 'trajectories' are defined by upstream innovation and supply (hardware vendors or systems software, development tools, programming languages, etc.). However, if vendors are not mere intermediaries, the opportunities that Ihde envisages for the involvement of science studies scholars (and philosophers) in the primary sources of innovation can be further exploited by appropriate down-stream operators.

Further research is needed to define fostering and hindering factors in developing such (inter)organizational learning. 'Multistability' can serve as a basic conception in IS research, especially when highly dissimilar contexts are studied for IT/IS public policy and firm strategy definition and management.

References

1. Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, Vol. 27 No 3, pp. 425–478.
2. Mao, E., Palvia, P. (2006). Testing an Extended Model of IT Acceptance in the Chinese Cultural Context. *The DATA BASE for Advances in Information Systems* – Spring-Summer (Vol. 37, Nos. 2 & 3).
3. Ihde, D. (2002) *Bodies in Technology*. University of Minnesota Press. Minneapolis, MN.
4. Howcroft, D. Mitev, N., Wilson, M. (2004). What we May Learn from the Social Shaping of Technology Approach. In Mingers, J. and Willcocks, L. eds. *Social Theory and Philosophy for Information Systems*. Chichester: Wiley.
5. Orlikowski, W.J. (1992). The Duality of Technology: Rethinking the Concept of Technology in Organizations. *Organization Science*. Vol. 3. No. 3, pp. 398–427.
6. Jones, M., Orlikowski, W.J., Munir, K. (2004). Structuration Theory and Information Systems: A Critical Appraisal. In Mingers, J. and Willcocks, L. eds. *Social Theory and Philosophy for Information Systems*. Chichester: Wiley.
7. Latour, B. (2003). The Promises of Constructivism. In Ihde, D., Selinger E. (eds) Chasing Technoscience. Bloomington, IN. Indiana University Press.
8. Ihde, D.(2003) If Phenomenology Is an Albatross, Is Post-phenomenology Possible?. In Ihde, D., Selinger E. (eds) *Chasing Technoscience*. Bloomington, IN. Indiana University Press.
9. Verbeek, P.P. (2005) *What Things Do*. The Pennsylvania University Press, Pennsylvania.
10. Ihde, D. (1990). *Technology and the Lifeworld. From Garden to Earth*. Bloomington: Indiana University Press.
11. Denton, J. (1998). *Organizational Learning and Effectiveness*. London, New York: Routledge.
12. Ciborra, C., Andreu, R.(2002). Knowledge across Boundaries. In Choo, C.W., Bontis, N. (eds.) *The Strategic Management of Intellectual Capital and Organizational Knowledge*. Oxfrod: Oxford University Press.

Effective Storage of Semantic Web Data

R. De Virgilio[1], P. Del Nostro[2], G. Gianforme[3],
S. Paolozzi[4], and R. Torlone[5]

Abstract The Semantic Web is an extension of the traditional Web aimed at facilitating information and knowledge sharing. In this context, RDF has been conceived as a means for a simple representation of any kind of data and metadata, according to a graph-based, lightweight model and a straight XML serialization. Although RDF has the advantage of being general and easy to use, it cannot be adopted as a storage model, since it can be easily shown that even simple data management operations yield serious performance problems. In this paper, we present a novel approach for storing, managing and processing RDF data in an effective and efficient way. The approach is based on a logical organization that is particularly suited for RDF constructs, but it can be easily extended to other RDF-based languages, such as OWL.

Introduction

From the origins of the World Wide Web, the activity of publishing information has been so intense that a huge amount of data is currently available over the Internet. In order to support the exchange and sharing of such a universe of information and knowledge, the W3C has launched the Semantic Web initiative whose goal is to turn the Web into a universal medium for the exchange of data. The basic component of the Semantic Web is the Resource Description Framework (RDF)[6]: a simple data model and language for the representation of Web resources. An RDF

[1] Università Roma Tre, Roma, Italy, dvr@dia.uniroma3.it
[2] Università Roma Tre, Roma, Italy, pdn@dia.uniroma3.it
[3] Università Roma Tre, Roma, Italy, gianforme@dia.uniroma3.it - Partially supported by Microsoft Research within the European PhD Scholarship Pro-gramme
[4] IRPPS-CNR, Roma, Italy, stafano.paolozzi@irpps.cnr.it
[5] Università Roma Tre, Roma, Italy, torlone@dia.uniroma3.it
[6] http://www.w3.org/RDF/.

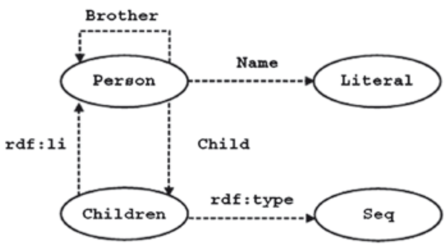
A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_21, © Springer Physica-Verlag Berlin Heidelberg 2010

document is made of a set of statements uniquely identified by an URI (Uniform Resource Identifier). A statement is a triple:

<Subject, Predicate, Object>

expressing the fact that a resource (the subject) is related to another resource or to a value (the object) through a property (a predicate in RDF terminology). An RDF document can be seen as a directed labelled graph where nodes represent resources or literals and arcs represent predicates. Given this triple based structure, an RDF document is commonly stored in one single relational table with a three-column schema. For instance, Fig. 1 shows an RDF graph representing family relationships between persons (left hand side) and the triple-based table storing a collection of RDF resources over this schema (right hand side).

A lot of systems adopt this simple storage model (usually using a relational DBMS) such as the ICS-FORTH RDFSuite (Alexaki et al., 2001), Sesame (Broekstra et al., 2002), the Karlsruhe Ontology and Semantic Web Tool Suite (KAON)[7], the TAP suite[8], Jena (Kiryakov et al., 2005), Oracle (Chong et al., 2005), and 3store (Harris et al., 2003). There are however a number of weaknesses in this approach involving both modelling and performance issues. On the modelling side, a crucial problem is the management of multi-valued properties that are difficult to represent and can lead to a large number of NULL values in the underlying table.



people

Subject	Property/ Predicate	Object
URI1	rdf:type	Person
URI2	rdf:type	Person
URI3	rdf:type	Person
URI4	rdf:type	Person
URI1	Name	"Priam"
URI2	Name	"Hector"
URI3	Name	"Astyanax"
URI4	Name	"Paris"
BLANK1	rdf:type	Seq
BLANK2	rdf:type	Seq
BLANK3	rdf:type	Bag
URI1	Child	BLANK1
BLANK1	rdf:_1	URI2
BLANK1	rdf:_2	URI4
URI2	Child	BLANK2
BLANK2	rdf:_1	URI3
URI2	Brother	URI4

Fig. 1 RDF classes and triple instances

[7]KAON: http://kaon.semanticweb.org/.
[8]TAP project: http://tap.stanford.edu/.

The other issue is related to the fact that queries often involve many self-joins on this table and this makes critical their optimization (limiting the benefits of using indexes). Moreover, the maintenance of large RDF data sets can involve complex operations due to the dependencies between nodes (for instance, cascading deletions are frequent operations). All of this motivates the need for a more effective, efficient and general storage strategy for RDF data.

In this paper we propose a model based approach for storing RDF data in an effective and efficient way. In this approach, data is grouped into different sets, each of which represents the RDF construct used to model such data. Sets are properly linked according to the RDF model structure. This organization has the advantage to represent RDF objects with a finer grain, both at instance (RDF) and schema level (RDFS) simplifying both data management and maintenance.

Storing RDF Documents

According to (Chong et al., 2005), in our approach the storing of RDF data is a three step process: (1) parsing, (2) representing, and (3) storing RFD data.

The *parsing* phase transforms the RDF data source, possibly expressed in different syntaxes (e.g. RDF/XML and N3), in triples. In the *representing* step, the triples are organized according to a special structure based on the constructs of the RDF

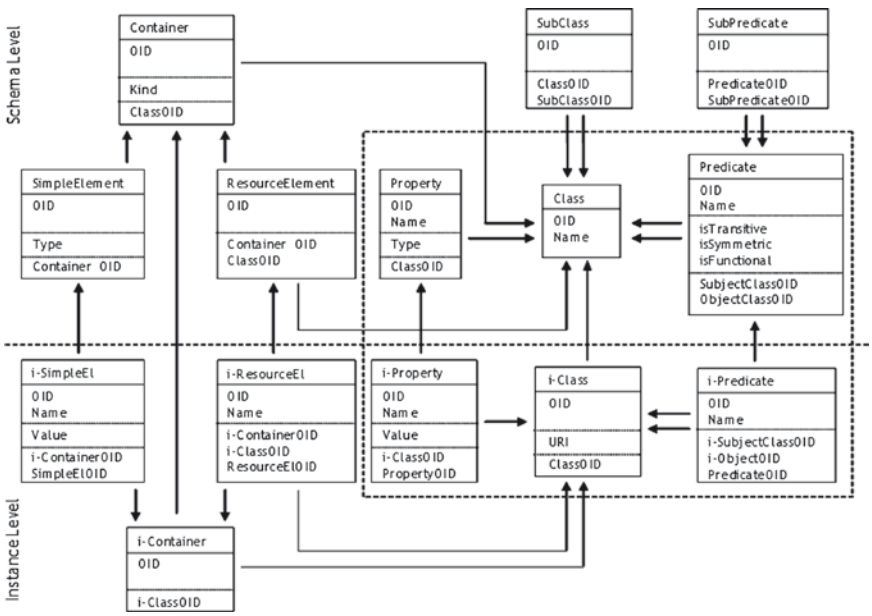


Fig. 2 RDF data organization

model. A UML representation of this structure in shown in Fig. 2. Finally the *storing* step maps such organization to relational tables.

The core of our organization is enclosed in the dashed box of Fig. 2: it includes a set of concepts properly representing RDF(S) and RDF constructs.

At schema level Class represents an RDF resource, Property represents an RDF statement that involves a primitive type as object, and Predicate represents an RDF statement that involves two classes.

At instance level, three more concepts have been introduced to store instances of the above RDF statements, namely: i-Class (a resource with a URI), i-Property and i-Predicate.

The various concepts have an object identifier and a name, are related to each other by means of mandatory references and may have properties specifying details of interest. SubClass and SubPredicate are used to represent generalization hierarchies: each of them includes two references to Class and Predicate. Finally, three extra concepts are added for managing RDF collections: Container (for storing any collection), SimpleElement and ResourceElement (for elements of a collection that are literals and resources, respectively).

Implementation

We have implemented our approach in Postgres, a popular open-source relational DBMS. Each concept of the structure presented in the previous section is stored in a table whose columns correspond to attributes of such concept. OIDs are used as primary keys and as references between the objects stored in the tables. As an example, according to this organization, Fig. 3 shows the relational database storing the RDF example described in the Introduction.

We have generated a RDF dataset of about 50 millions of triples and have stored those data in: (*i*) a standard three-column table having subject, predicate and object as attributes, and (*ii*) according to our organization illustrated above. Then, we have performed a large number of tests involving both query and update operations of increasing complexity to compare performance and scalability of the two approaches.

As an example of the differences between them, let us consider the query aimed at retrieving the name of all the brothers of Hector. In the first approach, the query can be formulated as follows:

```
SELECT p1.object
FROM people p1, people p2, people p3
WHERE p1.predicate = 'Name' AND p1.subject = p2.object
    AND p2.predicate = 'Brother' AND p2.subject = p3.subject
    AND p3.predicate = 'Name' AND p3.object = 'Hector'
```

Schema Level

Container		
OID	Type	ClassOID
ct1	Seq	c2

ResourceElement		
OID	ContainerOID	ClassOID
re1	ct1	ct1

Class	
OID	Name
c1	Person
c2	Children

SCHEMA	
OID	Schema Name
s1	Greece

Property			
OID	Name	Type	Class OID
prop1	Name	String	c1

Predicate						
OID	Name	is Transitive	isSymmetric	isFunctional	SubjectClassOID	ObjectClassOID
pred1	Child	false	false	false	c1	c2
pred2	Brother	true	true	false	c1	c1

Instance Level

INSTANCE		
OID	Instance Name	Schama OID
i1	GreeceInstance	s1

i-Property				
OID	Name	Value	i-ClassOID	PropertyOID
i-prop1	Name	Priam	i-c1	prop1
i-prop2	Name	Hector	i-c2	prop1
i-prop3	Name	Astyanax	i-c3	prop1
i-prop4	Name	Paris	i-c4	prop1

i-Class		
OID	Name	ClassOID
i-c1	URI1	c1
i-c2	URI2	c1
i-c3	URI3	c1
i-c4	URI4	c1
i-c5	BLANK1	c2
i-c6	BLANK2	c2

i-Predicate				
OID	Name	i-SubjectClassOID	i-ObjectClassOID	PredicateOID
i-pred1	Child	i-c1	i-c5	pred1
i-pred3	Child	i-c2	i-c6	pred1
i-pred4	Brother	i-c2	i-c4	pred2

i-Container			
OID	Name	i-ClassOID	ContainerOID
i-ct1	BLANK1	i-c5	ct1
i-ct2	BLANK2	i-c6	ct1

i-ResourceElement				
OID	Name	i-ContainerOID	i-ClassOID	ResourceELOID
i-re1	1	i-ct1	i-c2	re1
i-re2	2	i-ct1	i-c4	re1
i-re3	1	i-ct2	i-c3	re1
i-re4	1	i-ct3	i-c4	re2

Fig. 3 An example of RDF data storing

Performing this query with indexing support, we have obtained a response time of 1070.6 s. Query execution can be analyzed using the Postgres report shown in Fig. 4.

In this report, for each operation there is an estimated execution cost expressed as a pair *(a, b)*, where *a* is the start-up time before the access to the first row, and *b* is the total time to return all the rows (n is about 5,220 and k is about 51).

Two indexes (one on predicate and the other on predicate, object) are used to select all triples with property Name and subject Hector. This operation is not so expensive (about n and 2n). Then, an index on (subject, predicate, object) is used to join these triples with the whole table. This second step is much more expensive (it costs about 160n). In our approach, the same query can be written as follows

```
SELECT iProp.value
FROM i-Property iProp
WHERE iProp.Name = 'Name' AND iProp.i-ClassOID IN (
   SELECT iPred.i-ObjectClassOID
   FROM i-Predicate iPred
```

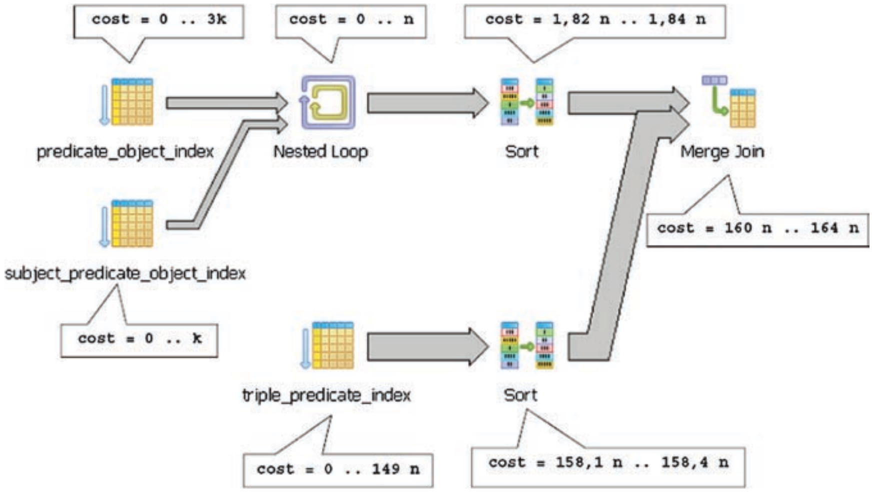


Fig. 4 Performance analysis of the triple-based approach

```
    WHERE iPred.Name = 'Brother' AND
    iPred.i-SubjectClassOID = (
      SELECT i-ClassOID
      FROM i-Property
      WHERE Name = 'Name' AND value = 'Hector'
    )
  )
```

With indexing support, this query takes 89.7 s. The corresponding report on query execution is graphically shown in Fig. 5.

Taking advantage from the indexes on Name, i-SubjectClassOID and i-ClassOID, the operations are relevantly less expensive (they costs about 2n) and the amount of data to scan is dramatically reduced. In particular the join operations are fewer and faster. This is just an exemplar of the advantage of our approach in the execution of queries. The vast majority of tests that we have performed show a dramatic improvement of effectiveness and efficiency.

Conclusions

RDF is one of the most representative ingredients of the Semantic Web. The large amount of information stored as RDF documents in modern Web applications has highlighted the importance of methodologies and techniques for managing these documents. In this paper we have proposed a model based method for storing, in an

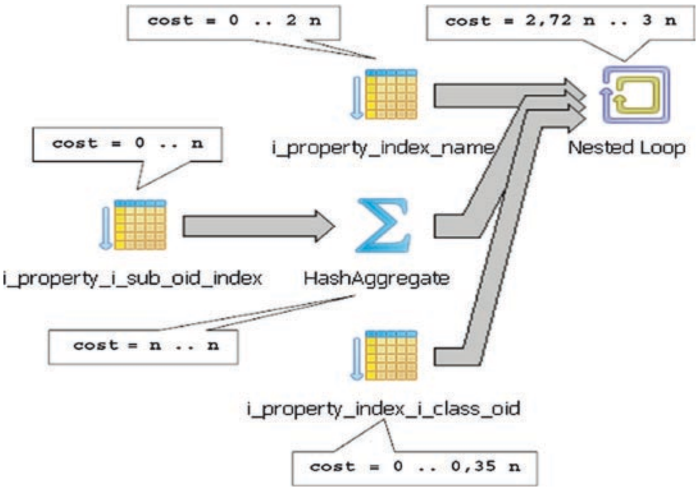


Fig. 5 Performance analysis of our approach

effective way, RDF data, overcoming limitations and rigidity of current approaches. A number of experimental results done on real world applications have demonstrated its efficiency and scalability.

Acknowledgment Giorgio Gianforme was Partially supported by Microsoft Research within the European PhD Scholarship Programme.

References

1. S. Alexaki, V. Christophides, G. Karvounarakis, D. Plexousakis, and K. Tolle. The ICS-Forth RDF Suite: Managing Voluminous RDF Description Bases. In *2nd Int. Workshop on the Semantic Web* (SemWeb'01), Hong Kong, 2001.
2. J. Broekstra, A. Kampman, and F. van Harmelen. Sesame: A Generic Architecture for Storing and Querying RDF and RDF Schema. In Proc. of *1st Int. Conference on Semantic Web* (ISWC'02), Sardinia, Italy, 2002.
3. E.I. Chong, S. Das, G. Eadon, and J. Srinivasan. An Efficient SQL-Based RDF Querying Scheme. In Proc. of *31th Int. Conference on Very Large Data Bases* (VLDB'05), Trondheim, Norway, 2005.
4. S. Harris and N. Gibbins. 3store: Efficient Bulk RDF Storage. In Proc. of *1st Int. Workshop on Practical and Scalable Semantic Web Systems*, (PSSS'03), Sanibel Island, Florida, 2003.
5. A. Kiryakov, D. Ognyanov, and D. Manovand. OWLIM: A Pragmatic Semantic Repository for OWL. In Proc. of *Int. Workshop on Scalable Semantic Web Web Knowledge Base Systems* (SSWS'05), New York, USA, 2005.

Electronic Medical Diary (EMD): Ethical Analysis in a HTA Process

D. Sacchini,[1] P. Refolo,[2] A. Virdis,[3] M. Casini,[4] E. Traisci,[5] V. Daloiso,[6] M. Pennacchini[7], and I. Carrasco De Paula[8]

Abstract Ethical analysis within Health Technology Assessment (HTA) – a comprehensive form of health policy research that examines the short- and long- term consequences of the application or use of technologies (in a broad meaning) – aims at analysing the moral questions raised by the technology itself and by the consequences of implementing or not a health technology as well as ethical issues that are inherent in the HTA process. The work intends to assess, within a HTA process, the ethical consequences of implementing the Electronic Medical Diary (EMD) in health care systems. The EMD is a device for supporting the daily registration and collection of clinical events related to a certain patient. The storage of these patient-specific clinical data constitutes the patient database (PDB) that may be connected with the many online tools which can improve the flow of information within the hospital information system. Such devices should be able to replace the traditional paper record.

Introduction

During the last four decades, health technologies have yielded notable advances.

As a first step, it is helpful to remind that the expression 'health technology' does not refer just to medical devices but – as the *International Network of Agencies*

---

[1] Università Cattolica del Sacro Cuore, Roma, Italy, dsacchini@rm.unicatt.it
[2] Università Cattolica del Sacro Cuore, Roma, Italy, pietro.refolo@rm.unicatt.it
[3] Università Cattolica del Sacro Cuore, Roma, Italy, andra.virdis@rm.unicatt.it
[4] Università Cattolica del Sacro Cuore, Roma, Italy, maria.casini@rm.unicatt.it
[5] Università Cattolica del Sacro Cuore, Roma, Italy, emma.traisci@rm.unicatt.it
[6] Università Cattolica del Sacro Cuore, Roma, Italy, viviana.daloiso@rm.unicatt.it
[7] Università "Campus Bio-Medico", Roma, Italy, m.pennacchini@unicampus.it
[8] Università Cattolica del Sacro Cuore, Roma, Italy, icarrasco@rm.unicatt.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_36,

for Health Technology Assessment (INAHTA) has observed – “it covers a wide range of methods of intervening to promote health, including the prevention, diagnosing or treatment of disease, the rehabilitation or long-term care of patients, as well as drugs, devices, clinical procedures and healthcare settings” [1].

A rapid introduction and diffusion of technologies within healthcare systems has followed the rapid technological progress. For example, in the United States (US), the coronary bypass surgeries executed in non-federal hospitals were 53,000 in 1974, 137,000 in 1980, 284,000 in 1986 [2], with a rapid and continuous diffusion during the years.

Consequently, the proliferation of health care technologies has accompanied burgeoning health care costs.

In these times of costs pressure, clinicians, regulators, patients, hospital managers, payers, government leaders, and others increasingly demand well-founded information to support decisions about whether or how to develop technology, to allow it on the market, to acquire it, to use it, to pay for its use, and more.

The growth and development of *Health Technology Assessment* (HTA) in government and private sector reflect this demand [3].

In fact, this research area has undertaken a more and more important role in many European and North-American hospital organizations to the point that now it represents maybe the most functional support to the management in decision-making process regarding the introduction and the use of electromedical devices, pharmacological therapies, procedures, organizational aspects and services in health structures.

The Term HTA

The expression HTA was first used in the US Congress in 1967 and it was initially employed in the areas of environmental problems and developments in the physical sciences; later, the emphasis was increasingly on medical technology.

In fact, in 1972 the *US Congressional Office of Technology Assessment* (OTA) was established (until 1995) and at the same time, Swedish researchers began to assess selected health care technologies [4].

Since then, the idea of technology assessment gradually spread to other countries and technology assessment activities started. It has attracted researchers from around the world and led to the establishment of governmental/non governmental agencies, many of them joined under international networks as the INAHTA, the *Health Technology Assessment International* (HTAi) and, more recently, the *European network for Health Technology Assessment* (EUnetHTA).

HTA definition is not univocal. For example, the INAHTA defines it as “the systematic evaluation of properties, effects, and/or impacts of health care technology. It may addresses the direct, intended consequences of technologies, as well as their indirect unintended consequences. Its main purpose is to inform technology-related policymaking in health care. Hta is conducted by interdisciplinary groups using explicit analytical frameworks drawing from a variety of methods" [1]; the EUnetHTA as "a multidisciplinary process that summarizes information about the medical, social, economic and ethical issues related to the use of a health technology in a systematic, transparent, unbiased, robust manner. Its aim is to inform the formulation of safe, effective, health policies that are patient focused and seek to achieve best value" [5].

Instead, its purposes are unambiguous: to advise or inform technology-related health policymaking [6].

In short – as Renaldo N. Battista noted – "health technology assessment is a bridge between the world of research and the world of decision making, particularly policy-making" [7].

HTA and Ethics

Within an HTA process, the ethical assessments evaluate the moral issues raised by a technology as well as the specific questions, those inherent in an HTA project [8–12].

Even though the assessment of ethical aspects of health technology is listed as one of its objectives, in practice, the integration of these dimensions into HTA remains limited [8].

As Henk ten Have has observed, such situation is paradoxical: "wishing to control the processes by which medical technology is developed, introduced, and used, and being concerned about the moral implications of new technologies, governments, agencies and researchers have developed programs of HTA; however, such programs mainly focus on effectiveness and safety, and hardly address in a systematic way the moral concerns that were part of their genesis" [13].

There are several reasons for producin the difficult ethics-HTA relationship [13]: (1) technologies are often considered by HTA producers as being ethically neutral and values-free; (2) the only questions perceived as relevant are technical and economical; (3) there are difficulties to integrating ethical considerations in HTA; (4) the training of HTA producers and available resources to conduct ethical analyses are often limited.

Once the importance of ethical analyses is admitted, the question of how to integrate ethics in HTA reports raises [14, 15]. In fact, ethical evaluations can be conducted very differently depending on the resources in the HTA organization, the technology in question and, above all, the research methodology [16].

Methods for integrating ethical aspects in HTA reports are object of several attempts. One of this is represented by the "triangular model" [17, 18], adopted by our school of bioethics.

The next step of this paper is precisely to realize, within an ideal HTA process, the ethical analysis of a recent technology, Electronic Medical Diary (EMD), using the "triangular model" as research methodology. Briefly, we describe the ethical methodology.

Based on the cognitivist aristotelic-thomistic ethical approach, this perspective is founded on the human person as a reference-value in the reality, around which all the ethical judgements should be subordinated [19–25].

Omitting the analysis of the theoretical aspects for the sake of brevity, practically this model realizes ethical evaluations through three steps [19, 20]: (1) data collection (gnoseological level); (2) ethical analysis (justifying level); (3) ethical evaluation (normative level) before the decisions and operative level. First step (the point A of an ideal triangle): an in-depth study of all factual data. In order to realize this study, putting these questions could be useful: (a) what is it about?; (b) how is it to be done?; (c) why is it to be done?; (d) what consequences? Second step: (point B): the ethical/anthropological understanding of facts or, in other words, the analysis of eventual values at stake or in conflict. In order to achieve this evaluation, the following operating criteria are utilized: (a) the respect for human physical life; (b) the contextual exercise of freedom and responsibility within decision-making process; (c) the safeguard of the therapeutic principle, according to which the human person has to be treated as a whole of body and soul; (d) the principles of sociality and subsidiarity. The third step (point C) consists of the ethical evaluation that guides the practical choices.

EMD: Data Collection

In medicine, data are increasingly being collected directly from the patients (*Patient Reported Outcomes*, PRO) [26]. This includes, for example, recording of symptoms, measurements of body function or the impact of the patient's condition on everyday activities.

To collect this kind of information, several electronic systems have been developed and, since the early 1990s, among them, the *Electronic Medical Diary* (EMD) is being increasingly being used in a wide range of clinical and research circumstances [27].

The EMD is a device for supporting the daily registration and collection of clinical events related to a certain patient. The storage of these patient-specific clinical data constitutes the *patient database* (PDB) that may be connected with the many online tools which can improve the flow of information within the hospital information systems. Such device should be able to replace the traditional paper record [28].

Its main purposes are to monitor the condition of patients suffering from a certain pathology and to collect primary data for pharmacological trials (for example, to evaluate the safety of drugs in wide clinical practice rather than in smaller controlled clinical trials) [27].

Ethical Analysis

The EMD produces benefits for patients: it has been shown to reduce medical errors, to facilitate quality improvement and to improve patient compliance [29–31].

The EMD also presents benefits for healthcare providers: for example, physicians are able to access health data through a common Internet connection at any time and to intervene at the right moment.

Nevertheless, the EMD raises considerable ethical issues. First of all, the EMD could affect patient's autonomy in two ways.

On one hand, it refers to the confidentiality of identifiable health information. As B. Lo has noted – "A single electronic health breach could affect more patients than a breach of confidentiality with paper records, because only one paper can be accessed at a time" [29]. In fact, several episodes of confidentiality breach have occurred: for example, the names of 6,000 persons affected by HIV infection were mistakenly attached to an e-mail sent to employees in the county health department [32]. So, all the adequate precautions need to be taken in order to protect health information placed in EMDs.

Moreover, patients may also become subjects of research studies without their awareness or consent. In this case, the use of the EMD involves a strain – which needs to be balanced – between protecting the confidentiality of personal information and allowing health information to be accessed to benefit patients.

On the other hand, the EMD involves "daily" registration and collection of clinical events. Therefore, patients should be prepared for the idea that their "obligation" will be constant and that this element could interfere with their future autonomy.

Another ethical issue deals with the consideration for which the EMD may produce incidental findings of pathologies, that still have not showed symptoms. Such incidental events could ask patients and clinicians to clarify their clinical relevancy. In other words, diagnostic investigation of fortuitous findings may requires further investigations. This is complicated since these random discoveries do not relate to the original reason of the use of EMDs but often drive patients into an additional diagnostic investigations with all the consequences. The eventual problem is that the true meaning of incidental findings could be difficult to know. In the worst case, someone could have been treated for something which in his/her lifetime would have not had any clinical relevancy.

Moreover, EMD could lead to a "depersonalization" of physician-patient relationships: as it reduces clinician's opportunities of communicating – it is well-known that patient-physician communication is a structural factor of whatever good clinical practice [20, 33] – effectively and orally with patients, it may damage this relation. In addition, patient must not get the impression that physician use EMD because he/she is "too busy" for taking care of his/her pathology.

Another ethical issue concerns the "complexity" of EMDs: even if patients are provided with sufficient information on procedures, possible benefits and risks of EMDs, they could not be able to understand how these technologies work correctly. Besides, surveys have found that a large number of physicians judge the use of EMDs to be very difficult [34].

Finally, the EMD presents economic and organizational issues. With reference to the first aspect, it involves the consideration for which technologies should be supplied to those who are in need of them in order to improve health. The concept of "need for a technology" means that there is adequate evidence that use of the technology provides a net benefit (benefit outweighs harms), also in comparison to other available modes of care. According to the available data, it should be unclear whether benefits outweigh harms in the context of EMDs. Up to now, an evidence-based decision whether a particular patient or a group of patients “need” or does not need EMDs can not be made. Besides, EMDs have high start-up costs and require additional modification and programming before use [27]. The charge for these extra costs depends on the reimbursement regulation of the respective countries. Taking into consideration the limited availability of resources for the health care sector, it will be mandatory to implement transparent and fair allocation procedures for the technology in order to respect the principles of sociality and subsidiarity, keeping in mind that the first means that the health status is a personal good, but is reflected in the society, depending on a responsible management of personal health; the second one tells that public/private authority is called to intervene to help the person only if he is not able to manage, to promote or safeguard himself.

With reference to the organizational issues, EMDs management could be hard. On this matter, the case reported by Lo is very instructive: “Cedars-Sinai Hospital in Los Angeles (US) abandoned a $34 million Electronic Medical Record system after three months. Physicians complained that the new Electronic Medical records increased time rather than saving it. Because of insufficient computer terminals in the hospital, physicians often had to wait to use the system. When the computer triggered an alert about a prescription, physicians rejected the alerts in over one-third of cases, because they believed that the alerts were not clinically meaningful. Furthermore, the computer did not accept common abbreviations and misspellings, forcing physicians to spend time making corrections” [29].

Ethical Evaluation

The work has intended to assess, within a HTA process – i.e. a process of systematic evaluation of properties, effects, and/or impacts of a certain health care technology – the ethical consequences of implementing the Electronic Medical Diary (EMD) – a new device for supporting the daily registration and collection of clinical events related to a patient – in health care systems.

From an ethical point of view, the implementation of EMDs proves to be complex because of the following reasons:

1. In fact, EMD causes benefits in terms of medical errors reduction, quality improvement facilitation, possible patient compliance improvement, easy access to health data, and incidental findings of pathologies.
2. The EMD could violate patient’s autonomy: major issues could spring from the possible episodes of confidentiality breach.
3. The EMD could make impersonal physician-patient relationship, as it could reduce clinician’s opportunities of communication.
4. Using EMD is often complex from a technical point of view.

References

1. International Network of Agencies for Health Technology Assessment (INAHTA) (2006) *Health Technology Assessment (HTA) Glossary*. http://www.sbu.se/filer/content11/ document/Edu_INHTA_glossary_2006_final. Cited 23 September 2008
2. Preston TA (1989) Assessment of Coronary Bypass Surgery and Percutaneus Transluminal Coronary Angioplasty. *Int J Technol Assess Health Care* 5: 431–442
3. Cicchetti A (2003) Strategic planning in healthcare organizations: the role of health technology assessment. In: Geisler E, Krabbendam K, Schuring R (eds) Technology, healthcare and management in the hospital of the future. Praeger, Westport-London
4. Banta HD (2003) The Development of Health Technology Assessment. *Health Policy* 63: 121–132
5. European network for Health Technology Assessment (EUnetHTA) (2007) *HTA definition*. http://www.eunethta.net/HTA/
6. Goodman CS (1998) HTA 101: Introduction to Health Technology Assessment. *Library of Medicine*, Bethesda
7. Battista RN (1996) Towards a paradigm for technology assessment. In: Peckham M, Smith R Scientific basis of health services. Bmj Publishing Group, London
8. Lehoux P, Blume S (2000) Technology Assessment and the Sociopolitics of Health Technologies. *Journal of Health Politics, Policy and Law* 25: 1083–1118
9. Heitman E (1998) Ethical issues in technology assessment. conceptual categories and procedural considerations. *International Journal of Technology Assessment in Health Care* 14: 544–566
10. ten Have H (2004) Ethical perspectives on health technology assessment. *International Journal of Technology Assessment in Health Care* 20: 71–76
11. Sacchini D, Refolo P (2007) L'Health Technology Assessment (HTA) e i suoi aspetti etici. Medicina e Morale, 1: 101–139 Anderson JG (2007) *Social, ethical and legal barriers to E-health, International Journal of Medical Informatics*, 76: 480–483
12. Braunack-Mayer AJ (2006) Ethics and health technology assessment: Handmaiden and/or critic?. *International Journal of Technology Assessment in Health Care*, 22: 307–312
13. ten Have H (1995) Medical Technology Assessment and Ethics. Ambivalent Relations. *Hastings Center Report*, 25: 13–19
14. Autti-Rämö I, Mäkelä M (2007) Ethical evaluation in health technology assessment reports: an eclectic approach. *International Journal of Technology Assessment in Health Care*, 23: 1–8
15. Hofmann B (2005) Toward a procedure for integrating moral issues in health technology assessment. *International Journal of Technology Assessment in Health Care*, 21: 312–318
16. Saarni SI, Hofmann B, Lampe K et al (2008) Ethical analysis to improve decision-making on health technologies. *Bulletin of the World Health Organization*, 86: 617–623
17. Sacchini D, Spagnolo AG, Minacori R et al (2005) HTA and ethics: the framework of ethical positions and the proposal of a person-centred model. *Italian Journal of Public Health* 2: 304
18. Sacchini D, Refolo P, Virdis A (2008) Gli approcci alle valutazioni etiche nei processi di Health Technology Assessment. *Medicina e Morale* 2: 319–349
19. Sgreccia E (1986) Bioetica. Manuale per medici e biologi. Vita e Pensiero, Milano
20. Sgreccia E (2007) Manuale di Bioetica. I. Fondamenti ed etica biomedica. Vita e Pensiero, Milano
21. Carrasco de Paula I (2004) Il concetto di persona e la sua rilevanza assiologia: i principi della bioetica personalista. *Medicina e Morale* 2: 265–278
22. Vanni Rovighi S (1963) Elementi di filosofia. III. La Scuola, Brescia
23. Cotta S (1981) Giustificazione e obbligatorietà delle norme. Giuffrè, Milano
24. Maritain J (1951) Neuf leçons sur les notions premières de la philosophie morale. Téqui, Paris
25. Seifert J (1989) Essere e Persona. Verso una fondazione fenomenologica di una metafisica classica e personalista. Vita e Pensiero, Milano

26. Bridges JF, Jones C (2007) Patient-based health technology assessment: a vision of the future. *International Journal of Technology Assessment in Health Care*, 23 (1): 30–5
27. Burton C, Weller D, Sharpe M (2007) Are electronic diaries useful for symptoms research? A systematic review. *Journal of Psychosomatic Research* 62: 553–561
28. Torchio M, Molino F, Sestero D, Seidenari C, Molino G (2003) An electronic medical diary for computer assisted patient management. *Minerva Medica*, 94: 167–179
29. Lo B (2006) Professionalism in the age of computerised medical records. *Singapore Medicine Journal*, 47: 1018–1022
30. Stanberry B (2000) Telemedicine: barriers and opportunities in the 21st century. *Journal of Internal Medicine* 247: 615–628
31. Stone AA, Shiffman S, Schwartz JE, Broderick JE, Hufford MR (2003) Patient compliance with paper and electronic diariesc. *Controlled Clinical Trials*, 24: 182–189
32. Health Privacy Project (2006) Health Privacy Storie, http://www.healthprivacy.org/ newsletter-url2306/newsletter-url_show.htm?doc_id=34076
33. Carrasco de Paula I, Comoretto N, Turriziani A (2007) Sulla richiesta di sospensione dei trattamenti nella prospettiva etico-clinica. *Medicina e Morale*, 2: 1149–1163
34. Anderson JG (2007) Social, ethical and legal barriers to E-health, *International Journal of Medical Informatics*, 76: 480–483

Epistemology of Information Systems: Time for Something New? Positivism, Interpretivism, and Beyond

F. Ricciardi[1]

Abstract Most of the major successes in IS field have occurred outside the scope of academic research (and of consulting activities). The central thesis of this paper is that such a "crisis of relevance" of IS research is (also) due to the quaint epistemological status that the discipline inherited from social sciences. Two epistemological approaches, in fact, are being put in practice in IS field research today: positivism and interpretivism. These are glorious and consistent approaches, but they are both rooted in a nineteenth-century, old-fashioned vision of science (the former to carry on its tradition, the latter to criticize and subvert it). Furthermore, positivism and interpretivism, by their own basic assumptions, deny validity to each other's outcomes, and this results in a sort of "epistemological apartheid" that causes further damages to the discipline.

Is a different epistemological approach possible? A new one, seeking to better receive the extraordinary amount of complex, original contributions that the last century has supplied about the question "how do we know?" The paper attempts to trace some essential lines of a proposal, and gives some very brief, but concrete examples about a new, "eco-humanistic" approach to IS research.

Introduction

Social Sciences Research: An Epistemological Apartheid

Information System researchers borrow their epistemological choices from social research. Within social research, many even complex epistemological approaches are taken into consideration, but IS field research is apparently polarized between

[1]Università Cattolica del Sacro Cuore, Brescia, Italy, francesca.ricciardi@unicatt.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_31,

just two of them: positivism and interpretivism (also mentioned as constructionism, or hermeneutics) [1]. Other possible approaches are actually mentioned in IS theoretical studies, such as criticism [2] and post-modernism [3], but they are almost completely neglected in *field* research. In fact, Chen and Hirschheim [4], and after them Richardson and Robinson [5] examined 1893 articles published in eight major IS publication outlets between 1991 and 2001. The outcome was that, within IS more influential journals, field researches concretely based on epistemological assumptions that differ from Positivism and Interpretivism are very rare: exceptions that somehow prove the rule. Positivism and Interpretivism, of course, are deployed by the different Authors in many different shades, but they are essentially characterized by their prohibitions: e.g., positivist authors are expected not to use subjective, moody opinions to validate a statement [7], whilst interpretivist researchers are expected not to generalize their findings [1]. Ironically, this "negative" epistemological approach widens the range of field researches that can be perceived either as positivist or interpretivist: e.g., in Latour's Dialog between a Student and his (somewhat) Socratic Professor [6] the Professor, though claiming that his position is not Interpretivist, gives the Student a series of suggestion (avoiding causal explanations, avoiding framework using/building, avoiding generalization, avoiding adding anything to the sensitive description of actors' experience and interpretations) that, if followed, would probably result in a Case Study that Chen and Hirschheim would perceive and classify as Interpretivist.

This paper stems from a deep dissatisfaction with this polarized epistemological state of IS research, that tends to answer to the question "how do we know?" by imposing mirror prohibitions; but the systematic discussion of the reasons of such a dissatisfaction would deserve a separate work. Here, I will confine myself to providing just an example, exploiting the synthetic power of paradoxes.

Post-Platonic Dialogue (a Good World for Murderers)

Moderator: "Ladies and gentlemen, we have a problem. There's been a murder. We must investigate".

Interpretivist: "Well, of course a murder is a social fact, and it can't be investigated with the methods of natural sciences".

Moderator: "Oh, that's awkward. Maybe the victim has fragments of skin of the murderer under her nails. I hoped we could make a DNA analysis".

Interpretivist: "It's out of question: it would not be epistemologically consistent".

Moderator: "Well, maybe we could talk with relatives and friends of the victim; maybe we could get some hints about what happened…".

Positivist: "Oh, it's definitively a naive idea. How could a chat or two guarantee the ascertainment of facts? You can't rely on the subjective opinions of few interviewees! No, we must be rigorous: we must identify a good number of similar murders, choose a significant number of people involved, prepare a survey, and by mailing the same well-designed questions to them all, well, with a statistical interpolation of data…".

Moderator: "But… don't you think that, in this case, some non-structured talks could be better? When talking, it's easier to scent tracks, to feel if your interlocutor has something to hide…".

Positivist: "We're not sniffing dogs, we're scientists! We need to verify, not to feel! Furthermore, an informal talk is not repeatable; how could I present such a stuff to my peers?".

Moderator: "But… just to start, just in order to hypothesize a possible motive of the murder…".

Interpretivist: "Looking for the motive is misleading! Causal relationships are dead abstractions, typical of positivistic will to power. The research activity must be aimed to understand, not to explain".

Moderator (sighing): "Well, maybe the Positivist researcher could manage the DNA analysis, and could also look for possible similarities between this crime and previous murders of still free serial killers… in the meantime, the Interpretivist could sensitively interview people to understand the context of this specific murder; and then, by integrating the outcomes, you could…".

Positivist and Interpretivist (together): "No, no! Are you nuts? Do you want us to lose our reputation? We can't work together! Interpretivist and Positivist research are not comparable! It would be methodologically wrong!".

(For Positivist and Interpretivist claims above, see for example: [1, 2, 7, 9]).

From Cognitive Diet to Epistemological Anorexia

I hope the reader doesn't deduce, from the brief paradox above, that I don't respect positivism and interpretivism. They have proved to be fertile and powerful approaches. Their respective prohibitions have precise historical reasons. Positivism had to cope with inveterate prejudices, that for example prevented people to consider severe depression as a disease: it was obstinately considered as a deadly sin (the medieval Acedia), and then as something to be blamed for. It's easy to understand why feelings and common, everyday interpretations were prohibited in every step of positivistic research. But also "engineering" approaches to social problems, on the other hand, led to severe failures, largely due to the typically positivistic overlooking of concrete everyday experience of actors – of meanings and feelings that shape their lives. Again, it's easy to understand why intepretivism prohibited all what "tasted" positivistic: causal investigations, theory testing and generalizations.

But sometimes passing from a healthy, detoxifying diet to a mortal anorexia is quite easy. I'm afraid it's not a chance that, during the last decades, academic research in IS (like, more generally, research in social sciences) has often been considered in crisis [8], whilst most of the major successes in this field (e.g., the

Web, or the systems for flight reservation) [9] have occurred outside IS academic (or consulting) settings.

Not surprisingly, many authors support epistemological “pluralism” [1, 4, 5] and suggest to choose opportunistically, each time, either a positivistic or an interactionist approach, according to circumstances and to research questions [2]. But pluralism is not very useful if the “plural” opinions are unable to dialogue; and methodological opportunism, even though pragmatic and aimed to overcome the epistemological apartheid, is not philosophically satisfactory [3]. Then, the ambitious purpose of this paper is to identify a new epistemological approach, rooted in contemporary (instead of nineteenth-century) science and sensitivity, to escape the unpleasant choice between being consistent and being effective.

Of course, there is not enough space here to systematically illustrate this attempt (this is deferred to further writings); this paper will just expound some fundamental features of the new epistemological approach I’m trying to propose.

An Eco-Humanistic Approach

1. Knowledge stems from the object (“the real thing”), from the subject, or from interaction between the two? Knowledge stems from the interaction between subject and object. Just like footprints, information (in-formatio, in Latin: the act of imprinting a shape) depends both from the foot and from the characteristics of the ground. But this interaction, unlike Interactionists say, cannot be wiped out within the (though important) social sphere: it’s something much more deep and much more ancient than any social negotiation.
2. What is knowledge? Why does it exist? Since we have discovered the DNA, our perception of knowledge has been deeply impacted. A new, ecological view of knowledge has been spreading in the last decades. Knowledge, in fact, is the only way available, for all living beings, to cope with their environments – and to go on being. Knowledge is the very strategy of life itself [10]. When talking of “right” or “wrong”, of “true” or “false”, we’re talking about life or death.
3. Is knowledge possible via rational thought only? No, definitely. Our immunity system harbors much more knowledge about infective agents than any medicine book – and a sudden explosion of anger can be much more precise than any philosopher’s logic deductions.
4. Is it possible to achieve a complete and absolutely objective knowledge about an object? No. Since the early 1900s, no serious scientist would answer “yes” [10, 11].
5. Can a knowledge process be more objective than another? Yes. Each knowledge process, like a cocktail, is made up of subject and object; but the reciprocal percentages are not fixed once forever. The share of knowledge coming from the object can increase or decrease to a certain degree. Double-checking can enhance the percentage of objectivity, within a cognitive outcome [10].

In IS research: What is the rate of subjectivity implied in the research? How and why is double-checking introduced, to raise the objectivity share? (AND[2] *what is the rate of subjectivity in the organization and IS*[3] *being studied?…)*

6. What makes knowledge valid? Our knowledge apparatus was selected through billion of years because it has been able to guarantee survival. Validation, then, has to do with survival, more than with "truth". That's why the outcomes of learning processes, just like organisms, can be involved in a real struggle for life: it's better that a "weak" idea dies, than having the organism itself weakened by an unfit knowledge. Validation is constructed during this struggle, in a complex process that involves and matches (1) direct observations of empiric reality (see positivistic claims), (2) cultural heritage and social negotiations (see interpretivist claims), (3) individual emotive conditions (see below, point 7), and (4) the use of innate frameworks[4] (like the cause-effect relationship) [12]. Valid knowledge, then, is not eternal nor absolutely true: simply, the more a knowledge resists haunting and vigorous attacks from the four sides listed above, the more it is valid.

In IS research: what are the validation criteria adopted by the researcher AND by the organization being studied? Why?

7. What is the cognitive role of emotions? Emotions and moods play a pivotal role in knowledge building. Some feelings, like boredom, trigger and manage the struggle *of meanings and ideas themselves* (see above, point 6), regardless of immediate survival needs of the organism. Figure 1 summarizes the seminal work of Lorenz about this issue [10, 13]. Need and competition, like a headwind, continuously push the little ship of our knowledge back, towards obsolescence and paucity: we need a sail to proceed against the wind, and this sail, Lorenz says, is *emotional*. But, as all sailors know, it is impossible to go straight against the wind: a zigzagging course is needed. That's why individuals and groups tend to alternate opposite cognitive moods: e.g., conformism and rebellion, optimism and doubt.

In IS research: what is the emotive momentum of the researcher AND of the organization being studied? Is "zigzagging course" granted, and how?

8. How is knowledge basically structured? As seen above, knowledge stems from challenges; but challenges can have different characteristics as to crucial factors connected with *time*. There are, in fact, *long term challenges*: problems that tend to have similar features during time. And there are *short-term challenges*: problems whose characteristics tend to be different and specific each time, and that require ad hoc solutions [10]. Long-term challenges are usually managed by

[2] IS researchers study *knowledge systems*. Epistemology, then, has a double feature in this discipline: it answers both the question "how do I know my object?" and "How does my object (the Information System) know?."

[3] Within this approach, an IS can't be studied without taking into account the whole organization, as a social system and as a sum of individuals. Separating the organization from its IS would be a sort of repetition of Descartes' error.

[4] The existence of innate knowledge, in the form of innate patterns/procedures, is difficult to deny today, after the recognition of innate behaviors in all animals.

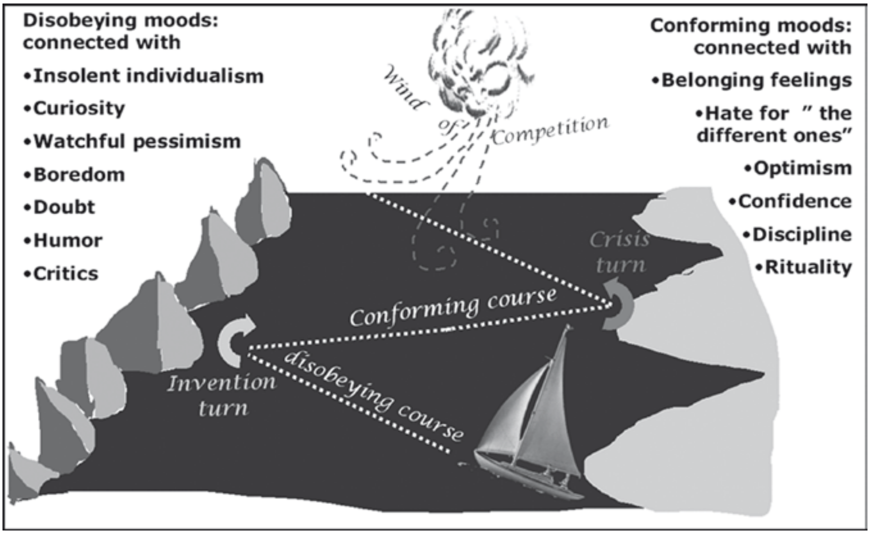


Fig. 1 The emotional "sail" allows the ship of knowledge to course against the wind of need and competition, on a bowline

long-term knowledge: that is, steady knowledge, stored in the form of automatic procedures and patterns. For example, knowledge about some ancestral risks can be stored in automatic procedures that cause adrenaline release if a snake appears. On the other hand, short-term challenges require intense learning activity to face the specific situation. For example, in case of ice on the road, the driver will stop listening to the radio and will concentrate on driving. Thus, knowledge flows in parallel layers, from the more slowly changing to the more rapid, extemporaneous ones, like submarine streams (see Fig. 2). Long-term knowledge may be very difficult to change; in some cases, it is locked in the deepest layers, where only natural selection can affect it. But also habits and traditions, even if they are not written in the DNA, may be quite difficult to change, and this exposes to the risks of rigidity. That's why *healthy* systems feature a continuous stirring of the sea of knowledge: what has been learned tends to be transformed in unaware, automatic habit or procedure, to save energy and to achieve major efficiency (pattern making); but the *a priori* in deepest layers, in turn, tend to resurface and to be weighed against reality (pattern matching/pattern testing).

In IS research: which are the traditions, fluencies, habits and maps of the researcher AND of the organization being studied? Is healthy "knowledge stirring" guaranteed by pattern matching/testing and pattern making?

9. What are the basic processes of knowledge development? They take place in the learning layer[5] (see Fig. 2), and they are: imitation, trial-error, training,

[5] Apart from those determined by natural selection.

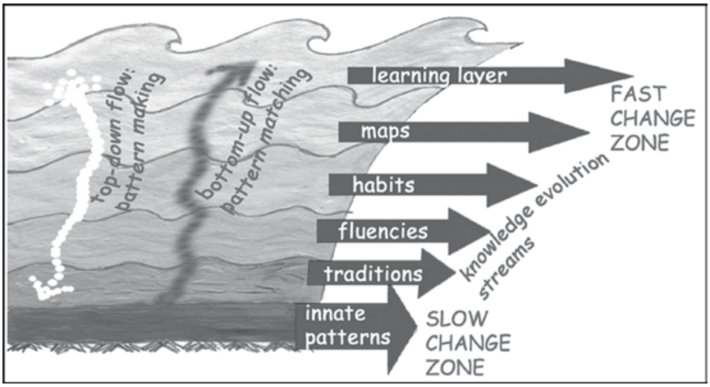


Fig. 2 Knowledge is structured in layers, like submarine streams. Pattern matching and pattern making provide flows of layer stirring

exploration [10, 13]. They all stem from *pattern matching* activities: e.g., a man (or a cat) locked in a box will identify the situation, making use of previous innate and acquired patterns, and will then make a series of "reasonable" attempts (trials-errors) to escape. The cat, for example, will try to squeeze its nose among bars; it won't try to escape by licking its foot or by closing an eye.

In IS research: which learning process does the researcher AND the organization being studied activate? Why? On the basis of what a priori patterns (e.g., traditions, fluencies, habits, maps) is pattern matching performed?

10. How can knowledge and reality be compared? Pattern matching is based on *analogy*, the powerful abstracting instrument that let us recognize what's similar – even *slightly* (but crucially) similar. By means of analogy, we are able to concentrate on few, important characteristics of the object, and to synthetically interpret it. The range of analogy is incredibly vast: it spans from natural language to mathematics, from figurative arts to the ability of animals to recognize predators [10, 12].

Let's see an example of complex analogy (an oriental aphorism): *"Pleasure and pain are two very near bells. When one chimes, also the other starts vibrating"*. Of course, pain and pleasure can't be *identified* as bells – nor can the territory be identified with the map; nor can the physical phenomenon be identified with the equation. But that's how we understand reality.

"*This looks like that*": analogy is at the very core of intelligence. In sum, *synthesis* and *linking* are crucial in pattern matching and pattern making, and make any further learning possible.

In IS research: what is the role of analogy in the researcher's (AND in the organization's) activity? How are the synthesis and interpretation activities performed? Which are the outcomes of analogy- based processes: pattern matching (classification), pattern testing, pattern changing, creative linking for new pattern making? Why?

A Breadcrumb Trace to go Beyond

Of course, in addition to the ten questions of Paragraph 2, some other questions are needed, to completely (and concretely) define the epistemological approach I'm trying to propose. For example: what is the role of goals, needs and values in knowledge building? What is the cognitive role of design? How do artifacts evolve?

The answers to such questions, and the in-depth examination of those included in previous paragraphs, are deferred to further writings. What's important here is to note that, according to the eco-humanistic approach, scientific knowledge isn't epistemologically different from all the other forms of knowledge: it is based on the same processes and structures described above, including emotive "sail", social negotiations, and so on. The peculiarity of scientific approach, from an eco-humanistic standpoint, is a matter of *method*, not a matter of epistemology. In fact, scientific methods stress particularly trial-error activities, performing them *on pattern matching itself.* During scientific work, patterns (and then analogies on which patterns are built) are made explicit and double-checked. As a consequence of this "making explicit" effort, scientific research can evolve rapidly, but can rely on less computing and memory power (most of human intelligence is allotted to *unaware, implicit* knowledge[6] [14, 15].

In other words, scientific methods make the learning layer of Fig. 2 faster, but thinner. In some circumstances this choice performs well, in others it doesn't. I hope that an eco-humanistic approach can give us tools for a lay, non-fundamentalist choice.

References

1. Orlikowski, W.J. and Baroudi, J. (1991) Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research*, 2, 1–28
2. Crotty M., (1998) *The Foundations of Social Research. Meaning and Perspective in the Research Process*, SAGE publications, London
3. Dobson, P.J. and Love, P.E D. (2004) Realist and Postmodernist Perspectives on Information Systems Researc: Points of Connection, Australian Journal of Information Systems 12/1
4. Chen, W. And Hirschheim, R. (2004) A Paradigmatic and Methodological Examination of Information System Research from 1991 to 2001, *Information Systems Journal*, 14, 197–235
5. Richardson, H. and Robinson, B. (2007) The Mysterious Case of the Missing Paradigm: A Review of Critical Information Systems Research 1991–2001, *IS Journal*, 17, 251–270.
6. Latour. B. (2004), A Prologue in form of a Dialog between a Student and his (somewhat) Socratic Professor. In Avgerou, C., Ciborra, C., Land, F.F. (editors) *The Social Study of Information and Communication Study*. Oxford University Press, Oxford.
7. Weber R., (2004) The rhetoric of Positivism versus Interpretivism, *MIS Quarterly*, 28, iii–xii

[6]Of course, the computer era is starting to change this situation.)

8. Pettigrew, A.M. (2001) Management Research after Modernism, *British Journal of Management*, vol. 12, S61–S70, special issue
9. Ciborra, C. (2002). *The Labyrinths of Information*. Oxford University Press, Oxford.
10. Lorenz, K. (1973), *Behind the Mirror. A search for a natural history of human knowledge*, Harcourt Brace, New York.
11. Einstein, A. (1954) *Ideas and Opinions*, New York, Random House.
12. Mayr, E. (1982) *The growth of biological thought: diversity, evolution and inheritance.* Oxford University Press, Oxford.
13. Ricciardi, F. (2008) The tacking knowledge strategy. Claudio Ciborra, Konrad Lorenz and the ecology of Information Systems, *Interdisciplinary Aspects of Information Systems Studies*, Springer.
14. Bateson, G. (1979) *Mind and Nature. A Necessary Unity*. Hampton Press.
15. Edelman, G.M. (1992) Bright Air, Brilliant Fire: On the Matter of the Mind, Basic books.

Ethics Among Peers: From Napster to Peppermint, and Beyond

U. Pagallo[1]

Abstract The aim of this paper is to analyse some ethical issues concerning the development of P2P systems. Some scholars consider them to be the key to a new social paradigm, others express alarm about how these systems undermine crucial elements of our societies. The result is often the ban of P2P technologies, like those on some campuses in the U.S. where Capitol Hill still debates on whether to impose more. Hence, by stressing why there is "ethics among peers," the idea is to strike a fair balance between the principle of precaution and the principle of openness, so that threats arising from P2P systems should not be a pretext to limit freedom of speech, research, or "the right freely to participate in the cultural life of the community," according to the phrasing of the Universal Declaration of Human Rights.

Introduction

There are two different ways to interpret the notion of "peering with" and, hence, the very idea of "peer."

On one hand, it is all about new forms of mass collaboration and participation that are creating, producing, and distributing goods and services on the Internet. The aim is to define this trend, according to the theory of information goods, the Internet distribution chain with its variable and marginal costs of production and distribution, along with network externalities and the very value of the "network information economy." Here, it is enough to mention the work by Benkler [1], and Anderson [2].

On the other hand, "peering" and "peers" are defined by a specific technology – namely, "peer-to-peer" (P2P) file sharing application-systems – known to computers scientists and experts for decades. Their notoriety to the greater public, nonetheless, came only with Napster in the late 1990s and, later, with the U.S. Supreme Court's

[1]Università di Torino, Torino, Italy, ugo.pagallo@unito.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_34, © Springer Physica-Verlag Berlin Heidelberg 2010

decision in MGM v. Grokster from 2005. By the end of 2007, this technology surpassed the Web in many parts of today's Internet as the most bandwidth-consuming application. However, P2P-systems have also become the favourite target of scholarly criticism concerning aspects of today's Internet and human interaction in digital environments.

In this context, I adopt the latter definition of "peer" for two reasons.

First, it enables me to limit the scope of the analysis in strict terms. The broader meaning, in fact, deals with such heterogeneous phenomena as Facebook, Second Life, Linux, Wikipedia, and, generally speaking, social networking and the Web 2.0. In addition, consider that for example YouTube's troubles with copyright claims are rather different than those of the open source movement. On the contrary, the second definition specifies a homogenous class of "peers" through proper P2P systems as Napster, Grokster, Steamcast, Gnutella, KaZaA, and so on. If every P2P system necessarily involves a peer-relationship, not any peer interaction or production concerns a P2P system.

Secondly, ethical topics are more specifically defined by the stricter perspective, even if, in both cases, political and sociological dimensions of the current debate can be summarised in two extreme positions. Some scholars present peer interaction as the key to a new paradigm: not only would communities spontaneously organise themselves on the Internet, but this organisation implies a normative judgement insofar as it represents positive developments that should be further encouraged [3]. This idea is strongly criticised by some other scholars who note that peer interaction undermines key elements of our societies such as incentives for knowledge producers or protection of the personal sphere from unwanted scrutiny. Andrew Keen's warning in The Cult of the Amateur is typical: "digital piracy, enabled by Silicon Valley hardware and justified by Silicon Valley intellectual property communists [sic!] such as Larry Lessig, is draining revenue from established artists, movie studios, newspapers, record labels, and song writers" [4].

So, in order to present a clear-cut picture of what is going on in the current debate, I rely on the second definition, analysing pros and cons of contemporary P2P interaction as debated before Courts and among scholars over the last years. This specific outlook allows me to focus on a set of well-defined issues which I present in four sections.

First of all, I insist on the impact of the laws adopted both in the EU and the U.S. In fact, in Section "P2P in Legal Systems," I consider some relevant cases that emphasise what judges believe to be P2Ps critical problem, i.e., their infamous ability to let people infringe other people's rights.

However, in Section "A Shift in Jurisprudence?," I stress a recent shift in jurisprudence as privacy is replacing copyright as the hottest legal issue discussed before some European courts in the more recent cases. This shift from copyright claims to privacy concerns, from intellectual property rights to human rights, sets the ethical framework of the paper.

In Section "Precaution, Openness, and Ethics of Information," I deepen the topic in connection with the principles of precaution and openness, considered as aspects of a more general theory of information ethics. So that, in Section "Some

Conclusions on Why Openness Should Prevail," levels of evidence, burdens of proof, and criteria for balancing fundamental rights, are summed up in a procedural standpoint in order to illustrate my main thesis, namely that openness should prevail in this specific realm of ethics. Indeed, there are some politicians in Washington like the Government Reform Committee Chairman Henry Waxman (D-CA), Rep. Tom Davis (R-VA.), or Rep. Paul Hodes (R-N.H.), who claim P2P systems should be banned or strongly regulated. Hence, the overall goal of the paper is to show why there is "ethics among peers," so as to ward off the risk that arise with these systems becoming a pretext for limiting freedom of research, speech, or infringing on "the right freely to participate in the cultural life of the community," granted by the Universal Declaration of Human Rights.

P2P in Legal Systems

Since the very beginning of the Internet in the early 1990s, scholars and, more importantly, legislators understood how computers would have changed society and, more generally, human interaction. Many years before any concern were raised about privacy and the protection of personal data, fears of such a technological revolution were emerging because of copyright infringements. Therefore, while spontaneous communities have been spreading via P2P systems on the Internet, lawmakers have often held this digital interaction to be "illegal." So, according to this version of the story, no room should be left for discussing ethical virtues of P2P systems, like free cooperation or symmetrical relationships for instance, since this technology would essentially let people infringe other people's rights.

After all, this is precisely the reading that prevailed in the first important decision on copyright and P2P systems in July 2000, when the U.S. District Judge Marilyn Patel granted the Recording Industry Association of America (RIAA)'s request to stop making copyrighted recordings available for download thanks to the Napster services. Although the San Mateo company did not store any information such as the recordings on its own computers, it was considered against the law to provide the information of the songs available on the computers of the community logged on. Indeed, it was not enough to claim that the Digital Millennium Copyright Act or DMCA (1998) grants immunity to ISP providers for what their customers do: This kind of protection would not include "contributory infringers" as the District Court of Appeals confirmed in its decision on Napster, in February 2001.

Four years later, it was the turn of the U.S. Supreme Court in MGM v. Grokster to present P2P systems, like Steamcast or Grokster, as technologies that promote the "ease of infringing on copyrights," so that its producers "can be sued for inducing copyright infringement committed by their users." Notwithstanding this unanimous holding by the Court, the Justices were however divided between the need to protect every technology "capable of substantial non infringing uses," as they stated in Sony v. Universal City Studios from 1984, and the necessity to provide remedies against new ways of copyright infringement.

So far, in the U.S., the problem is to determine whether software is creating "shared files folders" in order to make "available for distribution" that very information protected by copyright which would be illegally shared through P2P systems. In Elektra v. Barker, for example, a judge from the Manhattan federal court, Kenneth Karas, rejected the RIAA's "making available" theory in January 2008, although he admitted the sufficiency of the allegations of "downloading" and "distributing." Whereas Karas' whole reasoning revolves around the legal hypothesis of "offering to distribute for purposes of redistribution," it would perhaps have been more fruitful to stress that the suit was based upon a report of an investigator who claimed to have detected some "shared files folders" on the Internet.

In fact, besides copyright, there is a second major legal issue that involves P2P systems and their technological evolution, and that is privacy. Some recent cases suggest that a shift in jurisprudence has occurred. It might be too early to read it as a new hub in legal decision-making, but it surely draws attention to some key differences between U.S. and EU on P2P, copyright, and privacy.

A Shift in Jurisprudence?

The ethical issues raised by P2P systems are now cutting the edge. This is confirmed by some recent cases that have shifted scholarly attention from copyright claims to privacy concerns, or, in more general terms, from intellectual property rights to human rights. In order to grasp this trend, let me sum up two interesting cases from 2007. They clarify some crucial divergences between U.S. and EU legal systems.

The first case occurred in Italy, when Peppermint, a German music company, commissioned the Swiss firm Logistep to raise the IP addresses of people making available or downloading copyright-protected material through P2P systems. Claiming Peppermint to be the only right holder of some of the music shared on the Internet via P2Ps, the plaintiff required a section of the Tribunal in Rome to obtain from ISPs both "real addresses" and names of 3,000 suspected illegal file sharers. Judges granted the first wave of requests, so that three thousand letters were sent by a lawyer from Bozen (Italy) asking for EUR 330 from each indicted P2P user so as to settle the case and avoid further inquiry. (Peppermint would have received cash worth almost ten times its annual revenue in this way…) Few months later, however, the Tribunal of Rome changed its mind: On June 16th 2007, the Tribunal declared it illegal to spy on citizens "peering together" on the Web in order to protect copyright, on the grounds of articles 13, 23, and 37 of the Italian "code of privacy" (ICP) and articles 2 and 15 of the Italian Constitution. Neither art. 8, nor art. 9 from D-2004/48/EC, let alone art. 3.2 or 13 from D-1995/46/EC, or, finally, section 132 of ICP, can legitimate such a violation of privacy.

The second case occurred in the U.S., when the Motion Picture Association of America (MPAA) required – lawfully, according to federal judge Florence-Marie Cooper – the IP addresses of the users connecting to TorrentSpy files via their services in America. The MPAA had in fact filed a lawsuit against the popular P2P system, alleging that the company violated copyright law by helping users find pirated movies on the Internet. The dispute then overheated when TorrentSpy accused the MPAA of hiring a hacker, an ex TorrentSpy employee, to pilfer the company's trade secrets. Judge Cooper's interpretation, however, did not support the European company's thesis: Following the Wiretap Act, the word "intercept" would imply that someone intentionally intercepts e-mails and not just acquires them from an electronic storage. Since TorrentySpy used to store e-mails on its server before they were copied and forwarded to the hacker's e-mail account, the conclusion was that there would have been no interception at all! Forced to enable server logging against its own privacy policy, TorrentSpy, whose servers are physically located in the Netherlands, announced its decision to stop doing business in the U.S. on August 27th 2007.

The provisional moral of this story can be spelled out: What is legal in the U.S. – at least according to Judge Cooper – has been declared illegal in some recent decisions in Europe. A different approach that considers privacy as a fundamental right proclaimed by both the 1950 European Convention and the EU Charter of Nice from 2000, has made privacy into the most relevant legal issue debated in relation to the recent P2P cases. As the European Court of Justice confirmed on January 29th 2008, in Promusicae v. Telefónica de España (C-275/06), the EU law does not require Member States to lay down "an obligation to communicate personal data in order to ensure effective protection of copyright in the context of civil proceedings." Furthermore, the Court warned that, when transposing directives into national legal systems, EU member states must "take care to rely on an interpretation of them which allows a fair balance to be struck between the various fundamental rights protected by the Community legal order." (§ 70 of the decision)

The ECJ dictum must be taken into account and deepened for two reasons.

First, some exaggerations or unilateral conclusions drawn by both advocates and opponents of P2P systems can be avoided, by admitting pros and cons, merits and demerits of this technology in the light of that fair balance that has to be struck between various fundamental rights.

Secondly, some ambiguous parts of the decision – upon which I insist below – show that perhaps this shift in jurisprudence is not irreversible. Indeed, a normative perspective is required to clarify the metaphor of balancing rights in order to take sides in a work in progress.

Precaution, Openness, and Ethics of Information

I mentioned the popularity of P2P systems and the fact that they represent more than half of the traffic in many parts of today's Internet. Along with the current legal debate, the popularity of the technology has led to the increase of the ethical issues involved. For instance, they include intellectual property claims and new forms of cooperation as free software and/or open source models, hacker philosophy, gift economy and communal shareholding, or more general subjects like hierarchy, equality, and freedom among peers.

Bearing this in mind, I shall now focus on the ECJ decision from January 2008: The Court, in fact, did not exclude that, under certain circumstances, EU member states may oblige ISPs to disclose personal data, according to the latest directive on privacy: D-2006/24/EC.

Therefore, the current legal divergences – and different possible applications in balancing human rights – should not be read as campaigning for the reversal of copyright law claims into privacy priorities. You need not be an admirer of Andrew Keen and his criticism of the contemporary cult of amateurism, to recognize that P2P systems undermine key elements of our societies. Among the highly discussed issues we find privacy, connectivity and free riding, problems of national security, terrorism, and child-pornography. Compared to those threats, flowing from a weakly decentralized system in which the origin and destination of information could be traced with relative ease as in Napster, the new generation of strongly decentralized and encrypted P2P architecture is raising new concerns, since it provides plausible anonymity for its participants.

By weighing pros and cons, merits and demerits of these systems, let me clarify what the ECJ claims to be a "fair balance between the various fundamental rights protected by the legal order." The metaphor of balancing suggests a normative approach because we still ignore most of the potentials and risks of these file sharing application-systems. Are there new ways of exploiting P2P capabilities in optimising informational distribution while protecting, say, copyright holders? Is it possible to prevent crimes via P2P systems and securing people's privacy?

One traditional way to deal with the problem is the principle of precaution [5]. Several different formulations have been given. But, in a nutshell, the principle states that when science is not confident about whether or not a technology poses a threat, we should refrain from action. The burden of proof, in other words, has to fall on those who support the idea of taking action, because past experiences have taught us how to take precautions in the event of evidence on "false-negative" risks while acting against "false-positive" ones. In informational terms, the principle of precaution could be reformulated as follows: every adaptive attempt may reduce the complexity of the environment while enriching it at the same time, but highly sensitive issues as global warming, extinction of species, public health, or food safety, suggest that the burden of proof should fall on those who advocate taking action. The reason depends on the strict link between the reduction of complexity made by those attempts to adaptation and their direct consequences or impact on the whole informational sphere.

Still, the burden of proof varies according to the field and many cases have shown that the precautionary principle is inappropriate as a universal norm to deal with the unknown consequences of technology. Besides the aforementioned decision by the Supreme Court in the Sony case, some years later (1997), the Justices in Washington held part of the Communications Decency Act to be unconstitutional "due to the particular nature of the means," i.e., the Internet. In the same way Tim Berners-Lee, the inventor of the Web, believed it was crucial, both for philosophical and technical reasons, to develop a Web "out of control" [6]. Again, this is the idea shared by the Internet pioneer Vinton Cerf, who declared that "by placing intelligence at the edges rather than control in the middle of the network, the Internet has created a platform for innovation. This has led to an explosion of offerings that might never have evolved had central control of the network been required by design" [7].

So, the "levels of evidence" required by the precautionary principle suggest that in many cases in which we ignore the outcomes of technology, another norm is needed for orienting action; namely, the principle of openness that is obviously linked to the liberal tradition, say, of Karl Popper and Friedrich Hayek, and to some contemporary advocates of digital freedom such as Lawrence Lessig [8]. According to the principle of openness, we should act – and not refrain from action – when it is likely that engaging in action will increase the informational wealth of human life, while attempting to reduce the complexity of the environment.

Hence, if some scholars as Michael Bouwens present P2P systems as the new paradigm [3], and others, like Andrew Keen, simply view this technology as a threat to the basic tenets of our societies [4], the conclusion is that a "fair balance" must be found between openness and precaution. Keeping in mind some overstatements in the current debate that range from utopian communities with no "authoritative nodes" in pure distributed networks to the call for indiscriminate outlaw of P2Ps, the balance that is needed does not seem to offer, however, hard matters of principle. Let me explain how this result can be traced back to and founded on the Ethics of information.

Some Conclusions on Why Openness Should Prevail

The Universal Declaration on Human Rights (UDHR) offers a good testing ground in order to sum up the main points of this paper and to deepen the procedural approach on "balancing" that concluded the previous section.

On one hand, the second paragraph of art. 27 grants "the right to the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author." As I stressed in Section "P2P in Legal Systems," this is the right that has for a long time prevailed over the principle stated in the first paragraph: "the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits." The shift in jurisprudence analysed in Section "A Shift in Jurisprudence?" could thus be read as a search for a more appropriate balance between copyright and privacy, or in the terms of the UDHR between the protection of intellectual property and the right to freely participate in the cultural life of contemporary world.

On the other hand, pace copyright lobbies and despite the perils created by P2P systems, the idea is to balance the principle of precaution against the principle of openness. We therefore have to go back to the "levels of evidence" required by the precautionary principle: Indeed, the new ways to promote free participation and collaboration, to optimise the distribution of information on the Internet, together with new forms of producing goods, and the innovative means of cooperative and reciprocal nature with highly decentralized or distributed networks, illustrate the way in which this technology increases the informational complexity and wealth of digital environments and human interaction [1, 2, 9]. This is why the burden of proof falls on those suggesting that we should refrain from taking action and why openness should prevail when dealing with P2P file sharing-applications systems. However, the ultimate reason for this approach rests on substantial grounds: There is "ethics among peers."

References

1. Benkler, Y. (2006) The Wealth of Networks. *How Social Production Transforms Markets and Freedom*. New Haven, CT., Yale University Press.
2. Anderson, Ch. (2008) The Long Tail. *Why the Future of Business Is Selling Less of More*. New York, Hyperion.
3. Bauwens, M. (2005) P2P and Human Evolution. *Placing Peer to Peer Theory in an Integral Framework*. On line at http://integralvisioning.org/article.php?story=p2ptheory1.
4. Keen, A. (2007) The Cult of the Amateur. *How Today's Internet is Killing Our Culture*. New York, Doubleday.
5. Pagallo, U. (2008) Something Beyond Technology: Some Remarks on Ignorance and Its Role in Evolution, in Living, *Working, and Learning Beyond Technology*, edited by T.W. Bynum, M. Calzarossa, I. De Lotto and S. Rogerson, Tipografia Commerciale, Mantua (Italy): 623–631.
6. Berners-Lee, T. (1999) Weaving the Web. *The Original Design and Ultimate Destiny of the World Wide Web by His Inventor*. San Francisco, Harper.
7. Cerf, V. (2007) User-Generated Content Is Top Threat to Media and Entertainment Industry, interview in Accenture on April 16th.
8. Lessig, L. (2002) The Future of Ideas. *The Fate of the Commons in a Connected World*. New York, Vintage.
9. Pagallo, U. (2007) "Small World" Paradigm in Social Sciences: Problems and Perspectives, in Glocalisation: Bridging the Global Nature of Information and Communication Technology and the Local Nature of Human Beings, edited by T. W. Bynum, S. Rogerson, and K. Murata, Research Center and University of Meiji, Tokyo: 456–465.

Ethics in the Design and Use of "Best Practice" Incorporated in Enterprise Information Systems

C.M. Bull[1] and A.E. Adam[2]

Abstract This paper deploys case study research to examine the ethical issues arising from the design and use of "best practice" incorporated in enterprise packaged software, specifically a Customer Relationship Management (CRM) system. CRM like other Enterprise Information Systems (EIS) e.g. Enterprise Resource Planning (ERP) are global phenomena, increasingly influencing the strategic direction of a diverse range of organisations. Whilst the research on EIS continues to grow in a number of specific areas, there have been relatively few studies to examine the ethical issues associated with the design and use of such Information Systems (IS). This research reflects on MacIntyre's ideas in virtue ethics (MacIntyre A. After Virtue: A Study in Moral Theory (2/e). 1985: Duckworth, London), particularly his notion of "practice" to assess how such issues affect individuals in organisational life? For the purposes of scope we restrict our focus to the ethical issues arising from changes in task allocation and autonomy, and some of the associated issues in performance setting, monitoring and surveillance.

Introduction

The global market for the organisational adoption of packaged Enterprise Information Systems (EIS) continues to grow at a significant rate. According to AMR Research and Gartner, the specific market for two popular forms of EIS is expected to surpass $60 billion, e.g. Enterprise Resource Planning (ERP) $47.7 billion and Customer Relationship Management $13 billion in 2008. The research associated with EIS also continues to evolve, but has focused mainly on a core range of topics, such as; strategic objectives and the development of strategic

[1]Manchester Metropolitan University Business School, Manchester, UK, c.bull@mmu.ac.uk.
[2]University of Salford, Salford, UK, a.e.adam@salford.ac.uk

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_38,

frameworks [2–5], project implementation and the assessment of risk [6–8] and system maintenance or configuration [9] etc. Despite some relatively rare examples [10–12] there remain relatively few studies that assess the ethical issues associated with the design and use of such Information Systems (IS).

This paper seeks to address this void by evaluating some of the ethical issues arising from the design and use of enterprise CRM systems. We reflect on the experiences of an organisational case study of a CRM implementation within the United Kingdom. The remainder of this paper is structured as follows. Firstly, we evaluate diverse notions of "best practice" both in terms of those incorporated in or associated with EIS and those of MacIntyre's virtue ethics approach. This leads to a brief overview of the case study detailing some empirical practices and experiences of EIS. Finally we discuss the organisational changes arising from the use of such practices within EIS and how they affect individuals in organisational life.

The Packaged Software Notion of Best Practice

In packaged software systems design, the concept of "best practice" often refers to a belief that supposed "best" practices can be transferred to organisations when they purchase software packages. "Best" IS led business practices are often created through commercial partnerships between software producers and a few consumer organisations (often those who are involved in the piloting or initial uses of the original design stages of the software). Many of the features and processes within EIS are often well regarded by many organisations. However, whilst the purchase of an "off the shelf" package software system has some benefits, there are also some disadvantages if compared to a design of an individual bespoke system. Also implementation, training and migration issues are often broadly similar. The perceived benefits often result in the decision to implement without a sufficient evaluation of the changes, consequences or risks involved. The decision to source, implement and use an EIS inevitably disrupts organisational life and many existing processes. The scale of change and disruption varies depending of the nature and scope of the EIS. In the sourcing, implementation and use of EIS, the effects can be very significant to many organisations because such systems are designed to meet not only the needs of local organisational environments, but often also their regional / global operations and some of the other external relationships, e.g. suppliers and customers etc.

There are a range of potential issues arising from each process involved in the several stages through the design to the ultimate use of 'best practice" in EIS. This research could have focussed on the duties placed on software engineers [13], the existence in some areas of EIS of global monopolistic practices or a lack of competition and how that affects client choice or the quality of the software available [12]. However, this paper focuses on considerations of how some of the practices incorporated or associated with EIS, through the study of a CRM project impact upon individuals in a real life organisational environment. The organisational situations evaluated for this study relate to changes in task allocation and autonomy and the associated issues in performance monitoring and surveillance.

MacIntyre's Notion of Practice

In order to evaluate further the ethical issues in EIS, we refer to the work of Alasdair MacIntyre's virtue ethics [1], particularly his notion of "practice" because it is undervalued in terms of exploring organizational virtue and seriously neglected in relations to the study of IS. However, perhaps most important is the fact that MacIntyre's offers another notion of "practice" and this may illuminate our understanding of the issues raised by the notions often perceived and conducted within the packaged software industry. According to MacIntyre;

> '*A practice is a cooperative human activity whereby goods internal to that activity are produced in the course of achieving standards of excellence appropriate to that activity.*'

MacIntyre (1985) p.187.

There is some debate as to Macintyre's notion of "practice" [14]. However, in terms of IS, it would relate to a complementary notion of "practice" that delivers both external and internal goods. External goods relate to the need of organisational IS to be delivered on budget and according to the specification of organisational objectives. Internal goods involve developing techniques through education, research and training that help to produce new knowledge, development methodologies and treating users and other professionals well. Virtues are related to goods and practices – they are the character dispositions which allow people involved in a practice to attend to the maintenance of internal goods. A virtuous organization is one which affords its members opportunities to *act* virtuously, in maintaining the practice enshrined within the organization, in other words to act as moral agents. Thus, MacIntyre's virtue ethics is not necessarily at odds with some of the notions espoused with the packaged software industry, e.g. the needs for supplier and client organisations to generate profit objectives (an external good). However, MacIntyre's notion of practice somewhat departs in his caution and disapproval of the pursuit of profit objectives that seriously hinder the development of internal goods of excellence. Such constraints or the neglect of developing internal goods of excellence are considered to be unethical [1]. In summary, a virtuous organisation is one which affords its members opportunities to *act well*, in other words to display moral agency? In short, we ask whether the deployment of the information system can encourage or hinder the pursuit of the virtuous business organisation?

Research Approach

In order to evaluate the ideas of best practice in relation to EIS, this research reflects on the organizational use of a CRM system utilising a case study approach [15], [16] [17]. An in-depth case study was conducted over a period of a year.

The researcher (one of the authors) was based at the organization (UK-Co), at various periods for approximately 45 days. Whilst UK Co were fairly accommodating to the researcher in the conduct of the work, they did express that for a number of potential sensitive commercial reasons that their identity be kept anonymous. However, in line with their wishes, we are allowed to say that the company itself is an established manufacturer (more than 50 years trading) of urban furniture, employing approximately 220 employees. The company has a fairly traditional bureaucratic structure with strategic, tactical and operational levels of management and where work is performed in functions rather than integrated processes. Their strategic objectives for the use of CRM were varied but essentially centred on the need to constantly improve their customer focus in a highly competitive market.

The CRM project involved the researcher evaluating the CRM system, the conducting of interviews with approximately 32 people involved in the project. Evidence was also collected from ethnographic observations of spending time in the company and from attending several key meetings. Finally, the researcher was also allowed access to a number of corporate documents and insights into the negotiations and dealings with third parties such as external management consultants, software suppliers and training organisations.

Case Study

The company decided to use a CRM packaged software system to improve their customer focus in an increasingly competitive market. Before the CRM strategy began, senior managers conducted a survey of existing customer focused operations. The review highlighted some areas where the company had a number of strengths but also some weaknesses. Some important challenges highlighted were the needs to improve product delivery, customer liaison and after sales services. The sourcing of the EIS was perceived to be an efficient and effective method for achieving many of these goals.

In order to understand the impact of the CRM strategy and the resultant levels of change, it is necessary to highlight the legacy position at the company, prior to the project. UK Co's customer-facing process was divided between an External Sales Force (ESF) and an Internal Sales Force (ISF). The ESF were awarded relatively senior status within the company because of their market and product expertise, their ability to work independently and their contribution in generating customer revenues through regular customer contact and liaison. Some members of the ESF were specifically recruited on the basis of their proven abilities in these areas when working for other companies. The ISF are based within the Head Office and are mostly engaged in the administration and processing of some customer queries and orders. Many members of the ISF are awarded less senior status in terms of autonomy, decision making and remuneration.

The companies strategy centred on the adoption of "best practice" within the CRM packaged software. This was because the legacy IS were disparate, ad-hoc and fairly inefficient. In addition, there was a view that the CRM packaged software system had inscribed superior features because they had been tried and tested elsewhere. Space does not allow the detailing of the full ramifications of the changes involved and what follows is an analysis of the issues in relation to changes in autonomy, task allocation, performance setting and surveillance.

The use of the CRM system to direct the strategy established a series of changes in terms of disrupting some well established customs and practices. The changes were particularly acute for some individuals (or groups) than others. Changes for the ESF included; the need to record all diary appointments, customer contacts and customer site visits within the CRM system. In addition, ESF workloads were increasingly open to access by senior managers and the ISF and both groups could now schedule tasks for the ESF to perform with the CRM information system. The ESF and ISF were also given additional tasks to maintain in the CRM information system, e.g. reports on customer visits or contacts, an assessment of potential interests for products or services, advice on the potential of a customer to move to the quotation stage and what the company may do to gain an order from a quotation, pricing advice and delivery, installation and after sales service procedures. Finally, senior management could now monitor and scrutinise the performance of the ESF in far greater detail, e.g. they could now use the CRM information system to locate where members of the ESF were at any given time, how long activities were taking, how many activities were being performed, the success and failure rates arising from specific tasks, e.g. did a site visit to a customer result in a quote to supply or an eventual order.

The CRM system tended to judge success and failure within the processes of a number of short-term, fairly narrow, quantitative and tangible criteria, e.g. time spent on individual tasks, number of tasks pending or completed, the number of contacts or visits conducted, percentage estimate of a likely quotation or order from a customer, the size of a customer order, the cost of sales of each contract, the possibilities of a repeat quotation or order and a customer satisfaction rating etc. Previously much of this information wasn't recorded by the company in one central repository and some of this information was often retained in a tacit form.

Discussion

The case study raises a number of interesting issues in respect of packaged software development in practice and organisational notions of "best practice." This discussion will now reflect on some of the specific features of the case study in light of the two theories of "practice." The first observation from the case study is that organisations in a perceived problematic (or semi-problematic) state will often adopt the notions of best practice inscribed in packaged software systems, without critical evaluation if they have inferior legacy IS or that they are convinced that packaged software is designed by experts, with tried and tested capabilities.

Secondly, such IS can seriously change organisational customs and practices (depending on the nature of the EIS). Some changes in practice can be beneficial and some detrimental. Whilst senior managers were happy to set and monitor performance targets, there were several problems with such approaches. Some of the problems included the need for ESF and ISF members to perform a range a tasks which had previously been tacit, the ability of others (often ignorant of the nature of the processes involved) to schedule a range of highly demanding (if not impossible) tasks for others to perform. Resulting in many conflicts, e.g. the unrealistic scheduling of customer site visits or the excessive request to contact customers (often against the customers expressed interests).

Thirdly, the case study highlights some problems in relation to the additional and often un-productive time spent documenting tasks and activities. Some of these particular practices were eventually changed in line with the wishes of ESF and only those tasks deemed to be more purposeful or relevant were logged. There was also opposition from the ESF and ISF in relation to the needs within the EIS to provide forecasting data etc. Not only because the criteria was based on some fairly narrow and short-term quantitative criteria but also because staff were being increasingly judged on such unpredictable estimates. This monitoring and judging of performance resulted in some changes to this practice, e.g. over a period of time a more conservative approach evolved to forecasting the likely success of a likely quotation or order.

In summary, if the company balanced the notion of "best practice" inscribed in the CRM-EIS with that of MacIntyre's approach then our case study could have resulted in a different scenario. Firstly, a more holistic notion of practice would recognise the value of internal goods of excellence as equal to those of external goods. Thus, the ESF and ISF would have more involvement in the design and shaping of the tasks and activities required. Although the organisation required certain changes to some customs and practices, the existing performance of the ISF and ESF was often fairly effective. Some members of the ESF had been originally recruited because of their expertise and some level of initiative or risk taking. Many of the ESF had been used to practice where they could act and perform a range of tasks on a fairly independent and autonomous basis. Many resented the need to account more for their actions. Many objected to additional workload involved in populating the CRM system with tasks because of the relevance of performing such work. Some resented the interference in scheduling tasks because it was sometimes done by those lacking some expertise or knowledge of the nature of the tasks involved. Finally, some were opposed to the fairly narrowly based judgements based on the difficulties of gauging (often unpredictable) customer behaviour.

Some members of the ESF resisted such attempts to change such practices by failing to confirm to some of the demands of the CRM system or senior management (often in a covert manner). Some of the ESF blocked dairies with their own appointments (so no one else could). They also began setting a range of fairly safe or conservative performance targets for themselves (in order to look more successful) and they failed to record more high risk ventures unto they had actually succeeded. Whilst such real-world practices ran counter to the expectations of senior managers at UK Co, some members of the ESF and ISF were less surprised by such actions and perceived them to be a natural response to such imposed changes.

Conclusion

The organisational use of diverse packaged software systems, particularly EIS is increasingly a global phenomenon. Whilst there have been many studies of the development of EIS, there still remains a dearth of research focused on some other important issues, e.g. the ethical nature of EIS. This research sought to focus on the nature of implementing the design of EIS, through a study of two notions of "best practice," those often associated with the packaged software industry and those espoused by MacIntyre's virtue ethics approach. The study of EIS "best practices" and the use of MacIntyre's notion of "practice" offers some interesting in-sights, not only to the UK Co case study but also for packaged software information systems design and use in general.

Whilst the use of packaged software EIS can result in several benefits within organisations, an over-reliance of some of the practices inscribed in such IS can also have a detrimental affect. Our study highlights that some real-world problems arise from adopting a narrow notion of practice. It questions the nature of some packaged software systems design and development and also raises questions about some of the credentials especially the claim of it being "tried and tested." MacIntyre's notion of practice reveals a number of gaps in existing EIS notions of "best practice." These gaps relate specifically to how existing notions of practices inscribed in EIS can change existing customs and practices, even when some of these were originally purposeful or effective. The main contribution of MacIntyre's virtue ethics from this research is that it could help organisations to expand their notion of "best practice" when attempting to implement change. We argue that organisations (and the packaged software industry) may benefit from adopting a more holistic and inclusive approach in relation to the nature and focus of adopting "best practices." An approach based on the design and use of practices that include both external and internal goods of excellence.

References

1. MacIntyre, A., *After Virtue: A Study in Moral Theory (2/e)*. 1985: Duckworth, London.
2. Bull, C.M., *Strategic Issues in Customer Relationship Management (CRM) Implementation.* Business Process Management Journal, 2003. **9**(5): p. 592–602.
3. Newell, F., *Loyalty.com: Customer Relationship Management in the New Era of Internet Marketing*. 2000: McGraw-Hill, New York.

4. Fosser, E., et al. *Organisations and Vanilla Software: What Do We Know About ERP Systems and Competitive Advantage*. in *Proceedings of the 16th European Conference on Information Systems. Galway, Ireland,* 2008.
5. Zablah, A.R., D.N. Bellenger, and W.J. Johnson, *An Evaluation of Divergent Perspectives on Customer Relationship Management: Towards a Common Understanding of an Emerging Phenomenon.* Industrial Marketing Management, 2004. **33**(6): p. 475–489.
6. Sumner, M., *Risk Factors in Enterprise-wide/ERP Projects.* Journal of Information Technology, 2000. **15**(4): 317–327.
7. Parr, A. and Shanks, G. *A Model of ERP Project Implementation.* Journal of Information Technology, 2000. **15**(4): 289–303.
8. Bull, C.M. *Politics in Packaged Software Implementation*. In *Proceedings of the 11th European Conference on Information Systems (ECIS)*. Naples, Italy, 2003.
9. Light, B., *The Maintenance Implications of the Customisation of ERP Software.* The Journal of Software Maintenance: Research and Practice, 2001. **13**(6): 415–430.
10. Wagner, E.L. and S. Newell, *'Best' for Whom?: the Tension Between 'Best Practice' and ERP Packages and Diverse Epistemic Cultures in a University Context.* . Journal of Strategic Information Systems, 2004. **13**(4): p. 305–328.
11. Adam, A.E. and C.M. Bull. *Exploring MacIntyre's Virtue Ethics in Relation to Information Systems.* In *Proceedings of the 16th European Conference on Information Systems (ECIS). Galway, Ireland,* 2008.
12. Adam, A.E. and B. Light, *Selling Packaged Software: An Ethical Analysis*. In *Proceedings of the European Conference on Information Systems.* Turku, Finland, 2004.
13. Walsham, G., *Ethical Theory, Codes of Ethics and IS Practice.* Information Systems Journal, 1996, **6**(1): 69–81.
14. Moore, G. and R. Beadle, *In Search of Organizational Virtue in Business: Agents, Goods, Practices, Institutions and Environments.* Organization Studies, 2006, **27**(3): 369–389.
15. Walsham, G., *Interpretive Case Studies in IS Research: Nature and Method.* European Journal of Information Systems, 1995, **4**(2): 74–81.
16. Stake, R.E., *Case Studies*, in *Handbook of Qualitative Research*, N.K. Denzin and Y.S. Lincoln, Editors. 2000, Sage Publications, Thousand Oaks, CA, pp. 435–454.
17. Van Der Blonk, H., *Writing Case Studies in Information Systems Research.* Journal of Information Technology, 2003, **18**(1): p. 45–52.

Governance and Organizational Aspects of an Experimental Groupware in the Italian Public Administration to Support Multi-Institutional Partnerships

N. Casalino[1,2] **and M. Draoli**[3]

Abstract The partnerships between research, public administration and ICT industry are considered the main ways to enhance development and competitiveness, but often they involve several organizations, stakeholders and actors. Groupware systems can support collaborative activities using the technology to assist group processes such as information sharing, problem solving, documents editing, decision making, planning, scheduling, etc. We have to understand more about collaborative processes in public administrations to enhance contacts and communication between experts, competence and research centers. So we have to define a model for CSCW governance in order to identify and introduce technological innovations in multi-organizational and highly innovative contexts and, afterwards, disseminate the best practices.

Introduction

CSCW (Computer Supported Cooperative Work) is a term used mainly in the academic research context to summarize the use of ICT by groups of people working together. These techniques support collaborative activities using the technology to facilitate group processes such as information sharing, discussion, joint editing of documents, decision making, etc. CSCW studies investigate how people work in groups and how technologies can be applied in the best way to support their activities. The adoption of CSCW methods in Public Administrations requires multi-disciplinary approaches and fields (psychology, sociology, anthropology,

[1]Università Telematica G. Marconi, Roma, Italy, n.casalino@unimarconi.it
[2]CeRSI - Università LUISS Guido Carli, Roma, Italy, ncasalino@luiss.it
[3]CNIPA - Centro Nazionale per l'Informatica nella PA, Roma, Italy, draoli@cnipa.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_11,

human-computer interaction, etc.) [1]. Differently, groupware is a term to define systems that are used for collaborative working. An easiest way to understand is to see groupware as the technology, CSCW as activities, methods and practices.

Research about the adoption of CSCW and groupware in private enterprises is quite well established. There are relevant examples of how CSCW can support a collaborative efforts of different organizations in research activity. This is typical of consortia created to realize EU funded research projects. Few experiences have been made about the adoption of this approach to support organizations built on large and complex partnerships of many partners. The mechanisms for data replication, distribution and coordination, have a significant impact on the forms of interaction between Italian Public Institutions in which civil servants can engage, and therefore on how their work can be coordinated. To support this relationship, it is important to focus the attention on CSCW flexibility, and in particular on the choice and adoption of the several tools embedded. Flexibility is the key to support many requirements of a working group or of an individual (for example group tailoring, customization and re-purposing, changing group membership, projects and role, etc.). Based on an analysis of a current open-source CSCW system, and on the interaction between user behavior and system features, we want to verify how these ideas can be applied to provide an open and customizable framework, enabling civil servants and other employees to increase their productivity and support multi-institutional collaboration.

Partnerships for Innovation

It is a common convincement that public-public partnership should be fundamental for the innovation process of Public Administration (PA). In the specific of ICT driven innovation, partnership is aimed to integrate different organizations, stakeholders, and actors in the design and implementation of e-services [2]. The link between innovation and research is considered the main way to improve development and competitiveness. Specifically, the expectation is that the alliance with the system of public research could be relevant to accelerate the innovation process of the PA. In this scenario, CNIPA (the Italian National Centre for Informatics in PA) has the main goal of coordinating the innovation process when it is driven by ICT. The number of central administrations is about 80, with a dimension spamming from few tens to more than one hundred thousand employees. The whole ICT infrastructure counts more than 1 million PCs and has a cost of maintenance of about 2 B€ for year. More than 25,000 civil servants are directly committed to manage the system (Fig. 1).

The Italian public research system involves more than four thousands researchers in the ICT fields, with a public investment of about 350 m€ every year. The idea that underlies the specific strategy of CNIPA is that promoting partnerships and strong alliance between PA and Research is a fundamental step to accelerate the development and the adoption of innovative solutions.

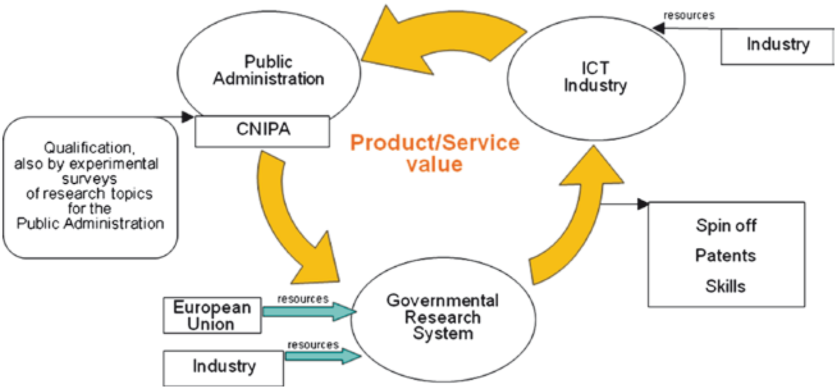


Fig. 1 The virtuous collaboration model between PA, Research and Industry

Theoretical Framework

The analysis perspective is organizational one, that emphasizes the study of the relationships and of the several configurations between Information Systems (IS) and hierarchical structures in PA. We have to consider the CSCW field, concerning the development of IS and technological instruments for multi-participant working activities. Research into CSCW seeks to understand how people and organizations interact and how it is possible to support them [3]. The growth of interest in the groupware systems has led many developers to adapt these tools for use in group situations. To develop effective group tools, it is important to understand more about collaborative processes. The goal is to identify models and best practices for the CSCW governance applied to multi-organization and highly innovative contexts. The subject of the IS to support collaborative work and their adoption in the organizations has been widely discussed in organizational literature and has produced, in the last 20 years, various currents of thought. Beginning of 80 Years, they evolved from simple processing technologies to organizational and relational technologies, increasing progressively the impact exercised on the organizations and making very crucial the moment of integration planning between IS and organizational structure [4]. The main approach in literature till first 90 years has been of deterministic type and technology determines, in an univocal way, organizational changes [5]. Therefore the IS are considered an independent variable that provides an one-way effect on the organizational behavior.

This approach has been defined too simple, since it considers the revolutionary potentialities of the IS without the conditions and ties of a business context. Some researchers asserts that binding relations between technology and structure do not exist [6]. The IS can be used in order to centralize the decisions or, on the contrary, to decentralize them. A different approach [7] consider the organizational and strategic information requirements as univocal determining of

IS dissemination and use degree. Also this approach appear to be too deterministic, since IS structurally have a modular and opened structure that prevents a right definition of the application modalities, without to consider the specific organizational context [8]. It is not enough therefore to analyze the technological aspect of the IS, but it is necessary to consider also their meanings inside the business context. Some authors support the perfect correspondence between the IS planning and the organizations planning [9]. A social analysis of these systems permits the inclusion of the main features in an organization. Some studious compare them to the "science of the artificial" in which the structure of the physical environment is studied to interact with the tasks in hand. The perspective adopted considers the social, organizational and technological internal processes of activities [10,11]. These subjects fit very well in Italian PAs, that operate especially in the research sector and in which people work in groups focused only on a specific process or a common goal. To support these kind of activities, it is also important to understand their information processing requirements so that technology can be implemented without disrupting activity by removing the resources used in co-ordination [12].

System Description and Features

The introduction of systems that involve the transformation of work practices, maintaining the resources used in coordination, may be critical such as proposing augmentative technologies. The findings of the trial is how work processes operate simultaneously at personal, organizational and inter-organizational levels. The difference between the formal organizational procedures and the informal social processes that compliment them, was analyzed to explain how these are interrelated in the performance of the working task and their importance to the mechanisms used to co-ordinate actions. Adopting or implementing technology is not enough, we need to learn more about how groups, organizations and technology are organized. The platform adopted for the testing phase is "eGroupware," a common open-source web-based and multi-user groupware suite. It is a flexible framework that contains many applications (at present 32), including group calendars (personal and group scheduling with notifications and alarms), a mail server, a task manager, a contacts management system, a document management system with versioning tracking, a wiki, an activities and disputes tracking system, a time-tracker application, a forum, a knowledge base and a project management tool including a Gant chart designer for planning and scheduling. eGroupware is widely adopted in many public contexts to manage international and multi-institutional projects, for example EU-funded research initiatives (Fig. 2).

It has been adopted and customized for a research conducted and coordinated at the Experimental Laboratory of the CNIPA. The name chosen for this online web-based framework is "CollaboraPA." In this situation the core of the system is a document manager called myDMS (Document Management System.). It allows to

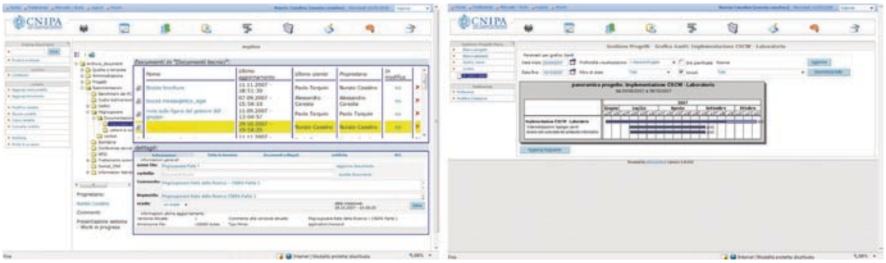


Fig. 2 Some screenshots of the document management system and of the project management tool including the GANT chart designer for planning and scheduling

upload whatever type of document. Once a document is in myDMS, it is possible to assign comments, permissions, versioning, expiration dates or to store it in folders and sub folders, as appropriate. The system notifies by email when a document is updated. Currently are available about 1,205 documents of which 914 are single issues. Besides the number of users registered on the platform are 261 from 33 different organizations. In particular about 80 users are researchers and academics, other 120 units come from PAs and 60 are university students. Other Italian partners with their IS offices are involved in this project. They adopted the platform for the test inside their organizations: CNR (National Research Council), Ministry of the Interior, ENAV (Italian Company for Air Navigation Services) and a CNIPA committee in the field of geographical information systems.

Research Method and Case Analysis

The goal of our research is to understand if and how CSCW systems can support the model of partnerships for innovation. The research method is based on the systematic observation of the project during its life time.

The steering group of the initiative is based on the experimental laboratory in CNIPA. Its main task is to involve in the projects individuals and administrations that can contribute to the development of innovative solution for PA. At this purpose the steering group manages the CollaboraPA framework and coordinates the development of similar platforms in the other administrations that decided to adopt it. Several research groups and academics are collaborating with the steering group to develop and improve the system. The period of observation of the experiment had a duration of about 12 months. During this period the key persons involved in the project and several users of the system have been interviewed. Meetings with the participation of the representatives of the administrations, researchers and developers have been observed. Workshops opened to all interested parties have been held about every 2 months.

The first result of the research is a more systematic view of the multi-institutional environment, where typically ICT is promoted and introduced. We recognize three typical organization models for innovation initiatives:

- Project group: is a multi-institutional group of individuals working to reach a common innovation result in a given timeline. It is usually formalized with a top-down administrative provision. The level of confidentiality of the group activity depends from the topic of the project. The group can be structured according to a hierarchical model.
- Organizational unit: is a group of individuals belonging to the same PA or to the same organizational unit inside the administration. Employees belonging to the same group contribute to a specific functional task supporting innovation programs and projects. Organizational units from different institutions often need to collaborate to reach shared goals, such as preparing a formal agreement, or managing human resources that can be involved in an innovation program. They usually adopt a confidential approach on their activities.
- Community of interest: is a group of people sharing a common interest for a specific innovation theme or for a competence on a specific technology. The main goal is knowledge sharing, without particular requirements of confidentiality. Typically, it is organized in a non hierarchical manner.

As already told, one of the explicit goals of the initiative is to enhance contacts and communication between experts, competence centers and managers in order to identify and introduce technological innovations in their organizations and, afterwards, disseminate the best practices. CollaboraPA stimulates institutional networking and partnerships for innovation. To reach this goal, it has been decided to adopt a further organization model: new groups involve individuals from all the managed interest groups, organization units and project groups, and have access to the widest set of resources (information, documents and tools) that have not been defined as “confidential”. These groups aims to create the favorable conditions for spontaneous “social networks” and individuals are actors of the relationships.

The second result of the research regards a systematic model to fit into a CSCW system the multi-institutional environment where technological innovation is promoted and introduced. A fundamental aspect for the governance of these systems is represented by the users’ groups, resources, contents and access rights management. If an user belongs to a group, he obtains some determined privileges to access to resources or to communicate with some colleagues. CollaboraPA allows, for each tool, the possibility of specifying the groups privileges by means of a sophisticated Access Control List (ACL) tool. This method is very flexible but at the same time quite complex to be governed. With the growth of the number of end users and the complexity of the groups, it is important to adopt a systematic representation of the system. The main rule is that for each physical group (project, organization or community) at least one group in the CSCW system must be configured. Moreover, two “virtual” social groups have been defined: Default and LAB. The users belonging to the Default group have a minimal set of access rights to tools and contents. The Default group is a whole that contains many other groups. It is possible to have groups of end users that don't take part to Default group and others in which end users belong to both typologies.

Figure 3 is a representation of the groups available in CollaboraPA experimental context. Each circle represents a group, the users associated to the group and the set of resources managed by the users themselves. The partial intersection of two groups G1 and G2 means that some users are in common and that they have access to a common subset of resources. The complete inclusion of a G1 group in a G2 group means that all the users of G2 are also users in G1 and that they owns at least all the rights of users in the wider group. The following typical configurations of the CSCW system can be recognized:

- The G1 is the simpler case: the resources available to the members match with those assigned to the group. It is a typical configuration to implement a "plain" project group or a community of interest.
- The second case represent an intersection among groups: there are civil servants and researchers that simultaneously belong to both G2 and G3. They inherit all features of both groups and obtain an higher number of resources and services. It is a typical configuration to implement "simple" project groups or community of interests that share one or more individuals.
- The G4 is like G1, but the difference is that the members do not belong to Default. This group does not share resources and documents with the others, typically due to security reasons.
- The G5 is a typical case of groups that are constituted owing to partnerships between CNIPA, Research Institutions, Universities and external consultants: some members do not belong to the Default group because they aren't involved in the main tasks.
- The G6, G7 and G8 represent the most complex combination. They represent the hierarchical organization of an area, an office, a sector, a working group or a

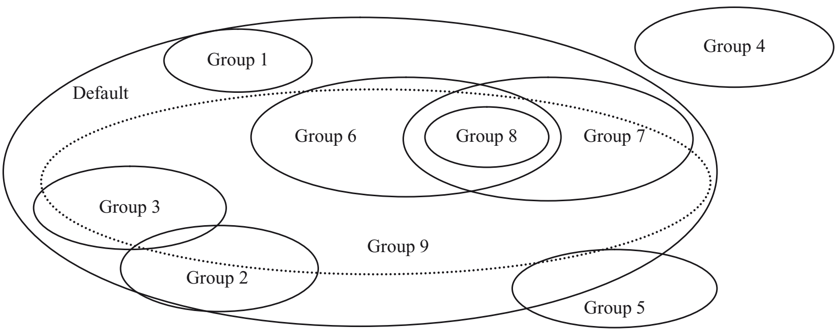


Fig. 3 Scheme of possible groups' configurations, in the research conducted at CNIPA

project. In the G8, in fact, the members inherit the rights of the other groups and obtain more.
- The dashed group represents the Lab virtual group. It comprehends all users and resources shared with all other groups, and its function is mainly social.

For each group can be defined a person in charge (that can correspond with the project owner). He manages the allocated resources, can add new members to a group and assign first and second level permissions.

The third result of the research regards suggestions for a systematic management and governance of multi-institutional collaborative environments.

The governance of the system has been driven by the following principles:

- The establishment of a well committed steering group, encouraging collaboration and ready to accept contributions.
- The establishment of a group of users committed to populate the system with a relevant number of value documents. Students are involved in this task.
- Researchers and academics are involved in the project. They can freely use the system and suggest improvements.
- CollaboraPA itself is developed in a collaborative way, through a multi-institutional working group, composed by researchers and other civil servants.

After more than 1 year, the project itself has been organized as follows:

- The steering group coordinates the development and involves new partners.
- For each partner we recognize two main figures: one manager, who makes the decision of participating to the project and one executive, whose goal is to involve employees to use the system.

Currently the whole number of users of CollaboraPA is about 600 units and a multi-institutional network of experts is supporting them.

Conclusions

Our study reveals that a groupware implementation, in a multi-user and multi-institution context, is a complex activity, because it involves several applications used by civil servants. Studies on the process of IS acquisition clearly show that it proceeds through several evolutionary stages [13]. During this development the priority doesn't seem to be tied only to the acquisition process, but mainly to the paths of learning and organizational change. Experience suggests that these paths should be designed and carefully managed in order to allow the acquisition and effective use of ICT applications by the users. The results of our research identify a lot of elements to organize multi-institutional activities and tasks. The investigation reveals how the analysis of some indicators and specific key aspects, that regard the current organization and IS implementation, are fundamental. It demonstrates how the technology can be used to coordinate behavior, and can influence the working performance. The analysis also demonstrates how social processes, organizational procedures, and local resources come together in managing the interdependencies between the civil servants in the Italian PAs.

References

1. Grudin J. (1994). Groupware and social dynamics, *Communications of ACM*, 37:92–105.
2. Casalino N., Draoli M., Petrucci A., Lancia M., Puccinelli R. (2007). Le reti nella Pubblica Amministrazione e nella Ricerca: metodologie e strumenti open source per la collaborazione multi-organizzazione, *AICA 2007*, Milano, 233–246.
3. Ciborra C., Olson M. H. (1988). Encountering electronic work groups: a transaction costs perspective, *ACM conference on Computer-supported cooperative work*, 94–101.
4. Baskerville R., Myers M.D. (2004). Making IS research relevant to practice. *MIS Quarterly* 28(3), 329–335.
5. Strassman P. (1985). Information Payoff: The Transformation of Work in the Electronic Age, New York, Basic Books, 16–23.
6. Galbraith J. (1977). Organization Design, Addison Wesley Reading, MA, 39–47.
7. Sampler J. (1996). Exploring the Relationship Between Information Technology and Organizational Structure, in Earl M., Information Management: The Organizational Dimension, Oxford University Press, Oxford, 132–144.
8. Boddy D., Buchanan D. (1986). Managing New Technology, Blackwell, Oxford, 45–59.
9. Lucas H., Baroudi J. (1994). The impact of information technology in organizational design, *Journal of Organizational Computing*, 11–18.
10. Ciborra C. (1989). Tecnologie Di Coordinamento, Franco Angeli, Milano.
11. Previtali P. (2003), L'impatto organizzativo delle ICT, *Business and Management Sciences International Quarterly Review*, 3–4.
12. Kling R. (1991). Co-Operation Co-Ordination and Control in CSCW, *Communications of ACM*, 34(12):31–34.
13. Bruschi G., De Marco M., Giustiniani G., Manna E., Rossignoli C. (1992). L'organizzazione Dei Sistemi Informativi Aziendali, Il Mulino, Milano.

Heterogeneous Information Model Unification as a Pre-requisite to Resource Schema Mapping

L.A. Kalinichenko[1] and S.A. Stupnikov[2]

Abstract An innovative technique for formation of collaborative consortia of enterprises in virtual organizations (VO) is considered. The technique is based on semantic integration of relevant enterprise information systems (EIS) in the VO specification treated as a subject mediator over the EISs involved. The paper explains how the canonical model for the VO specification is synthesized. Main part of the paper is devoted to the presentation of the process of EIS resource information models semi-automatic mapping into the canonical one assisted by the Heterogeneous Information Model Unifier. It is important to note that the Model Unifier is a universal tool that assists in development of mapping of various kinds of information. The process of mapping includes construction of a compiler from a resource model into the canonical one with the help of metacompilation tools. The mediation technique presented is applied in the astronomical Russian Virtual Observatory (RVO).

Introduction

This paper[3] is focused on forward looking contributions as a bridge between research in semantic interoperability and information integration in general and application of the results to the enterprise interoperability (EI) domain. Many organizations around the world work in accordance with the recently defined EI roadmap [1]. According to it, one of the most important next phase enabled by EI is the sharing of knowledge within a Virtual Organization (VO) to the mutual benefit of

[1]Russian Academy of Sciences, Moscow, Russia, leonidk@ipi.ac.ru
[2]Russian Academy of Sciences, Moscow, Russia, ssa@ipi.ac.ru

[3]This research has been done under the support of the RFBR (projects 06-07-89188-a, 08-07-00157-a) and the Program of the Department of Nanotechnologies and Information Technologies of RAS entitled as Basic principles of information technologies and systems (project 1-10).

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_43, © Springer Physica-Verlag Berlin Heidelberg 2010

the VO partners. “Formation of collaborative consortia to exploit product opportunities, and the application of enterprise and VO knowledge in operational and strategic decision making in VOs, leading to enhanced competitiveness and profitability” [1] identifies two primary needs by enterprises in successfully forming and exploiting VOs.

According to the approach evolved during our research it is assumed that to develop some virtual organization its abstract specification should be defined independently of existing enterprises and their Enterprise Information Systems (EISs). VO is specified in terms of ontology that defines concepts of the VO subject domain, in terms of data structures, services, processes that are characteristic for the VO. Such VO specification constitutes a definition of the respective subject mediator located above EISs of the relevant to VO enterprises. A set of specific facilities supports the mediation middleware [2]. Instead of middleware solutions for technical interoperability (like IBM WebSphere, Microsoft BizTalk, Oracle Fusion), semantic interoperation-oriented middleware based on mediation approach is emphasized. The mediator specification of the VO is assumed to be consolidated by the respective VO community.

Advanced enterprise modeling approaches share the fundamental strategy of integrating (interoperating) at the model level – taking fragments of information within the EISs relevant to VO and placing them in a larger context of VO. What model is to be taken and how a proper context is to be formed and implemented are the basic issues that are discussed in this paper.

Heterogeneous information resources of various kinds supported by the respective EIS work in its own, specific context. Many of such resources are autonomous and evolve with time. Justifiable identification of the resources relevant to VO in each of the EISs involved, reaching semantic integration of them in the context of VO, making VO stable in such rapidly evolving world constitute serious challenges. New innovative technologies for VO development over multiple distributed collections of resources supported by the respective EIS are required.

In this paper we start with a brief introduction into VO infrastructure based on subject mediator approach. One of the fundamental ideas of this infrastructure consists in specifying the mediator applying the VO canonical model as a set of language facilities sufficient for the VO conceptual modeling. Various resources relevant to EISs involved in VO should be semantically integrated in the VO specification. The canonical model plays a role of a unifying model, in which the resource information models can be represented without loss of information. The aim of this part of the introduction is to create a context for considering further an approach for the unification of heterogeneous information models used for specification of various EIS resources. This approach constitutes the main focus of the paper.

Definition of VO as a subject mediator and semantic integration in mediator of information resources belonging to the respective EISs is treated as a problem of *compositional development* of information systems [3]. Registration of EIS resources in mediator is a process of purposeful specification transformation including decomposition of mediator specifications into consistent fragments, search among specifications of ontologically relevant EIS resources, construction of expressions defining resource classes as a composition of the mediator classes. For such specification manipulation a specification calculus has been developed [3]. Important point in this scheme consists in treating resource data types as *refinements* of the respective mediator data types [3] and the type refinement proof applying modeling of the mediator and resource type specifications in the first order logic (the Abstract Machine Notation – AMN [4] is used for that).

A process of registration of heterogeneous information resources in a subject mediator resembles GLAV that combines two approaches – Local As View (LAV) and Global As View (GAV). According to LAV the schemas of EIS resources being registered in VO are considered as materialized views over virtual classes of a mediator. GAV views provide for reconciliation of various conflicts between resource and mediator specifications and provide rules for transformation of a mediator program results from a resource into the mediator representation. Such registration technique provides for stability of EIS application specification during any modifications of specific information resources and of their actual presence as well as for scalability of mediators w.r.t. the number of EIS resources integrated.

Identification of EIS resources relevant to the VO specification (that precedes the registration) is based on three models: metadata model (characterizing resource capabilities represented in external registries), canonical ontological model (providing for definition of VO concepts), and canonical conceptual model (providing for definition of structure and behavior of VO and EIS information resource objects). Reasoning in canonical models is based on the semantics of the canonical model and facilities for proof of the refinement. Reasoning in the metadata model is a heuristic one based on nonfunctional requirements to the resources needed in application (e.g., indexes of quality of data).

The techniques listed are used as a basis for the tool prototype [2, 3] developed for identification and registration of EIS information resources in the VO mediator. The main registration result resembles a GLAV expression defining how a resource class is determined as a composition of the relevant mediator classes. In process of resources evolution a specification of mediator remains stable, only such expressions need to be modified.

General approach for VO problem solving using subject mediators consists in problem formulation in terms of the VO mediator specifications and transformation of this formulation into the set of tasks (queries) over the real EIS information resources registered at the mediator. A method of the mediator programs rewriting in a typed object environment has been developed and implemented applying the inverse rule technique [2]. The method is based on the use of the refinement relationship between mediator data types and resource data types helping to get containment of the rewritten queries in the mediator original queries expressed in the canonical model.

It is important to note that for the design, the mediator and resource specifications should be given uniformly in the canonical model. Therefore a transformation into the canonical model of the EIS resource information models (languages) is required. These transformations are needed to map resource schemas into the canonical model. So creating the transformations of the EIS resource models into the canonical one (resource models unification) is a pre-requisite of resource schema mapping. In the following sections we introduce the heterogeneous model unification approach. How to develop the VO canonical model and how to automate mapping into it (by specific tools) of various information models (languages) used for EIS resource specifications will be presented in the rest of the paper in more details.

A Method for the Mediator Canonical Model Synthesis

The foundation of the integration and interoperation methods proposed is formed by the concept of a *canonical information model* serving as the common language, "Esperanto," for adequate uniform expression of semantics of various EIS information resource models that are to be used in VO. To prove that a definition in one language can be substituted with a definition in another one the formal specification facilities and commutative model mapping methods are provided. Currently the method of information model mapping and canonical models constructions looks as follows. As a formalism of the method the AMN [4] is applied. It allows to get specifications of the mediator and EIS resources in the first order logics and to prove the fact of the *specification refinement*.

The main principle of *canonical model synthesis* consists in its *extensibility* required to reach semantic integration and information interoperability in environments that include various heterogeneous models. A *kernel* of the canonical model is fixed. For each specific information model *M* of the environment an extension of the kernel is defined so that this extension together with the kernel is refined by *M*. Such refining transformation of models should be provably correct. The canonical model for the environment is synthesized as the union of extensions, constructed for various models *M* of the environment. Each EIS resource specification model should refine the canonical model. The refinement of the specification mapping is formally checked. The canonical information model synthesis method that we have developed initially for the structured data models provided a seminal role for synthesis of canonical models for various kinds of resource information models: object, service, ontological and process [5, 6].

This paper is focused on the problem of constructing a tool assisting in development of provably correct mapping of various EIS resource information models into the canonical one. With the help of the tool we get compilers transforming schemas into their canonical representation. Due to that schema mapping can be provided in frame of the common, canonical model. Besides unification of heterogeneous schema representations, development of the canonical model gives an ability to create a unified schema matching approach instead of inventing various approaches for matching schemas having heterogeneous information model semantics.

Automation of Heterogeneous Information Model Unification

A prototype of the Heterogeneous Information Model Unifier aimed at partial automation of methods of the canonical models synthesis has been constructed [7]. One of the practical purposes of this work is to support the heterogeneous information resource integration in a specific subject mediator [2]. Due to that, the subject mediator information model (the SYNTHESIS language [8]) has been chosen as the canonical model kernel. The SYNTHESIS language, as a hybrid semistructured and object-oriented information model, includes the following distinguishing features: facilities for definitions of frames, abstract data types, classes and metaclasses, functions and processes, logical formulae facilities applied for description of constraints, queries, pre- and post-conditions of functions, assertions related to processes. For extension of the canonical model kernel, metaclasses, metaframes, parameterized constructions including assertions and generic data types are applied. Comprehensive facilities of the kernel provide for an ability to construct refining mapping of various kinds of information models into the canonical model kernel chosen.

The aim of the Model Unifier is to unify a set of information models for their interoperability in some VO. An EIS resource model R is said to be *unified* if it is mapped into the canonical model C. To unify it is required to create an extension E of the canonical model kernel and a refining mapping M of a resource model into the extended canonical one. The refinement of C model by R means that for any admissible specification r represented in R its image $M(r)$ in C under the mapping M is refined by the specification r. Process of model mapping includes a possibility of proving that arbitrary specification r represented in R refines its image $M(r)$. Verification of model refinement is realized over a set of resource model specification samples. Hence the following languages and formal methods are required to support the process of model unification:

- Formal methods allowing to declare information model syntax and semantic mappings (compilers) of one model to another.
- Formal methods supporting verification of the refinement reached by the mapping.

For the formal description of model syntax and compilers the metacompilation languages SDF (Syntax Definition Formalism) and ASF (Algebraic Specification Formalism) are used. For the languages a tool support – Meta-Environment [9] is provided. The AMN language [4] based on the first order predicate logic and set theory is used for model semantics formalization and refinement verification. AMN is supported by technology and tools for proving of refinement (B-technology) [10]. Mapping of the resource model R into C constructed by an expert with a support of the Model Unifier is divided into the following stages (syntax and semantics of the canonical model kernel are supposed to be defined):

- Formalization of the model R syntax and semantics.
- Definition of *reference schemas* of the model R and the canonical information model (if the latter has not yet been defined).

- Integration of reference schemas of the model *R* and the canonical model.
- Creation of a required extension *E* of the canonical model *C*.
- Construction of a compiler of the model *R* into the extended canonical model.
- Verification of refinement of the extended canonical model by the model *R*.

The Reference schema of an information model is an abstract description containing concepts related to constructs of the model and significant associations among these concepts. Both concepts and associations may be annotated by verbal definitions (looking like entries in an explanatory dictionary).

The Unifier is considered as a constituent part of the subject mediator middleware [2]. The Unifier consists of the following main components:

- Meta-Environment (used for the formal description of information model languages and generation of compilers) [9].
- Atelier B (supporting formal language and tools for proving of specification refinement) [10].
- Metainformation repository.
- Model manager.

Meta-Environment and Atelier B are third-party tools. Metainformation repository is an object-relational database and is used for the implementation of the *model registry* and as a specification storage. Model registry contains *registration cards* of models, canonical model extensions, specification samples. All the information produced during mapping of models (including information produced during interaction of expert with Meta-Environment and Atelier B) is stored in the registration cards. Model manager provides a graphical interface allowing an expert to manipulate information model cards; to call specific components for model integration, compiler template generation, etc.

Recently the Model Unifier was applied for the unification of a subset of OWL (Web Ontology Language). Mapping of OWL into the canonical model has been constructed and verified [7].

Related Work

Note that no works focusing on a semantic enterprise interoperability in VO based on subject mediation are known. In this section we concentrate on heterogeneous information model unification works. Related works are concentrated mostly on mapping of a database schema expressed in one data model into respective database schema expressed in another model [11]. Some approaches rely on properties of specific data models (e.g., CLIO system [12] allows to generate mappings between relational and XML Schemas). Other approaches intend to be generic with respect to data models. The main idea of the ModelGen approach [13] is using a metamodel – a set of metaconstructions (independent of any data model) applied for abstraction of specific data models. Supermodel is a data model containing constructions that correspond to all metaconstructions known to a system. Mapping includes the following steps:

1. Translation of source schema into supermodel.
2. Translation of the result into target schema realized in the supermodel.
3. Translation of the target schema into the target model.

The first and the third steps are assumed to be labor-intensive and straightforward because every model (source or target) is subsumed by supermodel. Transformation coded by the authors relates only to the second step.

Comparison of an approach proposed in our work (SYNTHESIS) with existing approaches can be done by brief analysis of differences with the ModelGen.

Metaconstructions of the canonical model kernel (SYNTHESIS language [8]) are not restricted by structured data models as in ModelGen. Supermodel constructs are easily included into constructs of the canonical model.

Extending of the canonical model is a semantic process of introduction into model of the new parameterized generic data types, metaframes annotating additional properties of initial constructs, parameterized closed logical formulae patterns expressing data dependencies. A process of extending the ModelGen supermodel is mainly a mechanical introduction of new metaconstructions. In SYNTHESIS the EIS resource information models are considered to be defined by respective languages with their syntax and semantics. ModelGen approach uses only data structure specifications. Detailed analysis of language semantics, integrity constraints, functions are not considered. The SYNTHESIS approach is based on the formal definition of semantics of complete schemas in source and target models. It should be clear that the approach proposed is much more general than ModelGen.

Methods developed by the authors differ from existing ones by basing them upon the extensible canonical model constructed in a modular way by systematic extension of the kernel, having strictly defined formal foundations, widely applying of the refinement during construction of the unifying model transformations.

Conclusion

An innovative technique for formation of collaborative consortia of enterprises in VO is considered. The technique is based on semantic integration of relevant EISs in VO specification treated as a subject mediator over the EISs involved. The paper explains how the canonical model for the VO specification is synthesized. Main part of the paper is devoted to the presentation of the process of EIS resource information models semi-automatic mapping applying the Heterogeneous Information Model Unifier that assists in development of a mapping of a specific EIS resource model into the canonical one [7]. It is important to note that the Model Unifier is a universal tool that assists in development of mapping of various kinds of information models (data models, service models, process models, ontological models). The process of mapping of EIS resource models into the VO canonical model includes construction of a compiler from a resource model into the canonical one with the help of metacompilation tools. The mediation technique presented is applied in the astronomical Russian Virtual Observatory (RVO) [14].

References

1. Li, M-S., Cabral, R., Doumeingts, G., Popplewell, K. (2006) Enterprise Interoperability Research Roadmap. Information Society Technologies. ftp://ftp.cordis.europa.eu/pub/ist/docs/ directorate_d/ebusiness/ei-roadmap-final_en.pdf
2. Kalinichenko, L.A., Briukhov, D.O., Martynov, D.O., Skvortsov, N.A., Stupnikov, S.A. (2007) Mediation Framework for Enterprise Information System Infrastructures. *Proc. of the ICEIS 2007*, V. DISI: 246-251. Funchal.
3. Briukhov, D.O., Kalinichenko, L.A., Skvortsov, N.A. (2001) Information sources registration at a subject mediator as compositional development. *Proc. of the ADBIS'01, LNCS 2151*: 70-83. Berlin, Springer.
4. Abrial, J.-R. (1996) The B-Book: Assigning Programs to Meanings. Cambridge, Cambridge University Press.
5. Kalinichenko, L.A. (2004) Canonical model development techniques aimed at semantic interoperability in the heterogeneous world of information modelling. *Proc. of the CAiSE INTEROP Workshop*: 101–116. Riga, Riga Technical University.
6. Kalinichenko, L.A., Stupnikov, S.A., Zemtsov, N.A. (2005) Extensible Canonical Process Model Synthesis Applying Formal Interpretation. *Proc. of the ADBIS'05, LNCS* 3631: 183-198. Berlin, Springer.
7. Kalinichenko, L., Stupnikov, S. (2008) Constructing of Mappings of Heterogeneous Information Models into the Canonical Models of Integrated Information Systems. *Proc. of the ADBIS* 2008: 106-122. Pori, Tampere University of Technology.
8. Kalinichenko, L.A., Stupnikov, S.A., Martynov, D.O. (2007) SYNTHESIS: a Language for Canonical Information Modeling and Mediator Definition for Problem Solving in Heterogeneous Information Resource Environments. Moscow: IPI RAS.
9. Van den Brand M.G.J. et al. (2001) The ASF+SDF meta-environment: a component-based language development environment. *Proc. of the Compiler Construction 2001, LNCS* 2027: 365-370. Berlin, Springer.
10. Atelier B. http://www.atelierb.eu/index_en.html
11. Atzeni P. (2007) Schema and data translation: A personal perspective. *Proc. of the ADBIS 2007, LNCS* 4690: 14-27. Berlin, Springer.
12. Haas, L., et al. (2005) Clio Grows Up: From Research Prototype to Industrial Tool. Proc. of the ACM SIGMOD: 805-810. ACM Press.
13. Atzeni, P., Cappellari, P., Bernstein, P. (2005) ModelGen: Model Independent Schema Translation. *Proc. of the ICDE 2005*: 1111–1112. IEEE Computer Society.
14. Briukhov, D., Kalinichenko, L., et al. (2008) Application driven mediation middleware of the Russian virtual observatory for scientific problem solving over multiple heterogeneous distributed information resources. Scientific Information for Society – from Today to the Future. *Proc. of the 21st CODATA Conference*.

How to Exploit Data Mining Without Becoming Aware of it

N. Ciaramella[1] **and A. Albano**[2]

Abstract Data mining has proved to be a valuable tool in discovering non-obvious information from a large collection of data, however in the business world is not as widely used as it could be. Common reasons include the following: (1) Data mining process requires an unbounded rationality; (2) potential end users may not be available to inform developers on what problems they are interested in or what their requirements might be; (3) high costs in the use of dating mining experts; (4) the actual result of data mining may be irrelevant or simply cannot be used. The paper presents a methodology and a system to facilitate the use of data mining in business contexts using the following approach: many models are automatically generated and stored in a database; when the end users specify some features of the model they are looking for, a search engine then retrieves any relevant models.

Introduction

Data mining has proved to be a valuable tool in discovering non-obvious information from a large collection of data, however in the business world is not as widely used as it could be. This may be for many reasons.

Data mining is a process that contains all the typical elements of most information technology projects. For example, a well-known data mining methodology is the CRISP-DM that consists of the following phases [1]: (1) *Business Understanding*, (2) *Data understanding*, (3) *Data preparation*, (4) *Modeling*, (5) *Evaluation*, (6) *Deployment*. Although undoubtedly useful, this model shares a limit of all traditional models of software development: it requires an *unbounded rationality*, which

[1] Noesis s.r.l., Pisa, Italy, ciaramella@noesis-research.com
[2] Università di Pisa, Pisa, Italy, albano@di.unipi.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_24,

means there must be a complete understanding of the objectives, the process, and the congruence between the objectives and results.

In practice, most companies cannot support this model of development. The costs, times and risks involved may be high, and the return on investment is difficult to predict. In fact, the world of business is faced with uncertainty and limited resources, and needs a *bounded rationality*, based on heuristics that are simple (which do not require complex processing) and frugal (which do not require much knowledge).

The problem can also be seen from a financial perspective. The traditional data mining process follows the model of the equally traditional *economy of scarcity*, as opposed to an *economy of abundance*.

When production costs are important and scarcity rules, enterprises try to predict which goods or services the market will buy and produce only the most promising ones. The market then determines how effective these rules were. However, in an economy where production costs are minimal, enterprises can produce many products and place them all on the market, leaving consumers to decide which ones they want. In contrast, the digital economy often works in accordance with the principle of *abundance*. Today, digitally-created items such as music, videos, and books have a minimum cost for the seller, and therefore can be produced in large quantities without a preliminary marketing study. Consumers then select the content they want. So even the smallest niche markets have an economic value, the offer is huge and failures have a minimum cost. The *long tail economy* and also Web 2.0 are based on this concept. The time of production and consumption are split: the production is unplanned and redundant, and the outcome is a very wide choice. The success of this economic model depends on consumers being facilitated by effective tools, such as search engines.

Another obstacle for using data mining is the fact that in an enterprise it is difficult to find potential users who have the time to explain what problems need solving, to define requirements and to validate the resulting model. It is the classic problem of unavailability of experts in the application domain.

Then there is the cost related to data miners, because companies are often unable to feed with adequate workloads to justify their cost. This may also be a consequence of the fact that very few experts are available.

Finally, the data mining process often gives a large number of trivial hints, like "if a customer buys coffee, she is like to buy milk". Sometimes the hint is not trivial, like the apocryphal "if a customer buys diapers, she is like to buy beer". Such a statement is interesting, but it is difficult to see how to exploit it. The problem of relevance and actionability is extremely hard to solve a priori.

This paper presents a methodology and a prototype system which may facilitate the use of data mining in several business contexts. We assume that the goods to be produced are descriptive or predictive models about customers: typically regression, clustering, association rules, decision trees. The consumers of the models are decision makers or their consultants, e.g. marketing experts. Our methodology is designed to use data mining in a context of *bounded rationality* and *long tail economy*. Again the idea is to separate the time of the production of models from the times of their consumption. The production of models is automated to the maximum. Instead of choosing the right data and processing it with the right algorithms, the models are built in a massive and blind way, relying on heuristics to limit production to manageable numbers, which are nevertheless still high. Large collections of models are thus created and stored in a database.

The quality of models is low, much worse than would be obtained by human experts. Most results will never be relevant to any consumer. This is not as bad an idea, as it may seem. Even on the web something similar happens. Most web content is actually irrelevant for users. But the cost of producing such content is very low. For example, YouTube only has fixed costs for infrastructure. The same happens in our context, where the automatic production of mining models has a negligible marginal cost, and only fixed costs for the infrastructure are significant.

The issue of quality of the models is moved to the moment of consumption. The consumers (likely to be business decision makers) have a specialized search engine that select those models that *at a certain time* meet their interest. A user may require "a model that describes the purchasing behaviour of customers in Tuscany with respect to French wine when receiving an electronic brochure". The system is unlikely to have an exactly matching model, but it might have a model about Italian customers and French wine, another about Tuscany and wine in general, and another about Italian customers and their response rate towards electronic brochures. All of them may be interesting and able to give useful ideas (perhaps motivating the user to require a real data mining job).

This way of using of *existing* data mining models recalls the typical interaction with a web search engine. Consumers do not need to specify in advance the objectives of a data mining project, and the predictive model type that they are looking for. They just give some indication of the type of desired models only when *they need it*. Then they select what they consider the most interesting returns. This is much more acceptable to non-specialist data mining consumers and is based on a different data mining life cycle that consists of two asynchronous activities:

1. *Automatic model production.* Many models are automatically generated.
2. *Consumption by search.* The interesting models are discovered when the consumers need them.

Other authors have exploited the idea of computing beforehand relevant data mining models (*patterns*), and storing them in a *pattern database/warehouse* to be later queried by business users when needed [2, 3]. The focus has been on how to model, store, process and query patterns in a similar way to data in traditional DBMSs. Our approach shares some technical issues, but the main difference is that we promote data mining exploitation by providing users with a *search engine*-like environment that can respond to vague business user requests with interesting and actionable suggestions and help them to overcome the difficulties of the traditional approach.

In the following sections we briefly outline how our approach can be applied and the features of an implemented prototype system.

The Approach in Action

Let us assume that a customer data warehouse is available and the goal is to generate models for predicting customer *lifetime value* (*LTV*). We select a set of attributes as possible predictors of LTV: income, profession, education, age, location, family status and so forth.

The first step is to run programs that extract samples of customers to use as training sets for model learning. Many samples are extracted with many criteria in an automated manner. This is feasible with a data mining platform that provides a language for scheduling activities.

Then we launch algorithms for *data preparation*, i.e. treatment of missing values and outliers, discretization of continuous-valued attributes and so forth. These operations can be made in many ways, on the basis of the algorithms to apply and their parameters. The administrator runs a program that executes many transformation operations, generating many copies of the previously generated training sets. This process is automated following what we call *blind generation and filtering*: requirements and plans are not requested, we simply generate all possible versions of items of some kind, except that we filter versions that do not cross a certain quality threshold (quality being computed with whatever criteria). Items can be algorithms, algorithm parameters, datasets or other things.

At this point we have a large collection of training sets and create models by applying data mining algorithms to them. Again, we are not committed to specific algorithms or parameters. We generate a lot of models (like regression or decision trees), each equipped with quality indices expressing accuracy, reliability and so on. Models with bad quality indices are automatically pruned.

For example, let us consider a linear regression algorithm as a model generator. Using a subset of attributes as predictors, the algorithm creates a regression equation LTV = $a_0 + a_1 * p_1 + a_2 * p_2 + \ldots$, where p_i is a predictor value for a customer and a_i is its weight in determining the customer LTV. Together with the equation, the algorithm gives quality indices. The problem of selecting candidate predictors is not trivial. There are well known methods for selecting good set of predictors and in fact tools performing step-wise regression try to heuristically select good, not necessarily optimal, subsets, hence generating good models. But this is only "statistical goodness". Normally, the aim is to achieve "business goodness" in terms of the model corresponding to user needs, and this involves human analysis and judgement. In our approach, we merely store all models good enough (that are above an acceptance threshold) or the best ones in the ranking *using only mathematical criteria, not business ones*. In the production phase this is enough.

What we said about linear regression can be intuitively generalized to other kinds of data mining model. For example, tools offering the *random forest* algorithm generate many decision trees using different parameters. These trees are then evaluated and combined in a single model. They already do what we need, if we force them to output the intermediate results.

Models generated in this way are stored in a database which can be navigated by users. More precisely, *patterns* are stored, which in our approach is a more general concept than data mining model, as we will see.

At a certain time, a user will navigate the collection of models with search tools aiming to satisfy extemporary needs which have not been previously planned or forecast. When requiring *exact search*, users can retrieve models that satisfy some precise properties. For example, they can say "Give me all linear regression models where the variable to be predicted is LTV, age and income are predictors, the explicative power of the model is greater than 60%".

In an *approximate search*, the user shows a model scheme and wants to retrieve the models with the closest match to that scheme. For example he or she can say "My model scheme is: a linear regression on LTV where age is predictor and explicative power equal to 60%. Give me the five most similar existing models". The concept of similarity can be defined in many ways: the user and the administrator have a predefined repertoire of similarity criteria to choose from. Another approximate search query could be "My model scheme is: a logistic regression model on the event *LTV is High* with age as predictor and odds ratio of the event *age is Young* equal to 2". The logic of the model is different, but the structure of the query is basically the same. This can be intuitively generalized to other kind of models, such as associative rules and decision trees.

Overview of a Prototype System

We designed a prototype system for a concept proof of the proposed approach, which is part of an ongoing industrial research project. We concentrated only on features that are specific to the approach, postponing the solution of important problems to the final implementation.

The prototype focuses on data mining models describing *customer segments* and predicting *customer behaviour*. In marketing jargon, a customer segment is a subset of the customer population having some interesting properties has a whole, hence interesting as object of a data mining analysis. These are hot topics in business data mining, and the same approach can be intuitively applied to other applications. The system contains three subsystems: the *segment builder*, the *segment database* and the *segment finder*.

The system receives an input dataset extracted by a customer data warehouse, from which the segment builder generates data structures called *segments,* which are stored in the segment database. The segment finder provides users with tools for exact and approximate search of segments. The similarity metric for segments is a parameter of the system and can be chosen by users or administrators.

In our system, a segment is a data structure with three components: a *domain reference*, a *descriptive profil*e and a *predictive model*.

The domain reference is a tool for accessing the input dataset. It may be absent, because original data may not be available or users may not be interested in accessing them. Domains are created in our usual blind generation and filtering manner. For example, we can launch a series of SQL queries with different values of attributes. If we have 2 genders, 4 age ranges and 5 income ranges, we simply launch $2*4*5=40$ queries, obtaining 40 domains (segments in marketing jargon).

The profile is a description of some statistics properties of the segment. For example, it contains the number of customer in the segment, the mean amount invested in bonds, the frequency distributions of customers with respect to age and gender. It is possible to use multidimensional frequency distributions and other statistics, e.g. median, variance, and kurtosis.

The predictive model is a representation of a data mining model for the input dataset, for example a logistic regression, a decision tree or a set of association rules. For example, an association rules model contains a list of rules like *Stimulus 7 → Response 12 (support 7%, confidence 62%).*

This means that when a customer in the segment receives a marketing stimulus of type 7 (e.g. a certain offer by telemarketing) he or she is likely to give a response of type 12 (e.g. purchase of a certain item). This prediction is applicable in 7% of past transactions and is confirmed in 62% of cases.

The segment similarity is a function taking two segments as arguments and providing a number which is then passed to the search engine.

The Segment Builder

The segment production again follows blind generation and filtering.

The domain reference is likely to be, in practice, an SQL query that the user can execute to access the dataset. It may well be that a domain reference is empty: indeed, this situation is absolutely consistent with the spirit of our approach.

The prototype is implemented using Microsoft SQL Server Analysis Services and the segment building with the language DMX.

Automatically generating many models and exporting results to a repository are problems that can generally be solved with off-the-shelf tools and standard formalisms such as PMML [4] or research tools like KDDML [5] if one accepts a low quality level of results, as in our approach.

The Segment Database

The segment database can be implemented using a variety of technologies and design choices. The prototype uses a simple collection of XML files, representing segments, and indexes to facilitate their processing.

In view of a future commercial system, we still have to make a final choice with regard to the best implementation technology. For the time being, our focus is on clarifying the definition of concepts and the services offered. The final implementation will be largely driven by available off-the-shelf solutions for problems such as approximate searches and multidimensional indexing.

Segment Finder

The literature offers a wide repertoire of similarity measure that can be exploited for segment profiles, several of which we tried in the prototype, e.g. Minkowski distance, cosine similarity, Jaccard coefficient.

For the predictive model component, the similarity measure is more difficult to define. Consider the similarity between two sets of associative rules. By using measure for sets the problem can be reduced to comparison of individual rules. This can then be split into comparisons between antecedents and between consequents (which are sets of products). Such methods have been tested in the prototype, giving satisfying results. In the prototype, users or administrators can choose from a collection of similarity functions.

The distinction between descriptive profile similarity and predictive model similarity is important, because they are used to express different user intentions. In a query like "Give me a segment with a frequency distribution in which females are more than 60%", the user is perhaps trying to formulate predictions about a new segment, which will be the target for some new marketing action. The query provides her with models learned on similar segments. A query like "Give me a segment with a logistic regression predictive model, in which the regression equation contains attribute age and income and the odds ratio North vs. South is higher than a certain threshold" goes in the opposite direction: the user is looking for segments with a desired behaviour.

Technical feasibility

Experimenting with the prototype for a proof of concept, we came to the conclusion that our approach can be implemented at a satisfactory extent using current technology and off-the-shelf tools.

We found PMML rather adequate to build segments provided that XML files are enriched with some additional parameters, which can be obtained from the data mining engine. In practice, there is no need for a general formalism to express all kind of data mining models: just a collection of a few kinds (regression, decision trees, association rules, clustering) covers most of applicative requirements.

Implementing a repository allowing similarity search is definitely a complex problem, but the state of the art offers a repertoire of feasible approaches [6]. We experimented well-known similarity measures used in classical Information Retrieval, finding them rather satisfactory for practical use. For example, the simple Jaccard and Cosine similarities demonstrated to be quite convincingly.

We think that while the design of a general system implementing our methodology would be a formidable challenge, a practical implementation is a complex but affordable task, provided some reasonable simplifying assumptions.

Conclusions

Although data mining has proved to be a valuable tool in discovering non-obvious information from a large collection of data, in the business world it is not as widely used as it could be. Some of the reasons have been discussed and an approach has been presented to exploit the use of data mining models in the business contexts based on the idea of creating a repository of models, generated in a blind and automatic way. This repository can then be used by business users through a graphical interface to retrieve models when they need them. Although the presentation of the approach has been brief, we hope that there has been enough evidence that it is fruitful from a practical point of view and is worth of further development.

Acknowledgements This work was partially supported by the Italian Government. The authors are grateful to E. Acquaviva, D. D'Antonio, G. Di Rita, A. Falossi, and M. Italiano for their implementation of the prototype system.

References

1. http://www.crisp-dm.org/
2. Terrovitis, M., Vassiliadis, P., Skiadopoulos, S., Bertino, E., Catania, B., Maddalena, A., Rizzi, S. (2007) Modeling and Language Support for the Management of Pattern-bases, *Data and Knowledge Engineering* 62(2): 368–397.
3. Parsaye K. (1999) From Data Management to Pattern Management, *DM Review Magazine*.
4. http://www.dmg.org/
5. Romei, A., Ruggieri, S., Turini, F. (2006) KDDML: A Middleware Language and System for Knowledge Discovery in Databases, *Data and Knowledge Engineering* 57(2): 179–220.
6. Zezula, P., Amato, G., Dohnal, V., Batko, M. (2006) *Similarity Search – The Metric Space approach*, vol. 32 of *Advances in Database Systems*, Springer, Berlin.

Information Extraction from Multimedia Documents for e-Government Applications

F. Amato[1], A. Mazzeo[2], V. Moscato[3], and A. Picariello

Abstract Despite the exponential growth of information systems for supporting public administration requirements, we are still far from a complete automatic e-government system. In particular, there exists the need of automatic or semi-automatic procedures for the whole flow of digital documents management, in particular regarding: (1) automatic information extraction from digital documents; (2) semantic interpretation (3) storing; (4) long term preservation and (5) retrieval of the extracted information. In addition, in the last few years the textual information has been enriched with multimedia data, having heterogeneous formats and semantics. In this framework, it's the author's opinion that an effective E-Government information system should provide tools and techniques for multimedia information, in order to manage both the multimedia content of a bureaucratic document and the presentation constraints that are usually associated to such document management systems. In this paper, we will describe a novel system that exploits both textual and image processing techniques, in order to automatically infer knowledge from multimedia data, thus simplifying the indexing and retrieval tasks. A prototypal version of the system has been developed and some preliminary experimental results have been carried out, demonstrating the efficacy in real application contexts.

Introduction

Managing in an efficient way multimedia information still represents an open challenge, despite the management of such a kind of information is of great interest in a lot of application fields: the spatial, temporal, storage, retrieval, integration, and presentation requirements of multimedia data calls for new processing beyond the

[1] Università degli Studi di Napoli Federico II, Napoli, Italy, flora.amato@unina.it
[2] Università degli Studi di Napoli Federico II, Napoli, Italy, mazzeo@unina.it
[3] Università degli Studi di Napoli Federico II, Napoli, Italy, vmoscato@unina.it
[4] Università degli Studi di Napoli Federico II, Napoli, Italy, picus@unina.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_13,

ability of traditional database architecture. In e-government applications also, multimedia is becoming an important part of the produced and processed information. For example, the large amount of data related to criminal investigation or legal prosecution is intrinsically a multimedia data: videos, audio coming from different sources, pictures, scanned documents together to text are nowadays the common data sources that need to be stored and retrieved. In addition, for such kind of application another strong requirement should be provided, i.e. that the content of the document and the way in which the document is presented have to follow some certain legal constraints provided by common or civil laws.

It's the authors' opinion that the starting point is the extension of classic textual document to the multimedia one. Anyway, we first have to clarify our idea of document. According to the Italian civil law [1], a document is defined as the *representation of acts, facts and figures made, directly or by electronic processing, on a intelligible support*. In this framework, we think that a E-Government (E-Gov for short) document can be seen as multimedia information consisting in a *collection of co-related objects* such as text, images, drawings, structured data, operational codes, programs and movies, that, according to their relative position on the support, determine the shape and, through the relationship between them, the structure of the document. Note that such kind of document takes place on various types of media, such paper (using a writer, the typewriter or photocopy), a photographic film, microfilm, VHS cassette, tape Magnetic, DVD disk, whether magnetic, optical or magneto-optical, a radiological film on a printout, by an electronic processing and more.

Fast access to multimedia information requires the ability to search and organize the information. In such an area the main objective of the researchers is to index in an automatic way multimedia data on the base of *their content* in order to facilitate and make more effective and efficient the retrieval processing. The major challenges in developing reliable image and text database systems are discussed in [8] for what information extraction from textual documents concerns and in [7] regarding the image indexing and retrieval techniques.

To the best of our knowledge, this work represents the first formal attempt towards a definition of E-Gov document, that takes into account different formats and the interpretation rules provided by the law in e-gov processes.

The paper is organized as follows. In the next section we will provide the description of the proposed model, that will put us in the position of giving a formal definition of multimedia documents in the e-gov perspective. We will successively describe a possible system architecture that implements the described model. Conclusions will describe the enhancement of our paper with respect to the similar works in the literature, and will discuss further works.

Modeling e-Government Documents: The e-Doc

In our context an *E-Gov Document,* or more simply *e-doc*, should be a set of multimedia assets that can be opportunely combined for presentation aims. From a physical point of view, a *multimedia asset* is an aggregation of large byte streams, that can be decomposed and represented as a set of structured syntactic components: a text is a sequence of alphanumerical characters that can be organized into words, paragraphs, sections and chapters; an image is a set of pixels that can be grouped into regions; a video is a sequences of frames that can be grouped into shots and scenes; an audio clip is a sequence of audio samples, possibly grouped in audio segments. A generic multimedia database management system has to consider both low-level (syntactic) and high-level (semantic) features of multimedia objects in order to effectively manage multimedia data. Thus, a conceptual structure providing semantic information is requested on top of the syntactic representation of raw data, in order to completely characterize multimedia assets and e-docs.

Preliminary Definitions

In this subsection we introduce some preliminary definitions in order to provide a formal definition of the intuitive concept of *e-doc* from an *information retrieval perspective*.

Definition 1 [Multimedia Alphabet]

A MultiMedia-Alphabet *(*MM-Alphabet*) α is a finite set of* MM-Symbols ς*, where each MM-Symbol is an alphanumerical character or a pixel or an audio sample.*

Following the previous definition, two pixels or two characters or two audio samples, i. e. two symbols belonging to the same alphabet, are called *homogeneous* MultiMedia-Symbols. In the case of textual data, a MM-Alphabet is a set of alphanumeric characters. In the case of image data a MM-Alphabet is a set of all possible triples <*R,G,B*>, where *R*, *G* and *B* are the color components of a pixel. Eventually, the MM-Alphabet in the case of audio data is given by a set of audio samples.

Definition 2 [MM-Token]

Given an alphabetα, a MM-Token τ *of length k over α is a composition of k homogeneous MM-Symbols fromα.*

$$\tau = \langle \varsigma_1, \ldots \varsigma_n \rangle : \varsigma_i \in \alpha, \forall \mathrm{i} \in [1, \ldots, k]$$

A text or a region of an image are two examples of MM-Token that are composed of a set of alphanumeric characters and pixels, respectively.

Definition 3 [MM-Asset]

Given a MM-Alphabet α, a MM-Asset A *over α is a composition of MM-Tokens τ, defined over elements of alphabet a, through a set* R *of relations that represent the logical structure of the asset.* A = ({τ}, R). As a particular case, we notice that, if τ is a MM-Token, then A = ({τ}, Ø) is still a MM-Asset.

Definition 4 [MM-Information Source]

A MM-Information Source IS *is a set of* heterogeneous *MM-Assets defined on MM-Alphabets*. If k is the cardinality of the asset set,

$$IS = \wp\left(\bigcup_{i=1}^{k} A_i\right).$$

E-Government Document Definition

We are now in the position of introducing the fundamental definition formalizing the concept of *e-government document* or *e-doc*.

Definition 5 [E-Government Document]

An E-Gov document is defined as: $O =< IS, ID, R, l, H >$. Where

- *IS* is an element of information source set of *MM-Assets* composing E-Government document.
- *ID is the set of URIs (Uniform Resource Identifier) of the single MM-Asset.*
- *l is a set of low-level relevant features containing a content-based description of all the MM- Tokens (*low-level metadata *or* signature*) of component MM-Assets.*
- *H is a set of high-level relevant features containing a semantic-based description of all the MM- Tokens (*high-level metadata *or* concepts *or* semantic description*) of component MM-Assets.*

An example of the set l for E-Government-Documents containing assets of image and text type is given by visual descriptors coding color, texture and shape of image MM-tokens (whole image and/or decomposed regions) and by classical text features such as number of words, size and format of the document, terms frequency of each asset. The set *H*may contain semantic descriptors such as a set of relevant keywords, the topic of assets, and so on.

Multimedia Information System Architecture

A multimedia database management system is the heart of each multimedia information system such as an e-government information system: it must support different multimedia data types (e.g. images, text, graphic objects, audio, video, composite multimedia, etc.) plus, in analogy with a traditional DBMS, facilities for the indexing, storage, retrieval, and control of the multimedia data, providing a suitable environment for using and managing multimedia database information [2, 3].

More in details, a MMDBMS must meet certain special requirements that are usually divided into the following broad categories: multimedia data modeling, huge capacity storage management, information retrieval capabilities, media integration, composition and presentation, multimedia query support, multimedia interface and interactivity, multimedia indexing, high performances, distributed multimedia database management. All document management system applications should be designed on the top of a MMDBMS in order to support e-government processes in a more efficient way, in particular those tasks regarding: automatic information extraction from documents, semantic interpretation, storing, long term preservation and retrieval of the extracted information.

The architecture of the proposed MMDBMS system, shown in Fig. 1, can be considered a particular instance of the typical MMDBMS architectural model [2] and is a suitable support for the management of e-government documents. The main components of the system are the modules delegated to manage the *Information Extraction and Indexing* process and those related to *Retrieval and Presentation* applications. All the knowledge associated to E-Gov documents is managed by apposite *ontology repositories*.

In the current implementation of the system we have realized three main separate subsystems that are responsible of information extraction and presentation tasks: one for the text processing related to e-doc, an other one for processing the other kinds of multimedia information, in particular images, and the last one for presentation aims in according to the requirements of public administrations.

The multimedia indexing and information extraction modules can be also specialized for other kinds of multimedia data such as audio and video. In this case ad-hoc preprocessing components able to effect a *temporal segmentation* of multimedia flow are necessary to efficiently support the indexing process. The features of text and image management subsystems will be described in the following.

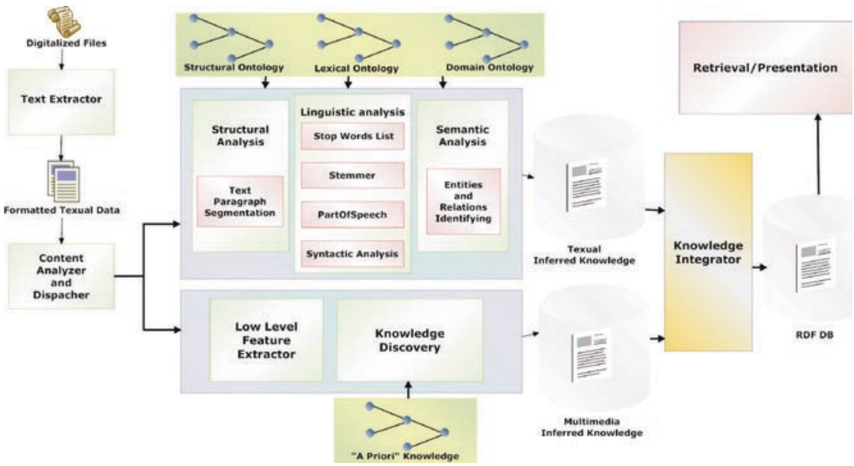


Fig. 1 The proposed architecture

The Text Processing Module: Automatic Extraction of RDF Information Triples from Unstructured Documents

The *Text Processing Module* aims at extracting the relevant information from the documents of the E-Government domain, starting from the analysis and the processing of the textual content of the submitted input document.

This module is based on both linguistic and statistical approaches for the early stages, and semantical function for the recognizing purpose.

The semantics methods make use of a knowledge domain, codified by onthologies, to guide the identification and extraction of the relevant words in the text, representing the instances of the concept of interest.

The text processing procedure is composed of several stages: (1) *Text extraction*, where the plain text is extracted from the source file; (2) *Structural analysis,* where the textual macrostructures are identified for text sections recognition; (3) *Lexical analysis*, where each text element is associated with a grammatical category (verb, noun, adjective, etc.) and a syntactic role (subject, predicate, complement, etc.); (4) *Semantic analysis* where, proper concepts are associated with discovered entities and relations among them, by means of structural, legal domain, and lexical ontologies. Such procedures produce a proper semantic annotation that is codified by RDF triples.

The Multimedia Processing Module: Automatic Annotation of Images Using Visual Information and Pre-defined Taxonomies

The goal of the *Multimedia Processing* subsystem is to automatically infer useful annotations for images looking at their visual content and exploiting an "a priori knowledge" (obtained in the training step of the system) in the shape of pre-defined taxonomies of image contents.

To such purposes, each image, belonging to a given concept (category) of the a-priori taxonomy, undergoes a particular indexing process, where in a first step a low-level description is obtained and then in a second one an apposite indexing structure is created/updated for facilitating the successive retrieval and annotation tasks. To obtain a low-level description of the images, we applied a salient points technique - based on the *Animate Vision paradigm* - that exploits color, texture and shape information associated with those regions of the image that are relevant to human attention (*Focus of Attention*), in order to obtain a compact characterization, namely *Information Path*, that could be used to evaluate the similarity between images, and for indexing issues. An information path can be seen as a particular data structure: $\boldsymbol{IP=<F(p_s;t_s),h_b(F_s),S_{Fs}>}$ that contains, for each region $F(p_s;t_s)$ surrounding a given salient point (where p_s is the center of the region and τ_s is the the observation time spent by a human to detect the point), the color features in terms of HSV histogram $h_b(F_s)$, and the texture features in terms of wavelet covariance signatures $\sum_{Fs}$ (see [4] for more details).

Furthermore, on the multidimensional space defined by image information paths and for each predefined category, we define: (1) a particular index, named *BEM Tree* (*Balanced Expectation Maximization Tree*), able to efficiently organize images in the feature space and to provide range query capabilities with good performances and accuracy for large image databases; (2) a *similarity measure* between different information paths, that is used to rank and refine range query results. The proposed indexing process can then efficiently support the *Knowledge Discovery* task (i.e. the "category detection" procedure presented in [5]), which aim is to automatically discover by a probabilistic approach concepts of the a-priori taxonomy that better reflect the semantics of input images. Thus, the obtained information can be used as useful annotations for each image, in order to infer knowledge about the content of database images, that is represented in the shape of a multimedia ontology (taxonomy concepts + images).

Finally, the inferred knowledge is coded using an extension of RDF language, i.e. the *probabilistic RDF* [6], because the automatically discovered taxonomy concepts for image are subjected to a given uncertainty.

The Integration and Presentation Modules: Merging Knowledge from Heterogeneous Multimedia Data and Delivery of e-docs in Different Formats

The objectives of the *Integration and Presentation* modules are: from one hand, to merge in a unique "container" the heterogeneous knowledge coming from text and multimedia data, and from the other one, to delivery the content of e-docs in different formats.

In the current implementation of the system the integration module uses a human-assisted semiautomatic approach to instantiate relationships among concepts of the different ontologies. The result of a such process is an ontology that contains all the knowledge related to the e-gov documents.

The presentation module works on the top of such an ontology and exploiting the set of relations about structure of multimedia assets and e-gov documents in order to present and delivery to final users the content of an e-gov document in different ways: printable (e.g. ps), portable (e.g. pdf) , word processing (e.g. .doc, .odt, .stw, .rtf, .txt, etc.) and web formats (e.g. XML, HTML).

Conclusions and Future Directions

In this paper we presented a system for management of multimedia information related to E-Gov documents. At the moment we have implemented a prototypal version of the system that realize the described information extraction and presentation tasks. Future efforts will be devoted to implement the other modules of the system and to obtain experimental results that validate the proposed approach.

References

1. Deliberation of 13 dicembre 2001, n. 42, published on Gazzetta Ufficiale della Repubblica Italiana n. 296 of 21 dicembre 2001.
2. W.I. Grosky (1997), "Managing Multimedia Information in Database Systems", *Communications of ACM*, 40(12):72–80.
3. D.A. Adjeroh, and K.C. Nwosu (1997), "Multimedia Database Management – Requirements and issues. *iEEE Transaction Multimedia* 4:24–33.
4. G. Boccignone, A. Chianese, V. Moscato, and A. Picariello, (2008) Context-sensitive queries for image retrieval in digital libraries. *Journal of Intelligent Information Systems*, 31(1):53–84.
5. G. Boccignone, A. Chianese, V. Moscato, and A. Picariello, (2005), Foveated Shot Detection for Video Segmentation*, IEEE Transaction on Cicuits and System for Video Technology*, 15(3): 365–377.
6. O. Udrea, V.S. Subrahmanian, and Z. Majkic, (2006) "Probabilistic RDF", *Proceedings of the 2006 IEEE International Conference on Information Reuse and Integration*, IRI, pp. 172–177.
7. M.S. Lew, N. Sebe, D. Djeraba, and J. Rain, (2006) "Content-based multimedia information retrieval: State of the art and challenges", *ACM Transactions on Multimedia Computing, Communications and Applications*, 2(1):1–19.
8. L. Reeve and H. Han, (2005) "Survey of semantic annotation platforms", *in Proceedings of the 2005 ACM symposium on Applied computing*, pp. 1634–1638.

Information Technology, Marketing and Organizational Factor in Corporate e-banking: A Qualitative Research

D. Pettinao[1]

Abstract The aim of this work is to delineate a possible reading in terms of the expansion and evolution of business-client relationships and to analyse the role played in these relationships by IT. The analysis will be conducted in relation to a specific sector, financial brokerage, and, within that, the principal player, the bank itself. This paper brings theory and practice together by synthesising the existing literature with real-life experience of an Italian bank.

Introduction

The study of relationships established by businesses and their clients is one of the most discussed topics in marketing literature [1–4] and, most of all, the role that these relationships play in allowing businesses to improve performance in the relevant markets [5, 6]. Among the numerous changes implemented in the span of the last ten years improvements in technology is that which, without a doubt, has created the greatest potential for improvement [7–9].

The aim of this work is to delineate a possible reading in terms of the expansion and evolution of business-client relationships and to analyse the role played in these relationships by IT. This analysis will be conducted in relation to a specific sector, financial brokerage, and, within that, the principal player, the bank itself. Extreme competition, saturation of the financial market and the growing demand for products and services made possible by new technologies has pushed banks into making major modifications to their business models [10–12], differentiating the functioning organisation from the client [13].

The current project seeks to combine aspects of theory with indications deriving from analysis of a specific case study of an Italian bank. The object is to tie in

[1]Università degli Studi di Cagliari, CagliariItaly, pettinao@unica.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_2, © Springer Physica-Verlag Berlin Heidelberg 2010

indications derived from marketing relating to the evolution of the client-business relationship with those deriving from the organisational study of the management of internal relations, and to the now-recognised growing importance of human resources in the organizational process.

Two principal questions motivate such research. In the first place, it is proposed to verify the effective use of information technology for the support and consolidation of the client-business relationship in the financial brokerage sector. Secondly, we intend to investigate the factors which render efficient and competitive the use of IT on the part of the bank. The investigation will be conducted with particular reference to the corporate sector, regarding which existing research has been undoubtedly quantitively inferior when compared with those which have as their object the retail sector, which constitutes the predominant business area of national banking.

Literature Review

The importance of relationships in a banking context has already been brought to light some years ago [14–16] and, with reference to the corporate sector, huge ambiguity, variety and complexity has been evident [17, 18]. The following up of these studies allows us to identify an efficient management of client relations born out of the strict inter-connection, of all corporate types, involved in the average client [19]. On this topic, Perrien et al. [20] note that diverse factors contribute to the development of good relationships: the turnover of management, extent of decision-making power, internal rules and procedures of the bank and its organisation and structure. Proenca and de Castro [21] indicate three important factors that indicate the nature of relationships in corporate banking: the nature of the relationship; the bonds that are developed (economic, information, knowledge, technical, social); the number of contacts the bank can cal upon with the aim of offering a complete and comprehensive package of financial services. The Authors also suggest that the various bonds are not all equally weighted, but that the most important are organisational know-how, followed by the social, economic, technical and information aspects.

These studies seem to agree with those which affirm that, for bank-business relationships, the human dimension is considered to be of equal importance to technological factors [22] and they underscore the importance of face-to-face contact for this type of clientele [23].

Parallel to the studies of the organizational matrix, numerous marketing studies have shown how, in a hyper-competitive market like this one, the development and maintenance of lasting relationships with existing clients have become almost more important than attracting new ones [24, 25]. The increased competition in these last few years has characterised a financial market in the process of deregulation in which intervention has pushed banks to re-evaluate their approach to marketing and to adopt the principals of relation marketing é [26, 27]. In this context, banks have realised the importance of establishing long term client relationships, particularly with corporate clients [28]. Many studies have demonstrated how corporate clients continue to prefer traditional-type relationships, as compared to those permitted by modern technology, to develop communication exchanges with the bank. However, the importance of technology for the development of bank-business relationships remains unexplored at many levels [29] and IT seems to constitute an important opportunity for improving performance and, consequently, important competitive advantages.

From this perspective it has been observed how the interactivity made possible by the internet facilitates the co-production of value between the seller and the recipient and constitutes an opportunity for the application of one-to-one marketing principles [30]. Thanks to the internet, in fact, banks can maintain direct relationships with their clients and, by means of the information thus gathered, provide a much improved and more personal service [31].

Research Method

To choose the research method we refer to the proposals made by Galliers [32] relating to the type of research to be adopted in relation to information systems. In his proposal, the author outlines the importance of the use of case studies as a research technique for the analysis of organisational aspects; techniques which may be identified as the most common method of qualitative research utilized in IT studies [33]. The research methodology selected for the achievement of the aforementioned objectives is, in any case, qualitative. In particular, it will be decided to employ the case study technique [34, 35] adapted to develop the theory through the understanding of the phenomenon in its proper context.

As to the choice of case study, we may select a good-sized bank, with a catchment area sufficient to cover all regions of Italy and which, from an organisational and marketing perspective, has recently reviewed and innovated its assets. The decision goes for the Banca Nazionale del lavoro (BNL) which caters for both retail and corporate clients and upon which we will focus our attention. Moreover, with reference to both of these markets, BNL has a strong corporate tradition, which allows for the introduction of IT into a pre-existing organisational structure which is already well-developed. A further element which has contributed to the choice of BNL is the recent amalgamation with the BNP Paribas group, which has launched a strong programme of review and redefinition of roles and objectives. It is on the basis of these considerations that we take it as an emblematic case to investigate. The data for analysis has been gathered from multiple sources:

- Interviews focussed on the traditional roles of interfacing with clientele and the staff bodies which support them in managing these relationships.
- Studies of company documents, bank balances and other sources, both internal and external (Internet sites, business magazines and sector sources).
- Analysis of specific e-banking products intended for corporate clients.

The access to a multiplicity of information sources has favoured the principles of interaction and the triangulation of the sources [36]. Once the primary observations are developed these are further compounded which the interview material which seems to emerge from the analysis. These cross-comparisons have been useful for the final compilation of the proposed interpretative model and for the individuation of the future direction of this research [37].

The BNL Bank

Strategic Evolution, Organisational Structure and Management of Client Relationships in BNL Bank

Founded in 1913, in 2006 BNL entered into a large international banking group. This entrance has triggered a strong process of change which hinges upon three key factors: the clients, the management, the collaborators. The key principles at the heart of the change revolve around the reorganisation of the distribution network; the sharing of the best practices of both banks; sharing of group expertise. Now, the client is at the centre of the organizational process and the new managerial approach to the evaluation of credit needs to assure more responses to fulfil client. At the same times, power of delegation and responsibility have been given to the management. The process of change initiated by the integration of the two groups, centred on the importance of people to guarantee the success of the organisation, requires the development of strong integration among the various acquisitions of the bank. The centrality of client relationships has meant, from the strategic viewpoint, refinements to the sectoring of the existing market and the redefinition of territorial area of operation, not to mention the expansion and renewal of the range of products and services offered.

The division of the commercial activities of BNL into corporate and retail sees the director of the BNL corporate supply chain answering directly to the delegate administrator of the bank. The same presides over the five macro-regions of into which the national territory is subdivided and which enjoy an elevated and strategic operative autonomy. At the head of each macro-region is a director upon whom depends the Central Territorial Affairs, allocated, in turn, to corporate bodies which represent the strategic and business units of the territory. Each territory has a chief on whom depend the managers of corporate clientele.

The corporate client managers, to whom is assigned a client portfolio, has the responsibility of administering client relations. The manager must implement the building up of the assigned portfolio; he represents the principal interface of the bank with the clientele and constitutes for the latter a point of reference. For BNL corporate, in fact, the bank-business relationship is not based on the selling point of financial services but is transformed into a partnership in which the bank contributes capital, in a multiplicity of diverse technical forms, which the economic processes of the business must reimburse in the form of financial obligations. It follows that the manager is not simply a buffer between the bank and the business: he represents a figure that the market, in the current climate, increasingly requires to be more and more productive, a role which embodies in itself, on the one hand, the supplier of financial resources and, on the other, the more complex role of strategic financial consultant. A further aspect of these types of management activities, undoubtedly relationship-based, is the personalised rapport with the client in which a two-dimensional relationship is established – technical-professional and human – which allows the bank to acquire useful data on clients with the aim of appraising risk in real terms in order to better satisfy the needs of the business.

Within the context of his specific competences, the manager avails of the support of professionals who have partial, though elevated, command of various aspects of the business. A sample job title which may be brought into argument is the Specialist in Special Credits and Loans who has the task of supporting commercial, administrative or operative processes pertaining to medium/long term operations; the outside expert, with deep knowledge of external banking operations and norms; the IT specialist, who has the dual role of technical assistance, both external and internal. From the brief description presented above emerges a pattern which shows how the management of bank-business relationships represents a very complex phenomenon, based on which the relational capacities of the manager take on a role of primary importance, along with his specific knowledge and problem solving capacities.

The Role of Technology in Bank-Business Relationships

The evolution in IT and in its application has brought about the introduction of a multiplicity of instruments for client relationship management. The principal Italian banks adhere to a system, known as "corporate banking interbancario" (CBI), which allows any business to work directly, via computer, with all Italian banks with whom they share a relationship exploiting internet technology. For BNL this IT product is "Business Way." We may take the example of remote banking, which offers clients the following options:

- Arrange directly and immediately bank transfers, utility payments, financial instrument transfers and foreign currency.
- Obtain global information held by the bank.
- Find out daily market quotations, and previous quotations, o particular stock.
- Enter into electronic procedure relating to the regulation of client supplier relationship and information pertaining to outstanding transactions.

One application of corporate banking offered by BNL to satisfy the need for information/operational services by businesses is the Cash Management Service, that is the process which allows the business to manage cash flow, in and out, by the use of IT. Besides being an efficient way of reducing costs for both business and bank, remote banking represents a supporting instrument in the bank-business relationship, even though the staff present in the bank itself, and who has the role of problem solving, acts as interlocutor.

Discussion and Reflection

In the course of the investigation into the application of IT in the bank/business relationship, the case of BNL has shown how all internal procedures in the conduct of such relationships have largely been automised. The same has also applied an information system for the process of credit concession with an examination of merit carried out by an expert system which provides for the acquisition of necessary data, both internal and external.

This analysis allows us to bring to light the ways in which the use of IT in the bank/business relationship constitutes a supporting element within that relationship. More precisely, these roles express themselves in a dual profile: informative and the strengthening of the rapport. In the first of these, the use of IT allows the bank to acquire an informational mastery, contributing to the construction and enrichment of a body of knowledge about each client. This is true both in terms of the financial volumes transacted, and in terms of the finalisation of the operations thus conducted. The monitoring of the usage of information technology, in fact, provides information about the counterpart of these operations and the relationships fostered by each individual business. In this way begin the active bank/business participation to the definition of the telematic services furnished by the bank and to the grouping of the relative activities according to its own preferences. This implicates that every decision of the client / business contributes to build and to feed the relationship bank/business. What we've now noticed allows to introduce the second aspect above underlined, regarding which it could be noticed as the IT allows the "de-bureaucratization" of the relationship releasing from the consequential administrative obligations. In the specific case of BNL, contrary to what happened in the past, the manager is no longer seen by the client as merely an overseer of the administrative aspects of the bank/business relationship but as a specialized interface providing a swift and certain response to the problematic financial complex of the business.

Conclusion

This paper has presented an exploratory case study of an Italian Bank, The BNL. The empirical evidence supports what the literature affirms: corporate clientele continues to prefer a direct rapport with the manager, retaining, however, IT technology as an indispensable instrument for better management. The contribution of IT seems, therefore, to provide an opportunity to increase the time that the manager can dedicate to the client, improving in the process, naturally, the quality of the service, bringing the bank to achieve the whole knowledge of the client/business operativity. Opening a channel of interactive communication with its own clientele corporate, the bank starts a process of construction of sceneries that allow the Manager to go beyond what it is strictly useful to be able to build, through continuous relationships, shared environments that foresee the possibility of multiple and alternative sceneries. In this perspective, the model of the sense making [38] seems to volunteer as possible interpretative tool, able to help the researcher to clarify better the contribution that IT technologies can give in to support the relationships bank /business.

The application of IT to this typology of relationship seems to put the manager, and consequently the bank, in the condition to create a great sense in the relationships with its own clientele. Nevertheless, to this could be possible, the investigation has, what's more, revealed how the success, or lack of it, of the adoption of IT in corporate banking relationships is the consequence of a multiplicity of factors. In the first place, it must necessarily be accompanied by an adequate formation process, with various specializations, based on the resolution of client problems. Secondly, the sharing of all levels (administrative and commercial) of one to one marketing principles acquires importance. Finally, an efficient management of these relations cannot but result in a satisfactory degree of organizational integration.

References

1. Dwyer F.R., Shurr P.H., Oh S. (1987), Developing Buyer and Seller Relationship, *Journal of Marketing*, 51:1–27.
2. Gummesson E., *Total Relationship Marketing*, Butterworth Heinemann, Oxford, 1999.
3. Morgan R.M., Hunt S.D. (1994), The Commitment-Trust Theory of Relationship Marketing, *Journal of Marketing*, 58: 20–38.
4. Perrien, J., Filiatrault, P. and Ricard, L. (1992), Relationship Marketing and Commercial Banking: A Critical Analysis, *International Journal of Bank Marketing*, 10, (7):25–29.
5. Dyer J.H., Singh H. (1998), The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage, *Academy of Management Review*, 4:660–679.
6. Morgan R.M., Hunt S.D. (1999), Relationship-Based Competitive Advantage: The Role of Relationship Marketing in Marketing Strategy, *Journal of Business Research*, 46:281–290.
7. Gulati R., Oldroyd J.B. (2005), *The Quest for Customer Focus*, Harvard Business Review, April:92–101.
8. Peppers D., Rogers M.(1999), *Enterprise one to one. Tools for Competing in the Interactive Age*, Random House Inc., Broadway, New York.
9. Rogers M. (2005), Customer Strategy: Observation from the Trenches, *Journal of Marketing*, 69: 262–263.
10. Bradley L., Stewart, K. (2003), The diffusion of online banking, *Journal of Marketing Management*, 19(9/10):1087–1109.
11. Jun M., Cai, S. (2001), The key determinants of Internet banking service quality: a content analysis, *The International Journal of Bank Marketing*, 19(7): 276–291.
12. Methlie, L. and Nysveen, H. (1999), Loyalty of on-line bank customers, *Journal of Information Technology*, 14: 376–386.

13. Jayawardhena C., Foley P. (2000), Challenges in the bankingsector – the case of Internet banking in the UK, *Internet Research*, 10(1):19–30.
14. Crane, D.B. and Eccles, R.G. (1993), Customer Relationships In The 1990s, In: *Financial Services - Perspectives and Challenges*, Harvard Business School Press, Mass.: 131–144.
15. Trethowan, J. and Scullion, G. (1997), Strategic responses to changes in retail banking in the UK, *International Journal of Bank Marketing*, 15(2):60–68.
16. Turnbull, P.W., Gibbs, M.J. (1987), Marketing Bank Services to Corporate Customers: The Importance of Relationships, *International Journal of Bank Marketing*, 5(1):19–26.
17. Eccles, R.G. and Crane, D.B. (1987), Managing Through Networks In Investment Banking, *California Management Review*, Fall: 176–195.
18. Eccles, R.G. and Crane, D.B. (1988), *Doing Deals - Investment Banks at Work*, Boston, Massachusetts, Harvard Business School Press.
19. Proenca, J. and de Castro, L.M. (2004), Business Relationships Dynamics and (In) Stability: A Comparative Case Study in Corporate Banking, *Journal of Customer Behaviour*, 3:235–256.
20. Perrien, J., Filiatrault, P. and Ricard, L. (1993), The Implementation of Relationship Marketing in Commercial Banking, *Industrial Marketing Management*, 22(2):141–148.
21. Proenca, J. and de Castro, L.M. (1999), Relationships in Banking, In: *Network Dynamics in International Marketing*, Naudé, P. and Turnbull, P.W., Oxford, Pergamon: 164–191.
22. Lee J. (2002), A key to marketing financial services: the right mix of product, services, channels and customer, *Journal of Services Marketing*, 16(3):238–258.
23. Tyler K., Stanley E., (2001), Corporate banking: the strategic impact of boundary spanner effectiveness, *International Journal of Bank Marketing*, 19(6): 246–60.
24. Grönroos C. (1990), Relationship approach to marketing in services context: the marketing and organizational behaviour interface, *Journal of Business Research*, 20(1):3–11.
25. Gummesson E., 1994, Making relationship marketing operational, *International Journal of Service Industry Management*, 5(5):5–20.
26. Axson D. (1992), A return to managing customer relationship, *International Journal of Bank marketing*, 10(1): 30–35.
27. Berry L., 1995, Relationship marketing of services-growing interest, emerging perspectives, *Journal of the Academy of marketing Science*, 23(4):236–245.
28. Zineldin M. (1996), Bank corporate client partnership relationship: benefits and life cycle, *International Journal of Bank marketing*, 14(3):14–22.
29. Zineldin M., 2000 Beyond relationship marketing: technologicalship marketing, *Marketing Intelligence & Planning*, 18(1): 9–23.
30. Peppers D., Rogers M. (1995), A new marketing paradigm: share of customer, not market share, *Planning Review*, 23(4): 278–81.
31. Cronin M.J. (1997), *Banking and Finance on the Internet*, Wiley Publisher, New York.
32. Galliers R. (1992), Choosing information system research approaches, *Information systems research: issues, methods and practical guidelines*, Blackwell Scientific Publications, Oxford.
33. Orlikowski, Baroudi, (1991), Studying Information Technology in Organizations: Research Approaches and Assumptions, *Information Systems Research*, 2(1):1–28.
34. Tyler K., Stanley E., (2001), Corporate banking: the strategic impact of boundary spanner effectiveness, *International Journal of Bank Marketing*, 19(6): 246–60.
35. Dubois A., Gadde L.E. (2002), Systematic Combining: An Abductive Approch to Case Research, *Journal of Business Research*, 55.
36. Eisenhardt K.M. (1989), Building Theory from Case Study Research, *Academy of Management Review*, 14(4).
37. Lewis M.W. (1998), Iterative Triangulation: A Theory Development Process Using Existing Case Studies, *Journal of Operations Management*, 16:455–469.
38. Weick K.E. (1995), *Sensemaking in Organizations*, Sage Publications.

Integration of Different Organizations and Stakeholders in E-services Design and Implementation: the Case of the Spider Card

M.C. Di Guardo[1] and I. Zuccarello[2]

Abstract As e-service becomes increasingly pervasive in modern public organizations management, its influence on organization and individual preferences and competences is hard to ignore. This work addresses this issue by analyzing the different dimensions of the design and implementation of an e-service. It reviews the impacts on the integration of competences and preferences of the different stakeholders and organizations involved. The focus of the case study is a pioneering e-service initiative of the University of Catania known as the Spider Card.

Introduction

The impact of Information Technologies (IT) on Public Administration has rapidly grown since governments worldwide embraced emerging technologies to restructure archaic bureaucratic procedures [1]. In order to improve the quality and efficiency of public services, many public organizations currently employ or are planning to implement electronic service delivery through the use of modern IT. In fact, lately the public sector's conservative approach to using IT began to change. Administrators started to recognize the benefits of putting innovative technologies into operation as an approach to change the traditional organization dimensions [2]. Allen et al. [3] postulated that the surfacing of new forms of e-service goes beyond the mere infusion of technologies to encompass novel patterns of managerial decision-making, power-sharing, and resource-coordination, and it calls for a deeper integration of different stakeholders' aspirations and competencies. Accordingly, the future of organizations is intimately dependent on their capabilities to exploit technological innovations in harnessing competencies within an enhanced network of stakeholder interdependencies [4, 5].

[1]Università di Cagliari, Cagliari, Italy, diguardo@unica.it
[2]Università di Catania, Catania, Italy, izuccarello@lex.unict.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_8,

As e-service becomes increasingly pervasive in modern public organizations' management, its influence on organizations and on individuals' preferences and competences is hard to ignore. Therefore, our study aims at analyzing the different dimensions of e-services design and implementation, and its impacts on the integration of competences and preferences of different stakeholders and organizations. This paper deals with a pioneering e-service initiative of the University of Catania. Using the case study method, we analyzed the design and implementation of a highly innovative e-service: the Spider Card. Developed by the University of Catania (UniCT) and the banking group Monte dei Paschi di Siena (MPS) -leader in the Italian domestic market in terms of market share-, this service, for the first time in the Italian area, permits to head quickly for the "fully digital administration" target.

The Spider card, and more generally the spider system (i.e. the integrated tools/services provided through the Spider Card foreseen in the agreement between the two organizations), will allow for the automation of administrative and bureaucratic processes, cutting down paper documents, optimizing work time and it is an overall turning point in terms of efficiency. The Spider System includes a set of tools each implying a different level of integration of stakeholders' interests: the UniCt Card, the MPS Spider UniCt Card and ultimately the MPS Spider UniCt Card with digital signature.

Analysing the development of this new e-service from its early stages to product delivery we open up the complex multi-agent environment in which innovations are developed and selected. Studying e-services in the public sector forces one to address a number of issues that have been downplayed, or simply ignored. Past studies have focused primarily on the private sector. The project stakeholders included different actors (i.e. professors, employees, students), public/private service providers (i.e. the University and the Bank) and customers (i.e. the student for the University and for the Bank; the University for the Bank), which are the key groups involved in the innovation process. These key agents shape the design and the implementation of the innovations provided by the service. This in turn can alter institutions, organizational structures, and the competences of these key agents.

The paper is organized as follows. Next to an overview of the relevant concepts and literature given in Sect. 2, Sect. 3 introduces the research methods used. Section 4 provides an analysis of how the design and subsequent implementation of this innovative e-service takes place. On the basis of this analysis, some critical reflections are presented in Sect. 5 with regard to the competences and integration of the various organizations and stakeholders.

The Multi-Stakeholders Impact on E-Service Characteristics

Despite the growing importance of e-service for firms and public administrations, academic research on this topic is still in its infancy [7]. Furthermore, since the nature of e-service is likely to vary depending on the type of activity, a general agreement on its definition is missing [8]. In e-service, the customer's interaction or contact with the organisation occurs through technology: thus in this paper, e-service can be usefully conceptualised as an interactive information service [7, 8].

The increasing availability of IT has provided an opportunity for the diffusion of e-services. However, limited research has examined how perceptions regarding the characteristics of the e-service [9] can be influenced by the preferences and competences of different stakeholders during the design and implementation phases.

In our model we take into account the multi-stakeholders' impact on the characteristics of e-service during design and implementation. Recent organizational literature has emphasized that effective collaboration among diverse stakeholders enables organizations to draw on diverse forms of expertise to create new competencies and produce synergistic solutions to complex problems [10, 11].

Research on e-services has highlighted the importance of human resources and organisational innovation. With regards to public administrations, researchers have emphasised how the set of e-service characteristics depends on the preferences and competences of public administration professionals (i.e. their ability to use the new technologies), and on the interaction between professionals' competences and end-users [5, 12].

The design and implementation on an e-service for public administrations can represents a potential revolution on internal preferences and IT competencies. According to Tippins and Sohi [13] IT competences can be conceptualized as the extent to which an organization is knowledgeable about and effectively utilizes IT to manage information. The effective usage of the new technology is affected by its perceived usefulness and perceived ease of use. These factors emerge as critical perceptions during the adoption phase mediating the relationship between exogenous factors and the e-service usage [14]. Moreover, the ease of use is related with the preferences and competences expressed inside the organization.

At the same time, design and implementation of the e-service change the competences of the service providers [15]. Accordingly, in our framework we consider the change in organisational structure of the service provider's competences as a variable.

E-service may also alter user's competences, i.e. when it affects the way in which the user uses the service [16]. In our framework, we include user preferences as well as user competences. A new e-service requires users to learn about its pros and cons, pushing the evolution of their preferences. For this reason during and after implementation, the interaction between users and the organization becomes critical because users' inputs help the team configure the e-service correctly [17]. Furthermore, user resistance has also been regarded as one of the major reasons why e-service implementations failed [18]; that is, users' preferences of the e-service is an essential criterion in the evaluation of IS success.

The interaction among users' competences and preferences, services providers, and the public administration is once more essential to the development process. The interaction among the competences\preferences of the different stakeholders determines the direction and rate of change of the application and its characteristics.

These in turn are related to a set of technical features which are strongly tied to the underpinning technologies on which the e-services are based. For this reason, our framework dispenses with a separate vector of technical features.

Our framework reviews how the interaction among providers, users and public administration during the design and implementation of a e-service fundamentally change and are changed by the preferences and competences of different stakeholders, and it is the result of a deep integration.

Research Method

The research was conducted at the University of Catania over a period of 9 months and through different methods of data collection [19]. Interviews [20] to solicit data on the intra-organizational and inter-organizational considerations behind the implementation of the project were conducted with the Dean of the University of Catania, the Spider Card system design team, the Spider Card administrative group, and the Spider Card system implementation team from MPS. This first set of data was triangulated with a second set of data collected though interviews to the main stakeholders (i.e. bank managers, professors, students, and employees of the University of Catania, etc.) and designed to capture their perspective [21]. The interviews were conducted at the end of the planning phase and again at the end of the implementation phase of the project and involved all project stakeholders.

The interviewees were asked about the critical organizational issues and competences that they needed to address during the pre-implementation and implementation phases.

To incorporate the wider organizational context and the backgrounds of participants into the analysis, we obtained supplemental data from University's human resource database, web pages, and internal communications. Additionally, supplementary data from other sources including meetings, press statements, and a significant compilation of archival records was also solicited. The interviews and the pool of secondary data were used to built an in-depth collection of qualitative data [22] focusing exclusively on developmental issues pertaining to the design and implementation of the Spider System.

The Case of the Spider Card

The Spider Card project originates from the long lasting cooperation between the University of Catania and the MPS. Over the years, this cooperation generated improvements in procedures, information systems and the facilities used jointly by both actors. They created the Spider card by following the evolution of the "student matriculation/enrolment" process, an integral part of which is the collection procedure of the tuition fees.

The idea of a student card (later extended to the University staff) was inspired by the news of an agreement between Siena's University Dean and the President of MPS for issuing a credit card that could be specifically used by Siena's students to pay tuition fees through instalments, at zero cost and interest free. In order to verify the feasibility of an operation that had similar characteristics to those developed in Siena, a preliminary meeting between the management of the University of Catania and MPS was set up. The objective was to evaluate the mutual interest in developing a co-branded tool that met both parties' needs and preferences. The University asked the Bank (MPS) to consider issuing a credit card that could also be used as an identification card, and thus be used by students and staff to access University services. The University requested that the card be at zero cost for both the students and the University.

The University had various motivations and drivers to launch this project. The Italian University system is mainly funded by state transfers, which will be progressively assigned considering strategic programs and goals, and through the qualitative and quantitative assessment of activities and services provided. Recognizing that better services to students may represent a plus in this assessment, the University of Catania started looking at solutions that would allow the quality and efficiency of the services to improve while at the same time keeping their costs down. This approach fully aligns with the guidelines given by the Government to Universities and to public structures in general.

Also the Bank (MPS) immediately and positively considered the project as something attractive. The project has various advantages such as potentially reaching a very high number of clients (the card will be distributed to approximately 70,000 users) who may generate additional business transactions and cash flows, as well as improving the integration of the tools historically adopted by the two organizations. These improvements will also grant to the Bank an advantage over its competitors when in the future, the treasury service of the University will have to be awarded.

The advantages seemed clear to the organizations from the very first phase of the project. Advantages would come from the use of common innovative tools for simplifying procedures, the removal of some redundant phases of the processes, reducing the number of clerical errors and an overall time and cost optimization.

The initial project entailed a preliminary request of the University to have a single identification card -able to contain different and heterogeneous data, including data necessary for the digital signature-, which could also be used as a credit card. This plan was quickly expanded into a more complex project to develop a multi-service product consisting in two single "tools": an electronic identification and credit card and a separate token for the digital signature. The former to be made available to all students and employees of the University, the latter dedicated – in the first resort – to the first year students, to the teaching staff, to the managers and to administrative staff. In particular, the digital signature feature was strongly requested by the University because of its suitability in a wide range of operative contexts: from the process of on-line matriculation and enrolment of the students, to the system for the electronic registration of the exams, experimentally started in 2003, to the computerized management of the students' careers.

The agreement was reached with some difficulties: many obstacles emerged both of a psychological nature, such as distrust, lack of information, and resistance to giving up some consolidated habits. These difficulties led to alternative and more effective technical solutions than those initially considered.

The University goal of distributing a payment card to all its stakeholders – students and employees – came up against the regulations which prevent banks running any bank services if they are not specifically requested to do so by the potential customers. The solution was found by offering two different cards: one for identification purposes (the UniCt card), distributed to all users; the other one for payments (the Spider card UniCt) – which adds the specific functions of a bank card to those of a simple identification card – only if explicitly requested by the holder.

The agreement, signed between MPS and the University of Catania on September 2007, finally allows the Spider cards to be released free of charge, (although during the first meetings the bank had asked for 10 euros per card). However, in accordance with the CNIPA (Centro Nazionale per l'Informatica nella Pubblica Amministrazione) regulations, each USB device (token) for the digital signature service is to be paid for by the University at a cost of only 5 euros (although its usual cost is 35 euros[3]). Considering that the agreement foresees the distribution of 15,000 cards with the USB device and 55,000 additional bank cards, the University will only pay € 75,000 rather than € 525,000 for the token, and save the € 550,000 due for the distribution of the other 55,000 bank cards.

In the development phase, which involved directly the operators of the two organizations, new obstacles emerged. In particular, reluctance to give up some consolidated habits by the operators who, in the past, had worked on the implementation of the procedures now involved in the innovation. In this phase, the interactions between the organizations became more frequent and at different levels: from plenary meetings with the top managers of the two organizations, together with the middle managers and the single operators, to the agreed and coordinated actions for the development of procedures, the implementation of the software modules for the automatic management of the enrolment requests, the content of the project web pages, and the management of communication by coordinating the media and spaces for the promotion of the initiative.

Among the variety of services offered to the students, the on-line payment system added another piece to the matriculation and enrolment on-line procedure already active, with an immediate advantage for the student. Students can pay tuition and fees directly from home through "the student portal" on the University website, by using any credit card authorized by VISA or Mastercard interbanking circuits. In addition to the convenience of paying on-line without any queues at the registrar, there was another – not less important – advantage: familiarize all operators involved in the process (Bank, University and students) to using the new pro-

[3] Compared to the current market price, one may also consider that, up to the 28th of February 2007, the list price practiced by the University provider of the digital signature smart cards, for the electronic registration service, is 48 euros.

cedure and to learn about the pros and cons of the new service, pushing the evolution of user preferences.

The presentation of the first card to the Rector of the University, and the first distribution planned for the end of January 2008, was on June 2008.

Conclusion

By means of a case study, we seek to unveil the strategic elements of an e-service that will promote economical and effective elicitation of stakeholder's value and change the competences of the different stakeholders involved [5, 23]. We analyze the "inter-networked government" in which public and private organizations thrive on the collaborative potential of networking technologies in forging virtual alliances able to create strategic value for different stakeholders.

We highlight the main phases taking place in the development of the e-service and those factors playing a role on the participants' preferences, competences and on the final product's characteristics. While some of these issues have been previously studied, our analysis may provide a fresh appreciation of their role in the acceptance of a deep integration of different stakeholders and organizations.

The spider system is the key to the coming digital revolution in the University of Catania and the study of this case represents a unique opportunity to understand the implications of e-services for the allocation of values of different organization and stakeholders.

References

1. Moon, M.J. (2002) The evolution of e-government among municipalities: rhetoric or reality? *Public Administration Review* 62(4): 424–433.
2. Leenes, R. and Svensson, J. (2004) Electronic Services in a Decentralized State, Computer Science, 496–502.
3. Allen, B.A., Juillet, L., Paquet, G. and Roy, J. (2001) E-governance & Government on-line in Canada: Partnerships, People & Prospects, *Government Information Quarterly* 18(1): 93–104.
4. Prahalad, C.K. and Ramaswamy, V. (2000) Co-opting customer competence, *Harvard Business Review* 78(1): 79–87.
5. Lin, T. and Huang, C. (2008) Understanding knowledge management system usage antecedents: An integration of social cognitive theory and task technology fit, *Information & Management* 45(6): 410–417.
6. Levina, N. (2005) Collaborating on Multiparty Information Systems Development Projects: A Collective Reflection-in-Action View, *Information Systems Research*, 16(2): 109–130.
7. Santos, J. (2003) E-service quality – a model of virtual service dimensions, *Managing Service Quality* 13(3): 233–247.
8. Rowley, J. (2006) An analysis of the e-service literature: towards a research agenda, *Internet Research* 16(3): 339–359.
9. Ancarani, A. (2005) Towards quality e-service in the public sector: The evolution of web sites in the local public service sector, *Managing Service Quality* 15(1): 6–23.

10. Carlile, P. R. (2004) Transferring, Translating, and Transforming: An Integrative Framework for Managing Knowledge Across Boundaries, *Organization Science* 15(5): 555–568.
11. Hardy, C., Lawrence, T.B. and Grant, D. (2005) Discourse and collaboration: the role of conversations and collective identity, *Academy of Management Review* 30(1): 58–77.
12. Lim, E., Tan, C. and Pan, S. (2007) E-Government Implementation: Balancing Collaboration and Control in Stakeholder Management, *International Journal of Electronic Government Research* 3(2): 1–28.
13. Tippins, M.J. and Sohi, R.S. (2003) IT competency and firm performance: Is organizational learning a missing link?, *Strategic Management Journal* 24(8): 745–761.
14. Saeed, K.A., Abdinnour-HeIm, S. (2008) Examining the effects of information system characteristics and perceived usefulness on post adoption usage of information systems, *Information & Management* 45(6): 376–391.
15. Jacobides, M.G. and Winter, S.G. (2005) The co-evolution of capabilities and transaction costs: explaining the institutional structure of production, *Strategic Management Journal* 26(5): 395–414.
16. Schultze, U. (2003) Complementing self-serve technology with service relationships: the customer perspective, *E-service Journal* 3(1): 7–31.
17. Yen, H.R., Li, E.Y. and Niehoff, B.P. (2008), Do organizational citizenship behaviors lead to information system success? Testing the mediation effects of integration climate and project management, *Information & Management* 45(6): 394–420.
18. Law, C.H. and Ngai, E. (2007) IT Infrastructure Capabilities and Business Process Improvements: Association with IT Governance Characteristics, *Information Resources Management Journal* 20(4): 25–47.
19. Benbasat, I., Goldstein, D.K. and Mead, M. (1987) The case research strategy in studies of information systems, *MIS Quarterly* 11(3): 369–386.
20. Merton, R.K., Fiske, M. and Kendall, P.L. (1990) *The focused interview: a manual of problems and procedures* (2nd ed.). New York, Free Press.
21. Orlikowski, W. (1993) Case told as organizational change: Investigating incremental and radical changes in system development, *MIS Quarterly* 7(3): 309–340.
22. Eisenhardt, K.M. (1991) Better stories and better constructs, *Academy of Management Review* 16(3): 620–627.
23. Schepers, J. and Wetzels, M. (2007) A meta-analysis of the technology acceptance model: Investigating subjective norm and moderation effects, *Information & Management*, 44(1): 90–103.

Interactions with Open Source Software: A Pilot Study on End Users' Perception

A.M. Braccini[1], C. Silvestri[2], and S. Za[3]

Abstract Interest of scientific research on Open Source software and its development process is frequent. The number of articles available and the number of tracks or workshops on this topic in most relevant IS Conferences is high. The usability of Open Source Software has been scarcely considered until few years ago, probably due to the particular role that the user has in such a development environment. In Open Source software development, users and developers are not so different. Anyhow, the diffusion of the Open Source software outside the development community contributes to sharpen the distinction among these two groups that are no longer equivalent. This circumstance has contributed to increase the interest on usability of Open Source software. Nevertheless, studies on end-users in Open Source contexts are still young. This paper introduces a pilot study on end user's perception of Open Source software. The aim of this pilot study is to identify how the end user perceives the Open Source software (in terms of Usability, Functionality, Reliability, Efficiency and Quality in Use).

Introduction

The interest of scientific research on Open Source software and its development process is directly witnessed by the body of articles available [1], and by the number of tracks or workshops devoted to this topic in most relevant IS Conferences (i.e.: ECIS 2007, ECIS 2008, Open Source Systems 2008 and IFIP WCC 2008).

Researchers acknowledge that Open Source software has a high impact potential on economic and social infrastructure [2]. On the base of the assumption that Open Source Software development processes contribute to a better output in

[1]Università LUISS Guido Carli, Roma, Italy, abraccini@luiss.it
[2]Università della Tuscia, Viterbo, Italy, c.silvestri@luiss.it
[3]Università LUISS Guido Carli, Roma, Italy, sza@luiss.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_63,

comparison to traditional development methodologies [3–5], several studies started to investigate the adoption of Open Source based solutions in different environments [6, 7]. Large part of available studies focus on the internal perspective on the Open Source software usage, without taking the end user into consideration.

This paper introduces a pilot study on end user's perception of Open Source software. The aim of this study is to identify how the end user perceives the Open Source software (in terms of Usability, Functionality, Reliability, Efficiency and Quality in Use). This article is structured as follows: after the research design, a brief literature review will describe the theoretical framework, and later the results of the pilot study will be introduced. A discussion of findings and a conclusion will follow.

Research Design

Studies on Open Source Software have to deal with the difficulties in the selection of a random sample of users [8]. Usually the source code of Open Source software is freely distributed over the internet: this makes the real population of users unknown and impedes the possibility to create a truly random sample of users. In this pilot study we therefore decided to adopt an interpretive approach in order to try to understand how end users perceive the Open Source software. Our aim is not to predict or establish general law (as in a positivist study), but to comprehend the phenomenon from the point of view of the people involved in it, and to gain thorough understandings of it.

The software adopted in this pilot study is Moodle, one of the most commonly used Open Source e-learning platforms. This software was used by a group of 80 students attending the "Computer mediated Training" course in a faculty of Education Science. These students used the platform for 6 months, both to download/upload contents, and to create contents in virtual on-line training courses.

We created a survey using the focus group technique (involving about the 10% of the final sample size) to define the most relevant aspects perceived by the users. The users' derived dimensions were confronted by those indicated in the ISO 9126 and ISO 25000 software quality model, that we used as a reference. We decided to adopt these models to deepen the understanding of our case, mainly because they include not only the Usability as a dimension, but others, interrelated, areas. We excluded from the dimension covered by the survey those that cannot be evaluated under the end user's perspective (ie: Maintainability and Portability). As a result the survey covers the following areas of the aforementioned standards: Functionality, Reliability, Usability, Efficiency and Quality in Use. In the survey we added another variable called General Satisfaction as a control variable to explain the other dimensions. Before submitting it to the end users, the survey was tested with another sample of users to ensure that it was clear enough.

Theoretical Framework

Usability in the Open Source Software development has been scarcely considered until few years ago, probably due to the particular role that the user has in such a development environment. Open Source Software development has usually been based on the blurred distinction between users and developers. In traditional Open Source Software development processes, the developer is a user at the same time, but it can easily turn into a developer, contributing to the project by submitting a patch, writing a piece of code or performing other activities. It can therefore be argued that the Open Source Software development process relies on the assumption that users and developers may converge. The diffusion of Open Source Software outside the development community contributes to sharpen the distinction between these two groups that are no longer equivalent. As a matter of fact they are nowadays too different [9]. In the traditional organization of an Open Source Software development process, users outside the community are hardly ever taken into consideration during the development. This call for major involvement of HCI expert inside Open Source Development projects, as the interface design might not be treated with the same openness that is used for the source code [9].

This set of circumstances has contributed to increase the interest of the research on Open Source adopting an end user perspective. As a consequence, the number of work on usability of Open Source software is increasing (see for example [10–13]). Recently large attention has been paid to flexibility, efficiency, robustness and effectiveness [10, 14]. Large part of available contributions try to provide suggestions to reduce the gap between the developers and the users outside the development community, trying to suggest methods to consider their needs in the development project. Studies on users' perception on Open Source Software are anyhow quite young.

Traditionally Open Source has been considered as a development process that could have a great chance to produce a successful piece of software due to the so called "Linus Law" [15] that synthesize the effect of the peer review process: "given enough eyeballs all bugs are shallow". This anecdotal assumption has been described by a predictive mathematical model [16] which states that OSS can converge to a bug free state even if average programmers quality is lower than the one employed in a traditional environment. Code inspection and statistical analysis of defect density have commonly been used to assess the goodness of Open Source projects [17, 18].

As a matter of fact, in a frequently cited IS success model [19, 20], DeLone and McLean contribute to highlight that the benefits derived by the use of a software (system) are mediated by users' satisfaction. In an adapted version of DeLone and McLean IS success model (specific for Open Source) [21], Sang-Yong et al. identify that the user satisfaction is affected by software quality. Anyhow, recalling the possible differences among developers and users in the Open Source context, it is not granted that the software quality level is exactly the one that the user needs and, at the same time, it is not even granted that this is the only relevant dimension for him. The internal characteristics of the Open Source Software might therefore be high and respect high standard but they might even be not what the user wants or desire or, under a different point of view, the users might not be in the position to perceive and evaluate them.

Results of the Pilot Study

In total we received 59 filled surveys. Data obtained from the survey have been analyzed using descriptive statistics. We calculated the Cronbach's alpha as a reliability index for the results of the survey. The value for our survey is 0.84, which is high enough for an explorative study [22].

The profile of respondents emerging from the survey is as follows. Almost two third of the respondents (69%) have an age between 23 and 32 years, they use the computer for more than 7–9 years (61%), and have been using the Moodle platform at least 1–2 times a week (for 57% of the respondents). In general, the respondents do not have great experience with other Open Source Software because, on average, more than half of the respondents have never used other Open Source software besides Moodle.

The profile has been analyzed using some descriptive statistics. The results are shown in Table 1: the scores of these variables have been obtained by calculating the average score of each group of questions (in the survey) that were specifically referred to the variables indicated in Table 1. These results show a good level of satisfaction of the respondents with Moodle, that is at the same time confirmed by the low level of the variance and of the standard deviation. Anyhow it has to be taken into consideration that the short Likert scale (from 1 to 4) tend to foster low variation.

Further information can be obtained dividing the respondents into two groups, according to the depth of usage of the e-learning platform. We therefore distinguish between basic and advanced users. Respondents were asked to state which features they had used in the Moodle platform. These features were divided in two groups (basic and advanced) and these distinction was used to establish the depth of usage.

The results are depicted in Fig. 1 and they show that beginners (45 users) have lower scores than advanced (14 users), especially in three areas: Functionality, Reliability and Efficiency. In general, beginners are less satisfied than advanced users. Similar considerations can be formulated referring to the experience of each user with Open Source software in general. The few respondents (4 users) that

Table 1 Descriptive statistic (1 min–4 max)

Area	Obs	Mean	Std Dev	Var	Min	Max
Functionality	59	3.12	0.59	0.35	2	4
Reliability	59	2.92	0.82	0.66	1	4
Usability	59	3.33	0.71	0.50	1	4
Efficiency	59	3.25	0.68	0.46	2	4
Quality in Use	59	3.29	0.58	0.33	2	4
General satisfaction	59	3.41	0.53	0.28	2	4

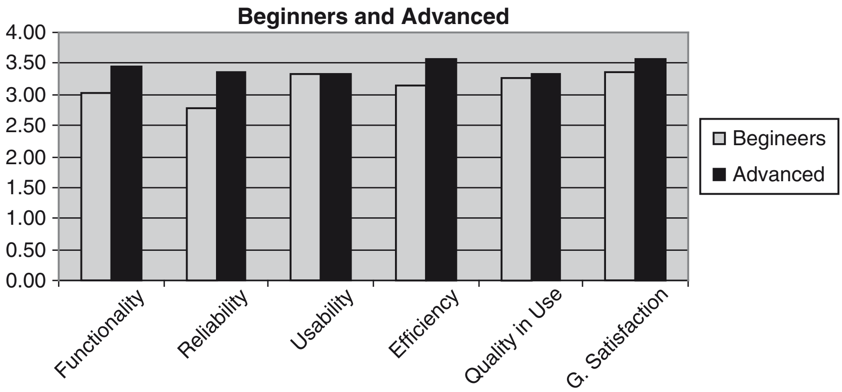


Fig. 1 Beginners and Advanced compared scores

Table 2 Correlation matrix

	Functionality	Reliability	Usability	Efficiency	Quality in Use
General satisfaction	0.61	0.39	0.56	0.38	0.56

Table 3 Linear regression

	Coeff.	t	P>|t|
Constant	0.820	2.46	0.017
Functionality	0.369	4.23	0.000
Reliability	–0.120	–0.17	0.866
Usability	0.182	2.01	0.049
Efficiency	–0.001	–0.01	0.989
Quality in use	0.248	2.21	0.031
Obs: 59	Adj R-Squared = 0.52	F Test = 13.50	

indicated to be familiar with other Open Source software, they have, on average, higher scores on all the dimensions.

Table 2 illustrate a correlation matrix among the five areas covered by the survey (Functionality, Reliability, Usability, Efficiency and Quality in Use) and the control variable called General satisfaction. The matrix shows positive correlation among the dimensions and significant values for the Functionality, the Usability and the Quality in Use areas.

Finally Table 3 contains the linear regression model where the general satisfaction has been taken as an independent variable and has to be explained by the other six variables. The results of the regression model allow us to affirm that there is a predictive linkage only for three variables: Functionality, Usability and Quality in Use. Out of these three variables, the Functionality is the one for which the linkage is the strongest. Reliability and Efficiency show a negative value.

The significance of the proposed linear regression model is partially validated by the F test study which is higher than 1 (13,50) and allow us to refuse the H_0: $\beta=0$

hypothesis (the absence of a linear regression linkage among variables taken into consideration), and implicitly accept the H_1: $\beta \neq 0$ hypothesis (the existence of a linear regression linkage among variables). Furthermore, the Adj R-squared index shows that only 52% of the total variance can be explained by the linear regression model.

Finally, the p-value indicator (that gives us information on the validity of the null hypothesis) shows low probabilities for the Functionality (less than 1%), the Usability (around 5%) and the Quality in Use (around 3%). The p-value for Reliability can confirm the existence of a negative value while for the Efficiency we can hypothesize the total absence of relationships.

Discussion

The results of the survey shows that end user's perception, measured on the dimension adopted in this paper, was quite high and in general, the user is satisfied of his experience with the software. Looking at the descriptive statistics on the six variables considered in this survey we can affirm that not all of them perform in the same way. In general, our sample of users, indicated the Reliability as the less satisfactory area. This area has, in fact, the lowest score and the highest variation. According to us, it is worthwhile to pay attention to the fact that Reliability (as defined in the ISO 9126 and ISO 25000 standards) is, among all the software characteristics, the one that considers software defects. This score let therefore us think that code quality and software correctness are not enough to achieve a successful user interaction with Open Source software. It is worthwhile to mention that this result is even confirmed by the test sample we used to validate the survey (which was formed by a smaller group of students who attended a different training course and who used the same Moodle platform).

The identification of the two user's profile (advanced/beginners, and expert/non-expert) has contributed to identify that both the experience with the specific software and the experience with other Open Source software may contribute to increase users perception. Anyhow, it has to be considered that these users received specific training to proficiently use the Moodle e-learning platform.

Finally, the correlation matrix and the linear regression model highlight that Functionality, Usability, and Quality in Use are the dimensions that mainly impact users experience with the software. From the linear regression model we can assert that the Efficiency is of no importance for end users, and that there is an inverse relationship between Reliability and Quality in Use.

Conclusions

Open Source software and its development processes are nowadays subjects of interest for IS research. Past research on this topic has contributed to assert that the Open Source development process can contribute to produce better software.

Anyhow these judgements have always been based on an internal evaluation of software characteristics, on the base of the assumption that a high quality software could lead to a better customer satisfaction. Under this point of view Open Source software development counted, for long time, on the similarity between users and developers. With its diffusion, Open Source software has now reached users outside the development community, and these users might have different needs than those expressed by traditional ones. Under this point of view, it is worthwhile to investigate end users' experiences with Open Source software.

In this research paper we introduced a pilot study on end user's perception of Open Source software. We analyzed the general perception of a sample of students that used the Moodle e-learning platform for 6 months. We used a model based on the following dimensions: Functionality, Reliability, Usability, Efficiency, Quality in Use, and General Satisfaction. Our results show that, in our case, the scores were sufficiently high, even if users perceive the Reliability as the less satisfactory area, and are not in the position to formulate adequate judgements on the Efficiency.

References

1. Darking, M.L, Whitley, E.A. (2007). Towards an Understanding of FLOSS: Infrasctructures, Materiality and the Digital Business Econosystem. *Science Studies*, 20(2): 13–33.
2. von Krogh, G., Spaeth, S. (2007). The Open Source Software Phenomenon: Characterstics that Promote Research. *Journal of Strategic Information systems*, 16(3): 236–253.
3. Mockus, A., Fielding, R.T., Herbsleb, J.D. (2002). Two case Studies of Open Source Software Development: Apache and Mozilla. *ACM Transactions on software engineering methodology*, 11(3): 309–346.
4. Stamelos, I., Angelis, L., Oikonomou, A., Bleris, G.L. (2002). Code quality analysis in Open Source software development. *Info Systems Journal*, 12(1): 43–60.
5. Fuggetta, A. (2003). Open Source software – an evaluation. *The Journal of Systems and Software*, 66(1): 77–90.
6. Stone, A. (2002). Open Source Acceptance Grows. *IEEE Software*, 19(2): 102.
7. Gallego, M.D., Luna, P., Bueno, S. (2007). User acceptance model of Open Source Software. *Computers in Human Behaviour*, 24(5): 2199–2216.
8. Crowstone, K., Annabi, H., Howison, J. (2003). Defining Open Source Software Project Success. In Proceeding of the Twenty-fourth International Conference on Information Systems (pp. 327–340).
9. Nichols, D.M. and Twidale, M.B. (2006). Usability processes in open source projects. *Software Process: Improvement and Practice*, 11(2): 149–162.
10. Benson, C. (2004). Meeting the challenge of open source usability. Interfaces: 9–12 Number 59, Autumn 2004. http://www.bcs-hci.org.uk/interfaces/interfaces59.pdf.
11. Benson, C., Muller-Prove, M., Mzourek, J. (2004). Professional usability in open source projects: GNOME, OpenOffice.org, NetBeans. Extended Abstracts of the Conference on Human Factors and Computing Systems. ACM Press: New York, 1083–1084.
12. Nichols, D.M., Twidale M.B. (2005). The usability of open source software. First Monday 8(1): http://firstmonday.org/issues/issue8_1/nichols/, 15 September 2005.
13. Nichols, D.M., McKay, D., Twidale, M.B. (2003). Participatory usability: supporting proactive users, Proceedings of 4th ACM SIGCHI NZ Symposium on Computer-Human Interaction (CHINZ'03), SIGCI: Dunedin, 63–68.

14. Raymond, E.S. (1999). The revenge of the hackers. In Open Sources: Voices from the Open Source Revolution, StoneM, Ockman S, DiBona C (eds). O'Reilly and Associates: Sebastopol, CA, 207–219.
15. Raymond, E.S. (2001) The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary, O'Reilly.
16. Challet, D., Le Du, Y. (2003), Microscopic model of software bug dynamics: Closed Source versus Open Source, *International Journal of Reliability, Quality and Safety Engineering*, 12(6): 521–534.
17. Chelf, B. (2006). Measuring software quality – A Study of Open Source Software. http://coverity.com/html/library.php.
18. Coverity Inc. (2008). Open Source Report. http://scan.coverity.com/report.
19. DeLone, W.H., McLean, E.R (1992). Information systems success: the quest for the dependent variable. *Information Systems Research*, 3(1): 60–95.
20. DeLone, W.H., McLean, E.R (2003). The DeLone and McLean model of information systems success: a ten-year update. *Journal of Management Information Systems*, 19(4): 9–30.
21. Sang-Yong, T.L., Hee-Woong, K., Sumeet, G. (2007). Measuring open source software success. *Omega*, 37(2): 426–438.
22. Hair, J.F., Anderson, R.E., Tatham, R.L., Black, W.C. (1998). *Multivariate data analysis*. Fifth ed. Englewood Cliffs, NJ: Prentice-Hall.

Introduction

A. D'Atri[1] and D. Saccà[2,3]

This book offers a careful selection of the best contributions to the Fifth Conference of the Italian Association for Information Systems (http://www.itais2008.org), which took place at the European School of Management, ESCP-EAP, in Paris (France) on December 13–14, 2008, in conjunction with the International Conference on Information Systems (ICIS 2008).

ItAIS (http://www.itais.org) is the Italian Chapter of the Association for Information Systems (AIS, http://www.aisnet.org). It was established in 2003 as and has since been promoting the exchange of ideas, experience, and knowledge among both academics and professionals committed to the development, management, organization and use of information systems.

The annual itAIS conference is the major annual event of the Italian Information System community and is thought of as an international forum among researchers in the field. The conference aims to bring together researchers, scientists, engineers, and scholar students to exchange and share their experiences, new ideas, and research results about all aspects of Intelligent Systems, and discuss the practical challenges encountered and the solutions adopted. The previous editions took place in Venice on 2007, in Milan on 2006, in Verona on 2005 and in Naples on 2004.

The 2008 edition of itAIS in Paris was titled "Challenges and Changes: People, Organizations, Institutions and IT" to highlight that innovation into Information Systems relies not only on the technology but also on all agents who are involved in them. Indeed technological IS development had brought, over the last years, several challenges and changes to existing organizations and has enabled new forms of organizations (e.g. collaborative networked organizations, virtual organizations, supply chains, communities, etc.) and new interaction and cooperation models for stakeholders (employees, suppliers, individual and corporate customers, governments, investors). On the other hand, both organizations and stakeholders are issuing more and more demanding requirements to the design and development of IS, thus raising new challenges to the underlying technology to effectively

[1]LUISS Guido Carli, Roma, Italy, datri@luiss.it
[2]Università della Calabria, Arcavacata di Rende (CS), Italy, sacca@unical.it
[3]ICAR-CNR, Arcavacata di Rende (CS), Italy

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_1, © Springer Physica-Verlag Berlin Heidelberg 2010

support business' interaction with stakeholders. The new scenarios open up a new set of research issues and extend the space of IS research and call for a interdisciplinary approach to harness a number of diverse disciplines in both the theory and the practice of information systems. This conference edition collected together IS researchers and practitioners to illustrate and reflect on their expertise and to discus new research issues, particularly those concerned with the IS support to the interaction of organizations, stakeholders and governments.

The itAIS 2008 statistics give an indication of the increasing success of conference: 113 submissions , 87 presentations and more than 130 participants. Out of the 87 accepted contributions, 63 of them have been selected for publication in this book and are herein grouped into 10 sections, corresponding to the 10 conference tracks, which investigate different facets of IS research and practice:

- E-Services in Public and Private Sectors.
- Governance, Metrics and Economics of IT.
- Information and Knowledge Management.
- IS Development and Design Methodologies.
- IS Theory and Research Methodologies.
- Legal and ethical aspects of IS.
- New themes and frontiers in IS Studies.
- Organizational change and Impact of IT.
- Human Computer Interaction.
- Strategic role of IS.

The Section on E-Services in Public and Private Sectors (coordinated by: Marco De Marco, Katia Passerini, and Jan vom Brocke) investigates the theme of e-services from multiple perspectives: from theoretical issues to empirical evidences developed in specific service areas (e.g. healthcare, tourism, government, banking), in processes (e.g. procurement, invoicing, payments), and in public or private environments. The section includes 12 contributions that deal with varying topics, from municipal e-services to corporate e-banking and e-democracy and other broader issues (eg, coordination processes and legal implications).

The Section on Governance, Metrics and Economics of IT (coordinated by Giuseppe Visaggio) identifies new economic and metric models to align IT strategies with organizational and business strategies, to create value through IT projects, to measure and manage performances of introduced innovations, to manage the risks related to adopting innovations. The seven contributions consider various topics: from the empirical investigation about new business models and process to the analysis of enterprise governance and of the value produced by IT, including special measures to enforce data security.

The Section on Information and Knowledge Management (coordinated by Valeria De Antonellis) presents on-going researches, case studies and best practices on information and knowledge management and collaboration in modern organizations and on the ways new systems, infrastructures and techniques may contribute to extract, represent and organize knowledge as well as to provide effective support for collaboration, communication and sharing of information and knowledge. The seven contributions of this section consider different perspectives and dimensions in various domains of discourse: relevant issues in the area of knowledge sharing and discovery, techniques and tools for effective knowledge and information management and querying, methods and tools to support design, classification and mining processes.

The Section on IS Development and Design Methodologies was coordinated by Carlo Batini. This section addresses various topics concerned with the evolution of methodologies for IS development and design, which take into account, besides ICT aspects, different issues and research areas, from social, to economic, juridical, and organizational issues. The three contributions included in this section deal with user centered and interoperable health information systems, ontology based analysis of information systems, and design of Web 2.0 applications.

Giovan Francesco Lanzara and Antonio Cordella coordinated the Section on IS Theory and Research Methodologies, which discusses novel and interesting ideas on how to conceive and study ICT and IS in the contemporary world by bringing together the contributions of many disciplines, from management and organization studies to economics, from cognitive science to ethnographic research and philosophical inquiry. The three contributions of this section address various topics: epistemological considerations on information systems as complex objects, experiments on new learning environments through simulations, case studies and role playing, analysis of how organizational capabilities related to information systems are developed in a competence center of a major company.

The Section on Legal and ethical aspects of IS (coordinated by Antonio Marturano) highlights legal and ethical issues in IS that arise both from the process of doing research, such as surveying, interviewing or gathering requirements and from the (mis-)use of IS not only in the organizational workplace but also from a global perspective. The seven contributions of this section deal with a wide range of topics, such as: IT and the workplace; access to information; ethical concerns of IT design; security and surveillance; computer crime and legislation; Internet governance; the digital divide and social justice; Social responsibility and codes of conduct for ICT professionals; ethics, agency, and structure; and The embodiment of values in IS design.

Michele Missikoff coordinated the Section on New themes and frontiers in IS Studies. This section gathers visionary and forward looking contributions, able to trace possible future trajectories in the IS research and, more in general, in the future interdisciplinary research, capable of achieving a synthesis between then typical IS areas, with emerging ICT, business and enterprise areas, to achieve more advanced technological solutions in the future economic and societal scenarios. The nine contributions of this section concern very heterogeneous and advanced topics from business models to schema mapping, from semantics to agents, from systems engineering to business processes, and from information systems crisis to security.

The Section on Organizational change and Impact of IT was coordinated by Ferdinando Pennarola and Aurelio Ravarini, and it collects contributions – both at the theoretical and the empirical level – on innovative approaches to interpret and manage the organizational role of IT in changing environments. The seven contributions of this section discuss various topics: the role of IT in change processes, both from a socio-materiality perspective and in terms of the impact on time orientations, organizational implications of the adoption and use of specific IT systems (Business Intelligence Systems, ERP Systems, and RFId-based Supply Chain Management Systems), innovative organizational mechanisms to improve the management of IT services sourcing.

Francesca Maria Costabile coordinated the Section on Human Computer Interaction. This section discusses theories, practices, methodologies, techniques and applications about the interaction among humans, information and technology and addresses emerging HCI research topics, such as designing for improving the overall user experience, favoring social connections and supporting collaboration. The eight contributions of this section consider various issues: usability and user-centered design, novel techniques in user interfaces, computer interfaces satisfying the needs and expectations of different user categories, end-users oriented analysis of Open Source software quality, such as functionality, reliability, efficiency, and quality in use.

Finally, the Section on Strategic role of IS (coordinated by Gabriele Piccoli and Cecilia Rossignoli) discusses the role of Information Systems in enabling organizations to create and sustain competitive advantage and to improve their competitive positioning. The two contributions of this section focus on how IT can play a strategic role in retail business, analyzing how IT supports business and organizational strategies, and on knowledge and training issues in multisite ERP implementations.

We conclude by thanking all the authors who submitted papers and all conference participants. We are also grateful to the chairs of the ten tracks and the external referees, for their thorough work in reviewing submissions with expertise and patience, and the President and the members of the itAIS steering committee for their strong support and encouragement in the organization of itAIS 2008. A special thank is due to all members of the Organizing Committee and to the staff of CERSI (Research Centre on Information Systems at LUISS University "Guido Carli" of Rome), for their precious support to the organization and management of the event and in the publication of this book.

IT Value in Public Administrations: A Model Proposal for e-Procurement

A.M. Braccini[1] **and T. Federici**[2]

Abstract Recent studies have affirmed the necessity of a discontinuity in the method of investigating the value produced in organisations by IT. Existing studies have in common a prevailing (when not exclusive) attention paid to the private sector, as testified by the frequent use of income or financial indicators to measure benefits. These approaches however cannot be directly applied to public utility organisations like Public Administrations. Taking into account this scenario, the present exploratory work looks at the analysis of IT investments in the public sector by identifying a viable approach to research in this domain. To move towards this objective, procurement management has been taken as the field to be observed, and an Italian public Local Healthcare Agency which has managed several e-procurement projects has been analysed. This case represents a valuable context for examination and discussion because the outcomes of each project were evaluated in detail. A rich IT Value Model devoted to the private sector has been adopted and discussed, and later some resulting adaptations are suggested, together with some hints and limitations.

Introduction

The existence of a positive correlation between investments in Information Technology (IT) and performance improvements in organisations (in terms of productivity, savings, or income) has often been taken for granted. However, the observation of the so-called productivity paradox by Brynjolfsson [1] made this statement uncertain and stimulated new interest in research into the strategic value of IT investments. Recent studies affirm the necessity of a discontinuity in this domain of research, by rethinking the method of investigating the value produced by IT [2].

[1] Università LUISS Guido Carli, Roma, Italy, abraccini@luiss.it
[2] Università degli Studi della Tuscia, Viterbo, Italy, tfederici@unitus.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_15,

The diversity in research methods adopted led to results that are hard to replicate in different contexts. Moreover, existing studies have in common a prevailing (when not exclusive) attention paid to the private sector. Such a tendency is testified by the frequent use of income or financial indicators to measure organisational improvements. These approaches cannot be directly applied in organisations operating for public utility purposes [3] such as Public Administrations (PAs). Actually, there are few studies investigating the relationship between investments in IT and value delivered to the stakeholders in this context.

Having in mind this scenario, the present exploratory work deals with IT value analysis in the public sector, and also identifies a viable approach to research in this domain. To move towards this objective, procurement management was taken as the field to be observed. The rationale for such a choice is the PAs' frequent recourse to e-procurement, which is seen as the most probable innovation to produce tangible value in this sector. Experiences and findings coming from an interesting context were used as a basis to discuss the IT Value Model of Melville et al. [4] and to draw a new one more suitable to investigate the public e-procurement domain.

The analysed context is that of the public Local Healthcare Agency (LHA) of Viterbo (Italy), which seemed pertinent to the research since this LHA managed several projects of IT-supported innovation to introduce e-procurement with the aim of gaining efficiency and cost reductions. Moreover, the outcomes of most of these projects were analysed in detail, and many studies were published over several years by different scholars, advisors, and consultants (while the public e-procurement topic is still neglected). Additionally, the Local Agency level is comparable with that of a firm, and is usually adopted in IT value assessment, and also in the adopted model, as the unit of analysis. Finally, the e-procurement is actually applied and produces real outcomes (if any) at the level of a single administration.

The paper is structured as follows: in the theoretical framework a brief literature review on IT value analysis, one of the most complete model for the private sector, and some definitions on e-procurement are introduced. Next, the adopted research methodology, a brief context description, and the research findings are reported. Then, the findings are discussed, and the resulting adapted model suggested. Finally, some hints and limitations are proposed in the conclusions.

Theoretical Framework

IT value research [4] focuses on the paradox consisting in the lack of productivity improvements resulting from massive investments in IT [1]. Available research papers in this area analysed the topic with several approaches and methodologies [5], in the end highlighting that IT affects organisational performance [6–8]. Even if the paradox cannot be considered to be solved, at least there is consensus on factors and loci affected by IT investments [5, 9, 10].

Research efforts have often been concentrated on the identification of metrics and measures (see [9 and 5] for a detailed list) to assess performances, but their suggestions can hardly ever be applied to PAs since such indicators are drawn from profit oriented organisations [3].

The need to identify common traits among available studies is considered a necessary foundation for further progress on this topic [5]. With the aim of analysing value delivered by IT investments in PAs, we decided to start from the IT value framework defined in [4]. This framework has been drawn by overlapping a series of 202 different IT studies available in the literature which had, as their core matter, the IT value generation process inside organisations. The model derived from this research, relying on a Resource Base View (RBV) theoretical perspective, places three layers behind such process. It identifies the locus of IT value creation as the focal firm, but it also stresses the relevance of the competitive environment and the macro environment.

Proposing the framework (see Fig. 1), the authors affirm that IT impacts organisational performance via intermediate business processes, with the support of organisational resources that may act as mediator or moderator, and under the influence of the external environment. At the same time they highlight the importance of disaggregating the IT construct into its meaningful subcomponents.

The focal firm is the domain affected by the IT investment, as it represents the organisation acquiring and deploying the IT resource, and for this reason it has to be identified in every analysis. This layer includes the IT resources, complementary organisational resources, business processes, and business process performance, which all together are components of the IT business value generation process and the organisational performance. The competitive environment is the specific context where the focal firm operates. This environment is divided into two elements: the industry characteristics and the trading partners resources & business processes. Finally, the macro environment, mainly focused on country characteristics, includes country and meta-country specific factors that shape IT application for the organisational performance improvement.

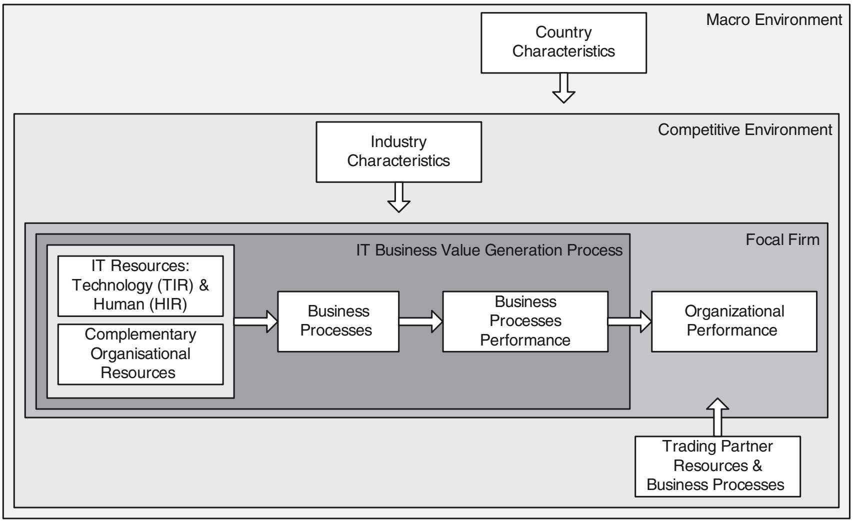


Fig. 1 IT business value model [4]

With the intent to apply this framework to a Public Administration, adaptations may be required. The IT business value generation process is, among all, the part probably requiring fewest modifications, even if metrics and measures may need to be modified. The last component of the focal firm layer (organisational performance) is more problematic, as all the income or profit indicators are unsuitable for PAs. The competitive environment may also require some attention, as it is disputable whether a PA may work in a competitive environment or not. Moreover, the environment where a PA operates is probably animated by a different set of agents that may have a different influence on focal organisation compared to the one possibly exercised on a private company by other actors in the same position. Finally, the Macro Environment layer might be relevant only when PAs from different countries are taken into consideration.

As regards procurement, following other studies [11, 12], in this paper it is intended as a broad process that starts with a need for a good or service and ends with its use and the payment for its supply. According to this statement, the term e-procurement indicates the organisational solutions supported by Information & Communication Technology (ICT)-based tools that allow electronic forms of procurement, which are potentially more effective and efficient than traditional ones, where a more or less broad and deep process redesign is required [13]. E-procurement solutions include tools in two areas, which must be jointly used to streamline the whole procurement process:

- *e-purchasing*, which includes many different tools supporting the purchasing phase, from finding a product to invoicing and payment, to be entirely managed through on-line tenders (e-tendering) or marketplaces and electronic catalogues (e-requisitioning), electronic invoice exchange and processing (e-invoicing), and liquidation activity (e-payment);
- *e-logistics*, which aim at optimising the management of inventories and internal goods flows on the basis of Intranet/Extranet technologies, integrating Supply Chain Management (SCM) solutions linking both internal and external players.

E-procurement in public healthcare is highly representative as the same domain in other PA sectors is a subset of it, since in healthcare [13]:

- Structures deliver more critical and specialised services than the rest of PA, and safeguarding high quality standards for many purchased goods is paramount;
- Spending is more composite, as it includes standard supplies for the whole PA, together with highly specific goods (e.g. operating room specific devices);
- The market involves about 500 thousand highly differentiated suppliers (multinationals, mid-size national companies, and local SMEs).

Methodology

The present research paper is based on the analysis of a set of individual studies focused on the organisational and performance consequences related to the implementation of e-procurement in the LHA under investigation. This analysis took into consideration about 35 research documents (only partially cited here due to lack of space; a complete list is available upon request from the authors). Each study has undergone a text analysis covering its content and results, in order to establish whether it had to be included. We mainly focused on measures, indicators, and agents involved in the IT investment/innovation processes, both inside and in the environment around the organisation representing our Focal Firm.

Case Description

The considered LHA is a public structure and provides healthcare services to the province of Viterbo. With the aim of gaining efficiency and reducing spending on goods and services procurement, since 2000 the LHA has managed several experimental projects on e-procurement, whose results were evaluated in detail in order to assess savings (both on final and on administrative costs) and to make the best decision on their definitive adoption. The results were remarkable, even though different in nature and dimension, taking into account the obstacles met (technological, organisational, and also normative) as for any innovation [14]. After the pilot experiences, since 2004 the LHA has launched an extensive programme to innovate the end-to-end procurement process through the implementation of the best tested solutions. The outcomes of the first steps of this phase (which is still ongoing) were also assessed in detail [14]. The analysis of reports following each project test is summed up in Table 1.

Discussion

Some considerations can be pointed out by reading the LHA e-procurement history. In all the innovations, even when based on a really fresh IT tool (often this LHA was a first-mover), the process re-design had a relevant part, which was often highly constrained by laws and rules. The effort required to internal human IT resources, if it existed at all, was always very poor, since most tools were based on Internet/Intranet technologies and were provided and managed by an external provider. External agents were many and their role was always relevant. The performed assessments denote a high interest in evaluating savings (on staff and administrative costs overall), speeding up processes, and workflow simplification. We can also formulate further remarks by applying all the aforementioned framework components.

The IT business value generation process does not need changes. The evaluation of the business process performance required the adoption of specific indicators that rely on the passive side of the financial cycle: the focus is mainly on cost reduction and time and effort savings. Remaining at the focal firm level, the impact of business process performance on organisational performance cannot be taken for granted in the context of PAs, as efficiency improvements at the organisational level (i.e. reduction in the number of employees involved in a process) do not easily

Table 1 Characteristics and used metrics of the projects carried out by the LHA of Viterbo

Project	Year	IT contents	Resources and processes	Role of the environment	Metrics used in the assessment
Marketplace	2000	Healthcare specialised marketplace test.	Purchases unit (part of).	Marketplace owner (also sponsor). Other healthcare structures participating in the test.	Savings on final costs.
PublicElectronic Catalogue	From 2002	E-catalogue accessible via Internet.	Purchases unit (part of). Change of internal rules and above-threshold tendering process.	CONSIP (Italian Central Procurement Agency) which created and manages system on the basis of new laws. Suppliers admitted by CONSIP.	Comparison of past/actual: – Effort in purchasing (standard and range) – Elapsed time in purchasing (standard and range) – Number of roles and offices involved – Number of tasks performed.
MEPA	From 2002	Wide-scope marketplace with special functions for requesting andsubmitting tenders.	Purchases unit (part of). Change of internal rules and below-threshold tendering and direct purchases processes.	CONSIP: created and manages system on the basis of new laws. Suppliers of goods/ services included in MEPA by CONSIP.	Comparison of past/actual: – Effort in purchasing (standard and range) – Elapsed time in purchasing (standard and range) – Number of roles and offices involved – Number of tasks performed
E-tenders	2003(test)	Platform for e-tender.	Purchases unit (part of).	Provider of the platformIT consultants.	Elapsed time reduction.

(*continued*)

Table 1 (continued)

Project	Year	IT contents	Resources and processes	Role of the environment	Metrics used in the assessment
E-logistics	2003	Intranet/ Extranet platform for SCM.	Purchases unit (part of). Warehouses and internal departments in receipt ofSCM process.	Logistics outsourcer. CONSIP (as advisor). IT consultants. Suppliers of goods.	Comparison of past/actual: – Savings on fixed and financial inventory costs – Elapsed time in supplying – Number of positions removed in the warehouses
Operating room e-procurement	2003	Intranet/ Extranet platform for SCM.	Purchases unit (part of). Warehouses.Wards. Specific procurement process.	Supplier/logistics outsourcer.IT consultants.	Comparison of past/actual: – Savings on fixed and financial inventory costs – Effort in inventory management – Savings in administrative costs.
E-tenders	2004 (actual)	Platform for e-tender.	Purchases unit (part of). Change of internal rules and tendering processes.	Provider of the platform. IT consultants. Suppliers ready for e-tenders.	Comparison of past/actual: –Effort in purchasing (standard and range) –Elapsed time in purchasing (standard and range) –Number of tasks performed.

turn into value, as real value is capitalised only when these resources are allocated to new activities or moved to other positions (improving the services offered) or even removed (yielding actual savings in the balance sheet).

Given the perplexities mentioned in the theoretical framework on the role of the competitive environment for a PA, it is indubitable that the focal PA is immersed in a totally different environment compared to that of a private company. We therefore suggest to call it the sector environment, as it groups all the agents and organisations that a PA may be in contact with. Organisations animating this sector environment may be in the position to facilitate or impede the IT innovation process of the focal PA. We propose to group the subjects animating the Sector Environment of a PA according to the hierarchical position they may have in relation to the focal PA. In this case we can identify two groups which become two components of the layer: partners (in trading partners resources & business processes) and Institutions (in the institutional sphere, instead of the former industry characteristics). Partners are normally in a peer hierarchical position in relation to the focal PA. Nevertheless, they can have a real impact on the IT value. They may promote IT innovation in a PA by introducing software and methodologies and then playing the enabler role. On the other hand, they may not be able to support innovation, because of a lack of skills, structures, or technology, or may even block it, showing opportunistic behaviours or resistance to change the established market state. Among institutions, first of all Agencies may be strong drivers in IT value creation. As CONSIP did in our case, they can further innovation through the arrangement and even the management of shared IT/organisational resources that will be employed by focal PAs afterwards. This is the case of the Public Electronic Catalogue or the MEPA, whose resources are shared among several PAs at the Focal Firm level. In the same area we can also find other institutions that may have an even stronger impact on the focal PA, being in the position of lawmakers. These bodies (such as the Ministry of Economics) can both foster the innovation (e.g. by giving more funds to PAs or Agencies to enable them to use IT in their processes) or prevent it (e.g. by freezing expenditures).

Finally, the macro environment is probably the least evident level in our empirical setting. Anyhow, we argue that the macro environment could affect the process of differentiating among PAs of diverse countries. For example, PAs from different European Union member states possibly rely on different stocks of funds and different IT infrastructures that may impact the IT value generation.

Conclusions

This research paper discusses the application of an IT value generation framework available in the literature [4] on the public e-procurement context. The analysis of the innovation history of the LHA of Viterbo contributed to identifying the need to adapt this framework for application in this sector. We highlighted the need to identify proper indicators and measures to assess process and organisational performances inside the focal PA. We identified the role and the position of institutional agents and partners that animate the Sector Environment external to the focal PA. We argued that the Macro Environment is not relevant in our case, but should however be considered when making a cross-country analysis of PAs.

We also suggest that, although related to the e-procurement process, the presented propositions could constitute a first basis for the development of a general framework to analyse also other IT innovations in the entire PA domain.

The LHA of Viterbo is an interesting case that has been analysed by many studies from several perspectives, but for its novelty it is still not comparable with others. This causes a limitation of this study, since it is based on a single organisational setting. Results may then vary when considering other PAs.

References

1. Brynjolfsson, E. (1993). The productivity paradox of information technology: review and assessment. *Comm ACM* 36(12): 66–77.
2. Kohli, R. & Grover, V. (2008). Business value of IT: an essay on expanding research directions to keep up with the times. *J AIS* 9(1): 29–39.
3. Bannister, F. (2001). Dismantling the silos: extracting new value from IT investments in public administration. *Inform Syst J* 11(1): 65–84.
4. Melville, N., Kraemer, K., Gurbaxani, V. (2004). Review: Information Technology and organizational performance: an integrative model of IT business value. *MIS Q* 28(2): 283–322.
5. Oh, W., Pinsonneault, A. (2007) On the assessment of the strategic value of Information Technologies: conceptual and analytical approaches. *MIS Quarterly* 31(2): 239–265.
6. Brynjolfsson, E., Hitt, L.M. (2000). Beyond computation: Information Technology, organizational transformation and business performance. In: Malone, T. D., Laubacher, R., Scott Morton, M. S. (eds) Inventing the Organization of the 21st Century (pp. 71–99), MIT, Cambridge, MA.
7. Kohli, R. & Devaraj, S. (2003) Measuring Information Technology payoff: a meta-analysis of structural variables in firm-level empirical research. *IS Research* 14(2): 127–145.
8. Mukhopadhyay, T., Kekre, S., Kalathur, S. (1995). Business value of Information Technology: a study of electronic data interchange. *MIS Q* 19(2): 137–156.
9. Lin, W.T. & Shao, B.B.M. (2006). The business value of information technology and inputs substitution: The productivity paradox revisited. *Decis Support Syst* 42(2): 493–507.
10. Tiernan, C. & Peppard, J. (2004). Information Technology: of value or a vulture? *Eur Manag J* 22(6): 609–623.
11. Somasundaram, R. (2004). Diffusion of e-procurement in the public sector: revisiting centralization versus decentralization debates as a twist in the tale. In: Leino, T., Saarinen, T., Klein, S. (eds) Proceedings of the Twelfth European Conference on Information System, Turku, Finland.
12. MacManus, S.A. (2002). Understanding the incremental nature of e-procurement. Implementation at the state and local levels. *Journal Public Procurement*, 2: 5–28.
13. Federici, T. (2006). Public healthcare: changes introduced when implementing e-procurement. In: Proceedings of the Mediterranean Conference on Information System, Venice, Italy.
14. Federici, T. (2008). Introducing e-procurement in a Local Healthcare Agency. In: Scupola, A. (ed) Cases on Managing E-services, Roskilde University, Denmark, IGI.

Key Performance Indicators to Relate Knowledge Governance with Knowledge Process

P. Ardimento[1], M.T. Baldassarre[2], M. Cimitile[3], and G. Mastelloni[4]

Abstract The work proposes an approach based on the use of Knowledge Performance Indicators and Knowledge Experience Base aiming to support and correlate KG and KP activities. The proposed approach has been adopted in the SERLab laboratory for transferring innovations from academic to industrial contexts. The preliminary results are described and discussed. The proposed framework needs to be further validated in industrial context in the way to test and to improve it.

Introduction

The environmental conditions that enterprises work in are characterized by a constantly increasing complexity. This complexity comes from factors such as markets globalization that make the external environment constantly larger and competitive. In this context the enterprises become aware of how important it is to manage and share their internal and external knowledge in order to easily adapt to the rapid changes of the surrounding environment and to the needs of a continuously expanding market with the aim of becoming globally competitive. In this context, knowledge represents a critical resource that needs to be focused towards specific processes and governance activities.

For this reason, in the last years many researchers have been interested to Knowledge Governance (KG). The concept of KG includes choosing management structures (e.g. markets, hybrids, hierarchies) and coordination mechanisms (e.g. contracts, directives, reward schemes, incentives, trust, management styles, organizational culture, etc.), for the purpose of improving the performance of

[1]University of Bari, Bari, Italy, ardimento@di.uniba.it
[2]University of Bari, Bari, Italy, baldassarre@di.uniba.it
[3]University of Bari, Bari, Italy, cimitile@di.uniba.it
[4]University of Bari, Bari, Italy, mastelloni@di.uniba.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_18, © Springer Physica-Verlag Berlin Heidelberg 2010

Knowledge Processes (KPs) [1]. KPs are processes for transferring, sharing and creating knowledge.

Even if there are many studies conducted on KG or KPs there is not a clear correlation between them. In particular the kind of information and knowledge necessary to support KG towards KP are not explicit. It causes some difficult for the manager in the selection and search of the information and knowledge necessary for the governance [2].

The proposed work aims to introduce some Knowledge Key Performance Indicators (KPIs) that provide the rapid communication and transfer of a new knowledge in KG and KPs. The Knowledge and its related KPIs are stored in a Knowledge Experience Base (KEB) that is available both by the KG and KPs experts in the way to support and align their activities.

The KEB and the introduced KPIs are used in an industrial context and some preliminary results are shown.

In our opinion, this study may be of interest for communities involved in innovation exchange and in particular, for small and medium sized businesses (SMB) that have strong need to exchange innovative results and to evaluate the acquisition of these results in their business. The remainder of this paper is structured as follows: the following paragraph recalls related work. The next shows the proposed approach then the preliminary validation and some preliminary results are presented and discussed. The last paragraph completes the paper by providing some conclusive insights and final remarks, and showing prospective works.

Related Work

In the last years many researchers have been interested to KG. The concept of KG is proposed in Grandori [3] as organizational design -governance- relating to the sourcing, deployment, sharing and building of knowledge assets.

Many studies investigate on the relation between KG and KP. The KG as development of the managerial work is presented in [4]. The aim of [2] is to identify the KG configuration adopted and KP implemented by the enterprise, and its impact on the development of KG. Also in [5], researchers compare KP and KG. In this work the relationship between them and a framework of KG structure was presented.

Each one of these studies, focus on few aspects of the problem here discussed and are limited only to public or government structure. The same limitations are also in studies proposing KG's KPIs [6–8]. Indeed even if many studies concern the KPI for measuring the Governance [9, 10], the proposed KPIs in these approaches are effective only in a specific domain.

The proposed approach aims to overrun the mentioned limits introducing some KPIs and a KEB usable by KG and KP in a structured and continuous information and knowledge exchanging process. This sharing is independent from the context.

Moreover, the proposed approach permits to validate the KPIs and to improve the KEB with the use. In fact the KEB using supports the individuation of new KPIs and of some improvements initiatives.

Proposed Approach

The proposed framework can be synthesized in Fig. 1:

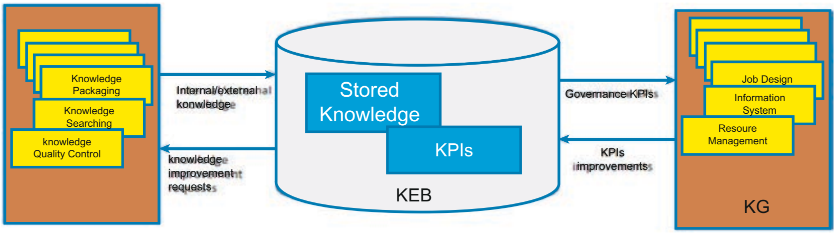


Fig. 1 KP and KG integration framework

KPs are used both by knowledge producer and users. Following to the execution of KP activities the process users apply the stored knowledge in their business processes and give their application feedbacks. The use of KPIs by the manager and by the knowledge stakeholders suggests the more suitable process for the knowledge acquisition of interest.

The framework is based on the use of a KEB, a repository that allows stakeholders to store, consult, acquire and eventually use collected and synthesized knowledge and experience.

The knowledge that is stored in the knowledge base must be formalized as Knowledge Packages. A Knowledge Package is any cluster of knowledge, sufficiently familiar that it can be remembered rather than derived.

KPIs are introduced to synthesize some package characteristics, helping the stakeholders in package searching and comprehension. They contain knowledge about KG that influence the KPs or knowledge about KPs supporting KG and are described in the Table 1.

For example we can consider the KPI named "Required Competences." According to this indicator the proposed package acquisition needs software maintenance competence. From the KG point of view it means the need to evaluate whether the internal competences are adequate, if it is necessary and convenient acquire or share this competence. Moreover for the KP, it means that there is the probability of starting a new learning process or a knowledge acquisition process

To better understand the proposed approach, an example of KEB, named Prometheus [11] is reported in Fig. 2. Prometheus is the knowledge base developed in SERLab laboratory [12]. The figure represents a Prometheus Knowledge Package proposing a model for software maintenance and evolution costs evaluation.

As shown in the figure, some KPIs are used to describe the knowledge.

A user can access to the package towards the Key Performance Indicators (called "Attributes" in Prometheus). Search within the package starting from any of

Table 1 KPIs example

KPI	Description	Value for KP	Value for KG
Required competence (Cm)	The skills required for using this knowledge/innovation implementation	Evaluates when or whether the organization has the appropriate skills to implement the innovation/ knowledge	Facilitates staff management (train or acquire)
Requirements (R)	The detailed resource (e.g. system, tools, hardware, etc.) that are required for using the knowledge/ innovation	Evaluates when or whether the organization has the resources necessary to implement the innovation/knowledge	Facilitates the internal resource management
Time for acquisition (T)	Time needed for acquiring the knowledge/innovation	Evaluates when or whether the innovation/ knowledge acquisition time corresponds to the time that organization wants to invest	Used to forecast and schedule the time for acquisition.
Cost for acquisition (C)	Cost needed for acquiring the knowledge/innovation (e.g. cost for training or staff, cost of tools etc.)	Evaluates when or whether the organization has economical resources necessary for the acquisition	This KPI should be used to manage the cash flow
Return in performance(RP)	How the knowledge/innovation improves the entire business process	Evaluates when or whether the previous business improvements correspond to the actual needs of the organization	Used to forecast the performance of the entire business process after introducing the knowledge

Fig. 2 Prometheus KPIs

its components is facilitated by the KPIs. For all the components, these allow rapid selection of relative elements in the knowledge base [13].

A Preliminary Validation

A Preliminary validation of the proposed approach was made in order to verify:

- Usefulness of the proposed KPIs model to facilitate in KG and KP activities.
- Capability of the model to be improved as it is applied.

Table 2 Experiment design

	Phase 1	Phase 2	Total
Observation time (years)	6	4	10
Nr of involved companies	19	11	30
Nr of KG involved manager	28	24	50
Nr of KP involved manager	26	21	46
Nr of proposed knowledge package	5	5	5
Nr of acquired knowledge package	4	5	5
Used KPIs	Cm, T, C	R, T, Cm, C, RP	R, T, Cm, C, RP

According to the research goals we considered five Knowledge Packages contained in the Prometheus platform. They related to some innovative approaches and models developed in SERLAB, are detailed in [14] and available at [11]. They have all been described and synthesized using KPIs.

The packages have been transferred over the last 10 years from the SERLab laboratory to industry [15]. The 10 years of observation were divided in two phases. During the first phase, five packages were proposed to the managers and some measures about the using of the packages KPIs were collected. At the end of the first period, new KPIs were added and new measures were collected according to the results achieved. In Table 2 we indicated for each phases the list of used KPIs. The mentioned KPIs were described in Table 1.

In the following table a characterization of the experiment is synthesized:

For a generically key performance indicator I (assuming values R, Cm, C, RP, T), we indicated with IE its expected value and with IR its real assumed value. N is the number of applications of the key performance indicator. The extracted measures for the each phases are "KPI Value" and "KPI Inaccuracy." KPI is valuated distinguishing KG and KP managers (KG KPI Value, KP KPI Value).

They are defined as in Table 3. Further details and examples are proposed in [14].

Preliminary Results

The following tables summarize the above described measurement values for each phase with respect to each proposed KPI.

The data in the Table 4 seem to confirm the utility of the KPI in the project lifecycle. All the proposed KPIs seem to be used by the involved manager and seem to influence their decisions despite their competence area (KG/KP). In fact their values are included between 70 and 90%. The inaccuracy of the KPI is quite slow. It means that the variance between evaluated KPIs and their real value is seam. So we can conclude that KPI have been evaluated precisely.

A particular interest is given by the manager to the "Cost of acquisition" as shown by the high value. It is also the KPI more difficult to expect. The inaccuracy range in fact is between 10 and 15%. An explanation of this result could be that the

Table 3 Extracted measures

KPI	KG KPI value (%)	KP KPI value (%)	KPI inaccuracy (%) min	KPI inaccuracy (%) MSE (Mean square error)	KPI inaccuracy (%) max
R	KG Managers that acquired a Package using information about requirements	KP Managers that acquired a Package using information about requirements	$\min_i \lvert R_{Ei} - R_{Ri} \rvert$	$(\sum_i (R_{Ei} - R_{Ri})^2)/N$	$\max_i \lvert R_{Ei} - R_{Ri} \rvert$
T	KG Managers that acquired a Package using information about time for acquisition	KP Managers that acquired a Package using information about time for acquisition	$\min_i \lvert T_{Ei} - T_{Ri} \rvert$	$(\sum_i (T_{Ei} - T_{Ri})^2)/N$	$\max_i \lvert T_{Ei} - T_{Ri} \rvert$
C	KG Managers that acquired a Package using information about cost for acquisition	KP Managers that acquired a Package using information about cost for acquisition	$\min_i \lvert C_{Ei} - C_{Ri} \rvert$	$(\sum_i (C_{Ei} - C_{Ri})^2)/N$	$\max_i \lvert C_{Ei} - C_{Ri} \rvert$
Cm	KG Managers that acquired a Package using information about required competence	KP Managers that acquired a Package using information about required competence	$\min_i \lvert Cm_{Ei} - Cm_{Ri} \rvert$	$(\sum_i (Cm_{Ei} - Cm_{Ri})^2)/N$	$\max_i \lvert Cm_{Ei} - Cm_{Ri} \rvert$
RP	KG Managers that acquired a Package using information about return in performance	KP Managers that acquired a Package using information about return in performance	$\min_i \lvert RP_{Ei} - RP_{Ri} \rvert$	$(\sum_i (RP_{Ei} - RP_{Ri})^2)/N$	$\max_i \lvert RP_{Ei} - RPm_{Ri} \rvert$

Table 4 Phase 1 results

KPI	KG KPI value (%)	KP KPI value (%)	KPI inaccuracy		
			min (%)	MSE (%)	max (%)
Requirements	80	78	0	3	10
Time for acquisition	70	73	3	4.5	7
Cost for acquisition	90	90	10	12.3	15
Other	10	10			

Table 5 Phase 2 results

KPI	KG KPI value (%)	KP KPI value (%)	KPI inaccuracy		
			min (%)	MSE (%)	max (%)
Requirements	85	82	0	2.5	8
Time for acquisition	78	79	1.9	3,7	6
Cost for acquisition	93	92	8.8	12	14.6
Required competence	82	86	0.5	2	4
Return in performance	79	72	2	4.7	6
Other	5	5			

Cost prevision depend by several measures (for example expected investment time and expected investment value)

Regard Table 5 we can observe that it confirms the observations made for Table 4. Moreover the table shows that the new KPIs seem to be useful to the managers. It appears that the proposed model has improved with the applications. Their values are similar to the other KPIs values.

Conclusions

The proposed work has introduced a KPI and KEB approach for enterprise knowledge governance and for supporting knowledge processes. The proposed approach has been implemented in SERLab. Some preliminary results show the utility and the precision of the approach in the knowledge acquisition and transferring activities and the capacity of the model to be improved with the use.

Obviously, in order to generalize the validity of the approach proposed in this work many replications, statistical validation and further studies extended to other contexts are needed. Also the proposed model needs to be further refined and improved as used in time. These activities are proposals for future works.

Acknowledgments We would like to express own thanks to Prof. Giuseppe Visaggio for contribution and insightful remarks during the work.

References

1. Foss N (2007) The Emerging Knowledge Governance Approach: Challenges and Characteristics,. Organization, 14: 29-52 (http://org.sagepub.com/cgi/reprint/14/1/29
2. Schroeder A, Pauleen D (2005) The Emergence of KM Governance in a Knowledge Intensive Research Organisation. NetPrint: http://kmap2005.vuw.ac.nz/papers/The%20Emergence%20of%20KM%20Governance.pdf
3. Grandori A (2004) Corporate Governance and Firm Organization: Microfoundations and Structural Forms, Lavoisier, France
4. Salvetti A (2006) Knowledge governance and surroundings: managerial work forthcoming future, Sociologia del Lavoro, 103: 17
5. Zyngier S, Burstein F, McKay J (2006) The Role of Knowledge Management Governance in the Implementation of Strategy, HICSS apos;06. doi: 10.1109/HICSS.2006.482
6. Furukawa S, Hoshino Y (2001) "Knowledge-Based Governance by Performance Measurement: Beyond the New Public Management" Newark, New Jersey NetPrints: http://homepage2.nifty.com/starhoshino/aspa0103.pdf
7. Genua A, Muscio A (2008) The governance of University knowledge transfer, Paper no. 173 SPRU NetPrint: http://www.sussex.ac.uk/spru/documents/sewp173.pdf
8. Peltokorpi V, Tsuyuki E (2006) Knowledge governance in a Japanese project-based organization. *Knowledge Management Research and Practice*, Vol 4, N 1, Feb 2006, pp. 36–45(10) Palgrave Macmillan
9. Dekker T (2006) IT Governance requires performance measurement, Dossier Tematico n.3, Instituto de Informatica Ministério das Finanças, Amadora Portugal
10. http://www.usm.my/ipptn/fileup/Key%20Performance%20Indicators%20(KPIs).pdf
11. http://prometheus.serandpractices.com
12. http://serlab.di.uniba.it/
13. Ardimento P, Cimitile M, Visaggio G, (2006) Knowledge Management integrated with e-Learning in Open Innovation, *Journal of e-Learning and Knowledge Society*, Vol. 2, n.3, Edizioni Erickson
14. Cimitile M, Matelloni G, Visaggio G (2008) *Lesson Learned about Key Performance Indicator for Knowledge Packaging, TR01, DI UoBari, January*
15. http://serandpractices.com/

Legal Issues in the Transition to Electronic Records in Health Care

D. Walsh[1], K. Passerini[2], U. Varshney[3], and J. Fjermestad[4]

Abstract In today's digital society, ongoing concerns about the privacy and security of personal data are ever increasing, especially in health care. While we gradually need higher electronic access to medical information, issues relating to patient privacy and reducing possible security breaches increase. In this paper, we focus on identifying the general rules and the regulations that are currently in place to protect the privacy and security of medical data, and more specifically information contained in electronic health records (EHR). This review is particularly important since EHRs are expected to become nationally adopted in the US by the next decade and are already underway in many European countries. Based on this legal overview, unresolved challenges are identified.

The Right of Privacy (in Electronic Health Records) in the United States

Unlike the healthcare systems of many western countries, the U.S. system is composed of private, independent individual and group providers, hospitals, ambulatory care and long term care centers that compete with one another. It is not centralized but has multi-payers of insurance bills and multi-health providers, all subject to different rules and laws. Many competing vendors, each with their own products, exist. Additionally, large private data collection agencies can obtain, analyze, and sell individuals' data.

The U.S. has a confusing, sometimes conflicting, patchwork of federal and states laws, as well as administrative agencies that deal with the protection of information, and the related right of privacy of individuals. Our review of the legal framework reveals various shortcomings. Starting from the United States

[1]New Jersey Institute of Technology, Newark, NJ, USA, walshd@njit.edu
[2]New Jersey Institute of Technology, Newark, NJ, USA, pkatia@njit.edu
[3]Georgia State University, Atlanta, GA, USA, uvarshney@gsu.edu
[4]New Jersey Institute of Technology, Newark, NJ, USA, fjerme-stad@adm.njit.edu

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_37, © Springer Physica-Verlag Berlin Heidelberg 2010

Constitution and moving through Federal, State, Administrative and Case laws, the protection of individual privacy rights in health information remains based on conflicting laws that vary from state to state. In the next sections, we discuss some of the relevant regulatory measures dealing with privacy of patient data, as well as their limitations. Our analysis identifies a few unresolved issues.

The Legal Framework for Information Protection in the US

The Constitution. There is no right of privacy explicitly stated in the Constitution of the United States. However, in a landmark case, *Griswold v. Connecticut*, 381 U.S. 479 (1965), the United States Supreme Court endorsed the view that the Constitution protects individual privacy rights. The United States Supreme Court held that "a constitutional right of privacy" was implied by the First, Third, Fourth, Fifth, and Ninth Amendments of the Constitution.

Federal Laws. Federal laws may intervene to protect the rights of the people. In the late 1960s, an increasing number of people were concerned with the accumulation of personal information in government files and pressured the Congress to pass the *Freedom of Information Act* that allows any person or citizens to request copies of any information contained in federal government files. In 1974, the Congress passed the *Privacy Act* guaranteeing to individuals the right to access and review their information held by federal agencies. The Privacy Act ensures that federal agencies use fair information practices with regard to the collection and dissemination of any medical information from a system of records. It protects the *kind* of information collected, the *use* to which the information is put, the *people* who have access to the information, the *disclosure*, the *means* used to gain the information, the *steps* taken to ensure the accuracy and completeness of the information and the *access* that individuals have to information about themselves.

The Privacy Act was amended by the *Computer Matching and Privacy Protection Act of 1988* to extend to records "for use in a computer matching program… [by another] agency or non-Federal agency" (U.S.C. 552a 2000) thus requiring written agreement prior to conducting database comparisons. The *Electronic Communication Privacy Act* (1986) prohibits any person from knowingly revealing to any other person the contents of an electronic communication while that communication is in transmission (and not in electronic storage). Electronic communications through devices "*furnished to the subscriber or user by a provider of wire and electronic communication services*" and used by the subscriber or by the provider of the service "in *the ordinary course of its business*" are excluded from coverage.

The *Americans with Disabilities Act* (1990) keeps employers from pre-screening prospective employees through the use of medical information and from discriminating against individuals because of their disability.

In 1996, the US Congress passed the *Health Insurance Portability and Accountability Act* (HIPAA) to address the growing need to safeguard the privacy of individuals' health records, particularly computerized electronic records. HIPAA requires healthcare providers and healthcare plans, including certain employers who sponsor health plans, to inform patients of their privacy rights and how their personal medical information may be used.

HIPAA specifies how to ensure availability, confidentiality, and integrity of electronic health information through a set of administrative, technical, physical, organizational and documentation requirements. HIPAA directly governs "covered entities," which may be anyone who provides, furnish or receive payment for medical services [1]. In HIPAA, the meaning of privacy is the ability of an individual or group to exclude others from accessing one's own personal information, and thereby reveal personal information only selectively. In contrast, confidentiality prevents any disclosure, to others than authorized individuals, of individual's or group's proprietary information, investigation findings, or of an individual's identity unless previously consented by the individual [2].

In summary, while HIPAA finally addresses the issue of computerized health records more holistically than previous acts, it seems more focused on articulating procedures that ultimately protect "covered entities" (insurance companies, health providers, health plans) from liability rather than protecting the individual patients.

State Regulations. The Fourteenth Amendment to the Constitution provides that states shall not "*deprive any person of life, liberty or property, without due process of law*." Since most of the rights enunciated in the Bill of Rights apply to state government (as opposed to individuals), state legislation is also needed to protect individuals' privacy rights. Federal laws will only supersede state laws, when "covered entities" cannot comply with both federal statutes and state laws at the same time. However, state laws can and must be more stringent than federal laws. For example, HIPAA will not supersede more stringent state laws. Rigid state laws usually contain tougher restrictions and may allow individuals broader rights to access or amend their records.

Case or Common Law. Privacy rights are also protected under tort and contract laws. The basic purpose of these laws is to provide compensation for the invasion or breach of various protected interests. These protected interests include, but are not limited to certain intangible interests such as personal privacy, family relations, confidentiality, reputation, and dignity. Case law provides remedies in order to compensate for invasion of these interests. State case law safeguards privacy rights through the tort or breach of invasion of privacy, confidentiality, and it may vary significantly from state to state and are decided by the courts on an case-by-case basis [3].

International Comparisons on Privacy and Data Protection

The United States and the European Union (EU) have elected two different approaches to address the issues of privacy, and the related data protection, because of ingrained cultural attitudes about personal privacy which separate the United

States from many European countries. Europeans are more restrictive in regulating the way companies collect and process personal data. The EU has enacted comprehensive legislation to deal with personal privacy on the Internet. In contrast, the United States has not enacted comprehensive data protection legislation, instead has allowed the Internet industry to largely self-regulate [4].

The different approaches trace back to fundamental different approaches in the functioning of the legal system. Several nations in Europe and elsewhere base their legal systems on Roman civil law, or "code law." In the civil law system, the official source of law is the statutory code. Courts and judges interpret the code and apply it to individual cases. However, the courts may not depart from the code and develop their own laws [4]. Trials procedures in civil law systems differ from common law or case law, which is the system used in the US. In the US, the case law system is adversarial while the civil law system is inquisitorial. Unlike judges in common law systems, judges in civil systems often actively questions witnesses while in the US, judges listen to both parties' attorneys arguments. Furthermore, the judges may modify or even overturn previous judicial decisions.

There are also some important ethical differences among nations that may require the enactment of legislation to clarify an official position across borders. Gifts are a common practice in several nations between companies in a contractual agreement or gifting to government officials. In the US, such gifts are considered a source of conflict of interest and, if not regarded as an illegal bribe, they are considered unethical. To clarify the US standing on this practice, the *Foreign Corrupt Practices Act in 1977* prohibits US firms from offering certain side payments to foreign officials to secure favorable contracts [3].

We identified that both common or case law practices and overarching international agreements apply in this complex arena to regulate legal, ethical and also technical issues. For example, under what is known as the principle of *"Comity"* nations will apply the laws or judicial decrees of another country if these laws are consistent with local laws, public policies and benefit the greatest number of people in the nation.

Companies operating in foreign nations are also subject to the laws of those nations. Because the exchange of goods including personal information, services, and ideas on a worldwide level is now routine, questions are raised about the extraterritorial application of a nation's laws. To what extent do U.S. domestic laws apply to other nations' businesses? The extraterritorial application of the Sarbanes-Oxley (SOX) Act was at issue in *Carnero v. Boston Scientific Corp* [5]. Carnero, a citizen of Argentina, who began working for BSB in Brazil, a subsidiary of BSC, a Delaware corporation with headquarter in Massachusetts, which makes medical equipment. Carnero reported to BSC that its Latin American subsidiaries were improperly inflating sales figures and engaging in other accounting misconduct. In 2006, the U.S. Court of Appeals affirmed the lower court's dismissal of Carnero's complaint. According to the court, the SOX act "*does not reflect the necessary clear expression of congressional intent to extend its reach beyond our nation's borders*" [5].

More broadly, the EU data privacy directive has set the standard for global data management. Since 2000, the US companies may now satisfy the directive requirements by applying under the *US-EU Safe Harbor Agreement*. This allows for privacy protection that is deemed adequate but not equivalent to the EU laws. If the US companies comply voluntarily, then they will be given safe harbor from lawsuits by EU countries [4].

Another legal instrument which provides for uniform provisions on private international law within the European Community is Rome II Regulation, which determines the laws that can be applied in specific international disputes [6].

Unresolved Issues

A number of issues remain unresolved and they span from security, privacy and the pace of technological adoption. Electronic health records may not be secure. Many EHR systems are Web-based and hackers may merely need some sniffing equipment to access wireless networks and alter the information while in transmission. From the patients' view, enforcement is placed in the hands of those who are primarily interested in ensuring efficiency and lower costs, more than attending individual interests.

Additionally, most doctors are not using electronic health records. A recent report found that doctors who use electronic health records (EHR) claimed substantial improvements in the quality and timeliness of care [7]. Despite the improvements, The New England Journal of Medicine reported that only one in five US doctors have started using EHRs. More specifically, EHRs are used in less than 9% of small offices (with one to three doctors). This is alarming if we consider that half of the doctors in the US practice medicine in such small offices.

There are various reasons behind this lag. One of such reasons is costs. "*The initial cost of upgrading the office's personal computers, buying software and obtaining technical support to make the shift could be $15,000 to $20,000. Then during the time-consuming conversion from paper to computer records, the practice would be able to see far fewer patients, perhaps doubling the cost*" mentioned Dr. Paul Feldman in a New York Times article [7]. Because it is mainly doctors who need to invest personal funds for the upgrades, they are reluctant to speed up the adoption pace.

Conclusions

With the advancement of technology, electronic health records will become the norm of storing and sharing health information across many healthcare providers, facilities, including those engaged in health system planning and research. This trend provides a great benefit to patients' healthcare by reducing the probability of medical errors, but may impact privacy protection. In the US, it is up to the State courts through case law and, ultimately, the Supreme Court to determine the point at which legislations have violated an individual's privacy rights.

Based on the review of privacy standards in other nations (such as those in the EU), we believe that stricter regulations that address privacy concerns and minimum security standards are indispensable. In addition, higher legal safeguards and sanctions concerning those who are involved in establishing privacy rules, consent processes and security systems must be implemented. Without these essential changes, electronic health records may put at risk the societal and constitutional pillar of personal privacy. To address these challenges, we presented and discussed legal EHR issues in the US and identified some unresolved legal issues related to privacy, security and the pace of adoption. These unresolved challenges may become the basis for both new research in this area as well as improvements in protecting patient's privacy and security in e-health by governments and the healthcare entities.

References

1. Gerberry, R.A., *Legal Ramifications of the Formation of Digital Hospitals.* The Health Law, 2002. p. 152.
2. Dunlop, L., *Electronic Health Records: Interoperability Challenges Patients' Right to Privacy* Shidler Journal of Law, Commerce+Technology, 2007. **16**(3).
3. Clarkson, K., et al., *West's Business Law*. Vol. 10th edition. 2006: West Legal Studies.
4. DiMatteo, L.A. and L.J. Dhooge, *International business law: a transactional approach.* 2006: Thomson West, Mason, OH.
5. *Ruben Carnero v. Boston Scientific Corporation*. 2006, The United States District Court for The District of Massachusetts.
6. EU, *Regulation (Ec) No 864/2007 of The European Parliament and of The Council*. 2007, Official Journal of the European Union: http://eur-lex.europa.eu/LexUriServ/site/en/oj/2007/l_199/l_19920070731en00400049.pdf.
7. Lohr, S., *Most Doctors Aren't Using Electronic Health Records*, in *The New York Times*. 2008: NY

Managing IS Services with Something in Between Outsourcing and Insourcing: Buffer Organizations

J. Bulchand-Gidumal[1] **and L. Mola**[2]

Abstract Traditionally, organizations have faced the dilemma between outsourcing and insourcing, both of which have shown a certain amount of problems. In between the two of them a new concept arises. This is the use of internal markets as a buffering mechanism for organizations, which create an intermediate society between the main organization and the market. This article shows two cases of organizations from different environments in which the sourcing process involved the creation of an intermediate organization to act as the described buffering mechanism. Both processes were related to the IT function. The first case was that of a Public Spanish University that decided to create the buffer society as a way to outsource certain IS/ICT functions while retaining a good level of control over workers and over management of these functions. The second case was that of an Italian SME which decided to create a buffer company in order to manage the implementation project of an ERP System. The study of the two cases has helped us identify and confirm empirically a number of features achieved by this internal mechanism use.

Introduction

When dealing with Human Resources issues, organizations have traditionally had two alternatives: outsourcing and insourcing. Outsourcing is the process by which external agents perform organization's activities while insourcing is the process in which the organization undertakes an outsourcing process and later decides that the services should be performed again by its own personnel. Insourcing also refers to the case in which an organization examines the costs and possibilities of outsourcing but finally decides to perform the function in-house [1].

[1] University of Las Palmas de Gran Canaria, Las Palmas, Spain, jbulchand@dede.ulpgc.es
[2] Università di Verona, Verona, Italy, lapo.mola@univr.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI: 10.1007/978-3-7908-2148-2_49, © Springer Physica-Verlag Berlin Heidelberg 2010

Both alternatives have shown a certain amount of problems. Outsourcing has been blamed for making organizations lose control over IS/ICT assets [2–4], lose flexibility [3,4], have to go trough the possibility of threats of opportunism from the supplier [2, 4], a loss of IS/ICT expertise and corporate memory [2, 4], a loss of qualified personnel [3,4] and a loss of competitive advantage in information management [3] as well as in the innovation capacity [5].

Moreover there are also problems derived from the complexity of breaking a contract in case of dissatisfaction [6, 7], the use not very qualified personnel by the contractor [6], misaligning between the outsourcing organization and the contractor [7] and even an increment in costs when many organizations outsource as a way do cut down costs [7].

On the other hand, insourcing means not achieving the main reasons that make organizations outsource. This is not been able to control costs, not being able to concentrate on the nuclear capacities of the organization and having a very low level of flexibility over workers.

Due to the problems with insourcing and outsourcing, organizations have found other alternatives to overcome these problems. Between these we can mention internal markets, strategic alliances, business process outsourcing and selective sourcing. We now define these four alternatives.

- *Strategic Alliances*. These come about when two or more organizations jointly develop functions in the search of scale economies. For a strategic alliance to function and be successful over time, all the participating organizations must consider that they are obtaining value from the alliance; in other words, that a "win-win" situation occurs [8].
- *Internal Markets*. These occur when a company creates its own organization to undertake certain tasks or when it allows one or more of its units to act autonomously and to transact with other units of the company.
- *Business Process*. Outsourcing (hereafter BPO). BPO consists on handing over control of an IS/ICT based process (for example, human resources management or accounting) to another organization [9]. The firm thus eliminates the need for determined IS/ICT areas since the company who supplies the service will be responsible for the IS/ICT required to provide it.
- *Selective Sourcing*. Selective sourcing consists in subcontracting just certain parts of a given organizational function while retaining others in-house [7], this is, to find a perfect mix between what is done outside the organization and what is done inside [4]. It is specially used in the IT area, due to the complexity of the function and the number of tasks involved.

This article will explore the second of alternatives listed, the internal market strategy, based on two practical cases developed in Spain and in Italy. Both these cases were related with the IT function. The one in Spain involved the use of this solution in a Public University as a way to outsource certain IT functions while retaining a good level of control over workers and over management of these functions. The one in Italy was that of a SME which decided to create a buffer company to manage the implementation project of an ERP System.

This article is organized as follows. First, we explore in depth what the internal market strategy is. We then present the two cases that have been studied, followed by a section in which we show the research methodology that was used in each of the two cases. Then some common findings to both cases are shown. We believe many of these findings can probably be generalized to all internal market strategy cases. Last we discuss on the results and we end with some conclusions which we hope can be used by managers facing sourcing alternatives.

Internal Markets

As has already been defined, internal markets occur when a company creates its own organization to undertake certain tasks. Usually this new organization or the autonomous unit will provide services not only to the parent company but also to other companies in the market, thus guaranteeing a competitive pricing structure and an appropriate quality of service [2] since the subsidiary should be almost the same as any other external supplier [10]. In the following we are going to concentrate in the case in which there is a new company and it is not a unit that has been allowed to become independent.

This created company acts as a buffer organization between the mother organization and the market, thus allowing for [2]: "[…] increased responsiveness of internal suppliers, better quality with lower cost of internally-supplied services and products, elimination of fluff, de-bureaucratization, de-monopolization, uniform measures for comparing the performance of various units, and greater opportunity for development of management skills […]" (see [4]). This is due to the created company being very close to the mother organization but, at the same time, being independent.

The Two Cases

In this section we describe the two cases that have been used in this study.

Case 1: Spanish Public University

The first case was that of a Public Spanish University that decided to create the buffer society as a way to outsource certain IS/ICT functions while retaining a good level of control over workers and over management of these functions. The university has roughly 20,000 students and a total budget for the management of IT of around 8 M . It has 45 staff dedicated to IT management.

As the university faced the need to enlarge the number of staff dedicated to IT following the natural increase that has happened in all organizations in IT service demands, it found that growing the internal structure was very difficult due to tight restrictions in Spanish Public Administrations. Outsourcing was also considered but the geographical position of the university (the Canary Islands, more than 2,000 km. from Mainland Spain) and the specificity of tasks to outsource meant there was an important shortage of providers available.

Due to this, the decision to create a buffer organization was taken. This organization was created during the year 2005 and it started providing services in 2006. Its budget for 2007 was about 700,000 Euros with a number of staff of about 25. It provides help desk services as well as some application development services. The objective of the enterprise is to break-even at the end of each financial year.

Rough estimates showed that if the same tasks had been developed in-house the total cost would have been around 1 M , due to higher salaries that public employees are entitle too. On the other hand, outsourcing would have also meant a figure close to the same 1 M , since, as was stated previously, enterprise from Mainland Spain willing to provide the services would have charged that extra quantity in accountancy for their benefits and for the extra costs of having to operate a unit in a remote place.

Case 2: Italian SME

The second case was that of an Italian SME, Gruppo Manni, which decided to create a buffer company called RATIO, in order to manage the implementation project of an ERP System. The company was created in 1996 and started providing consulting services immediately. The following year, the implementation project took place and RATIO started providing consulting and technical services as programming, customization and training. RATIO turn over was 200,000 Euros the first year, 700,000 the second year, 1.5 million the third year and 2 million the fourth year. RATIO ended his activity in 2001 after the last go-live of the ERP project and when the ERP became stable.

Considering the high level of outsourcing provided by the software vendor and the dimension of the IT department, the top management of Gruppo Manni decided to found a RATIO as Consultancy Company owned by Gruppo Manni (45% of the shares) and by the four experts in BPR, in programming an Project Management (55% of the shares).

The RATIO team started analyzing the main business processes, in order to identify the critical aspects that had to be taken into account in the ERP selection phase.

As result of the analysis, RATIO suggested the adoption of a national ERP, called Diapason that had already been developed by Gruppo Formula S.p.A. This reccomendation was made due to economic reasons and because Diapason was considered to be the reference in the industry in Italy.

The RATIO management decided that the implementation was done through a gradual rollout per module and per site.

Rather than buying an ERP implementation project (software and services) Gruppo Manni decided to sign a partnership with the ERP Vendor. According to the contract, RATIO would become a business partner of Gruppo Formula. RATIO personnel was involved in Formula's ERP implementation projects as observers. This would allow for an internal group of consultants in RATIO to be able to run an ERP implementation project from both sides, the technical and the managerial one.

After 6 months RATIO become able to run implementation projects on Gruppo Formula's software. From that moment RATIO personnel were involved in the Gruppo Manni Project and in Gruppo Formula's clients project "body rental" agreement.

Methodology

In both cases, the key to the research methodology was that one of the authors of this work was a decisive agent in the process.

Four types of techniques or data collections methods where used: participant observation, document retrieval, in-depth interviews and focus groups. Evidence obtained was qualitative as well as quantitative. The time frame considered starts at the creation of the enterprise and ends when the later had been working for 1 year. This accounts for a total of 20 months for the case 1 and 36 month for the Italian SME. In both cases, the analysis took about 3 months and it started after the enterprise's first year of operation, except for some data that was collected as the process was happening, as explained below.

Participant observation and document retrieval was possible since, as has been stated previously, the authors of this work were part of the process. More than 50 h were spent over the 1 year study period directly observing the help desk area in the case of the public University. In the case of Gruppo Manni, one of the author was involved in the ERP implementation project and he spent 3 day per week taking part to designing, modelling and training session. Data was transcribed, structured and double checked by the authors to ensure accuracy.

Observation was supplemented with several in-depth interviews that were carried out with participants in the action. Four focus groups were carried out. Last, measures of the performance of the services delivered by the firm were obtained trough a survey carried out by the evaluation department of the university. In this survey, every service delivered by the university was evaluated: student registration process, IS/ICT services, campus services, transportation, etc.

Findings

The study of the two cases has helped us identify and confirm empirically a number of features achieved by this internal mechanism use:

– It allows a very good balance between the best of insourcing and the best of outsourcing. On the one hand, there is a good control over human resource practices and over technical decisions (i.e. which products to specialize in). On the other, a good level of control over the function being sourced is achieved, since it is no more a black box where the managers do not know what is going on, becoming a function that can be analyzed.

- In the process of subcontracting to the buffer organization, the mother organization learns how to organize contracts, which means to dimension properly prices, times and requirements as well as even the process of choosing which things to outsource and which not. This learning process can be very useful for a later process of outsourcing to markets directly.
- The cost control and cost reduction that is usually followed by outsourcing processes is also achieved, as well as allowing for a good level of alignment between the objectives of both organizations.
- It reduces resistance to change in the workers of the mother organization, since the process is not a full outsourcing, which is always seen as more fearful, but a subcontracting to an organization which is quite close to the mother organization, and over which this later retains a certain level of control.
- It allows the implementation of human resource practices similar to those in the mother organization, reducing resistance to change as well as problems derived from frictions between workers in similar job posts with very different contracts.

But the experience in the two mentioned cases has also shown that this is a very complex process and that there are several issues that have to be carefully dealt with:

- Since this kind of mechanism is not used very often, the process has to be carefully explained to all the involved workers. Even doing this, a certain resistance to change and certain fears will probably be found in workers, since they may not fully understand what is going to happen to them, specially in the long run. Basically, they can think the final objective is to pass their job posts to the buffer enterprise.
- Workers of the mother enterprise may not fully understand the buffer organization is an independent organization, with its own managers that make their own decisions. This means that influencing human resource practices can be done only at a very high level, not at the base level.
- The buffer organization works best when it also provides service to third party companies, allowing this way a competitive mechanism. But it not easy to achieve a good balance between the quantity of effort dedicated to each kind of client.

Discussion

When and why should the internal markets mechanism be used? Basically, when the organization and market fail to deliver a consistent solution to organizations. If the organization and its environment are comfortable with an increase with the number of HR that dedicate to a function (being IT or any other), insourcing can be used.

If the organization considers the task not nuclear, not long term, and has a number of service providers in the market around it that can deliver those services, outsourcing can be used. Knowing of course, the dangers of outsourcing that have been warned by several authors and that have been explored previously in this article.

But when none of the above happens, when organizations cannot o do not want to increase the number of internal human resources and when outsourcing is not advisable or desirable, new sourcing strategies have to be explored. Here is were internal markets come in.

Our experience with two very different cases show that, although the process of building a new enterprise has a high initial cost, the benefits that are achieved are quite rewarding.

Conclusion

We consider that these two cases prove that the use of the internal market mechanism trough buffer organizations allows enterprises to find a very interesting sourcing alternative, especially for their IT function, by providing a method that brings together the best of insourcing and of outsourcing. This is, we have proven in practice that the internal market approach is superior to outsourcing and to insourcing, as was theoretically suggested by [2].

References

1. Hirscheim, R., Lacity, M. (2000), "The myths and realities of information technology outsourcing", *Communications of the ACM*, 43(2):99–107.
2. Lee, J.-N., Huynh, M.Q., Kwok, R. C.-W. and Pi, S.-M. (2003). IT outsourcing evolution: past, present, and future. *Communications of ACM* 46(5): 84–89.
3. Gupta, U.G. and Gupta, A. (1992). Outsourcing the IS function: Is it necessary for your oganization. *Information Systems Management Journal* 14(2): 74–77.
4. King, W.R. and Malhotra, Y. (2000). Developing a Framework for Analyzing IS Sourcing. *Information and Management* 37(6): 323–334.
5. Earl, M.J. (1996). The risks of outsourcing IT. *Sloan Management Review*, 1996, 37(3): 26–32.
6. McFarlan, F.W. and Nolan, R.L. (1995). "How to manage an IT outsourcing alliance". *Sloan Management Review* 36 (2): 9–24.
7. Lacity, M., Willcocks, L., and Feeny, D. (1996). The value of selective IT sourcing. Sloan *Management Review*, 1996, 37(3): 13–25.
8. King, W. (2001). Guest editorial developing a sourcing strategy for IS: A behavioral decision process and framework. *IEEE Transactions on Engineering Management*, 48(1), 15–24.
9. Rouse, A. and Corbitt, B. (2004) IT-supported business process outsourcing (BPO): the good, the bad and the ugly, 2004 Information Systems Adoption and Business Productivity, the Eighth Pacific Asia Conference on Information Systems, PACIS, Shanghai, China
10. Dearden, J. (1987). The withering away of the IS organization, *Sloan Management Review* 28(4), pp. 87–91.

Managing Security Projects: Proposition of a Cost Model

M. Sadok[1]

Abstract Security project management must take into consideration the business requirements of the enterprise, the extension and complexity of its networked information system and the evolution of attack techniques. The efficiency of such project presumes a thorough cost-benefit analysis of the structure and dynamics of the IT components as well as the assessment of human and organisational parameters. Managers are more and more concerned with how security costs are planned, monitored and controlled. To this end, managers need a cost model including cost representation and risk parameters and capable of adapting company operational procedures, resource management, and corporate strategy to the evolution of digital risk. However, we have noticed a lack of security cost models in the project management literature. Only cost factors related to the technical task of security project have been addressed. This paper discusses the limits of the available technical cost models and proposes additional cost parameters including organizational, human and managerial aspects that must be considered and assessed in order to provide a more accurate estimation of security project cost. Our attempt is to provide two general cost models integrating these parameters. To conduct an accurate estimation of the involved parameters, a methodology is described based on expert intervention and decision making.

Introduction

The use of Internet and networked systems by the enterprises to support information flows and communication between business process activities has increased the risk of security attacks which can disable temporarily their activities and induce losses in business profits and client trust. Despite the external sources of these attacks, internal abuse and malicious activity may generate an unexpected damage.

[1]Institute of Technology in Communications, Tunis, Tunisia, moufida.sadok@gmail.com

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_28,

The enterprises should protect their networks by the means of ad hoc security solutions. Conducting relevant security projects, that determine the assets that need to be protected according to business requirements, and identifying the different vulnerabilities and threats that may affect the enterprise integrity, may be a good approach for the efficiency of the desired solution, since it may include procedures to prevent and respond to security incidents by means of access control measures, continuous monitoring and risk assessment. It also can optimize security solutions design and cost.

The management of security project must take into consideration the business requirements of the enterprise, the extension and complexity of its networked information system and the evolution of attack techniques. The efficiency of such project presumes a thorough cost-benefit analysis of the structure and dynamics of IT components and the assessment of human and organisational parameters. Managers are more and more concerned with how security costs are planned, monitored and controlled. To this end, managers need a cost model including cost representation and risk parameters in order to guide their decisions, particularly when the level of security required by the enterprise and its trading partners is high. Accurate cost estimation of a security project is critical for managerial control and use of the resources allocated to security activities.

Several recent studies have addressed IT/IS project management [1–6]. Security issues are not fundamentally considered in these researches. We have noticed that the security issues and related costs are insufficiently developed in the management of IT/IS projects and are considered as one variable among others in the management of such projects. However, the benefits and potential opportunities created by these projects may be constrained by the security risks and costs inducing, therefore, productivity dilemma. Consequently, security project can be a necessary complement and efficient support to IT/IS management.

On the other hand, a literature review reveals that the Boehm's Constructive Cost Model (COCOMO) is the most widely known and studied as a software cost estimation model [7, 8]. Parameters within this model include the size, stuffing, cost and duration of each phase of the software development. This model, however, fails to estimate the cost because it does consider specific parameters related to the security policy imposed by the enterprise and the business way conducted through the IT system.

Based on COCOMO, security cost model referred as SECOMO provides additional parameters appropriate to security field in order to evaluate time, cost and personnel required for security project management [9, 10]. To our knowledge, SECOMO is the unique security cost model proposed to estimate and assess cost factors related to security project.

However, and despite the interest of SECOMO, this model addresses the estimation of the cost related only to the technical task of the project. Additional human, managerial and organizational parameters must be considered and assessed in order to provide a more accurate estimation of security project cost. A dynamic and efficient cost model capable of adapting company operational procedures, resource management, and corporate strategy to the evolution of digital risk is necessary.

Thus, the objectives of this research are firstly, to identify specific cost factors related to security project including technical and managerial issues; and secondly, to provide a cost model to facilitate executives to make the decision. Our contributions in this paper are three-fold. First, we propose an estimation and representation of cost factors in security project according to a managerial view. Attention will be focused on risk assessment, organizational and human parameters in planning and conducting security project. Second, we propose an extension of SECOMO to address the organizational, managerial and human factors. Finally, we address a classification of enterprises according to their security needs and show that the cost of security project can be linked to the development strategies of the enterprise.

The remaining part of this paper is structured as follows: the next section sets out the estimation and representation of cost factors in security project management according to SECOMO. It is followed by a description and assessment of additional cost parameters including organizational, managerial and human issues. The cost models management is then described and the models equations are presented. The final section presents the conclusion and an indication of further perspectives.

Estimation and Representation of Cost Factors in Security Project Management According to SECOMO

The estimations of the effort and duration needed to conduct a security project are performed based on the network size, scale factors and effort multipliers. The network size involves variables such as the technology level and complexity. The complexity is indicated by the number of control points implemented to secure the enterprise assets. The technology level depends on the network distribution and its related risk level. A high technology level increases the risk factor because the hackers are getting more inventive and skilled. The Table 1 provides the description of scale factors according to SECOMO.

The effort multipliers, as presented in Table 2, can be classified into four categories related to the project, the information system, the product and the personnel.

Table 1 Scale factors description according to SECOMO

Scale factor designation	Scale factor description
Precedentedness	Measures the level of the project similarity with previously developed projects.
Team cohesion	Measures the team members ability to work in group.
Project maturity	Reflects the level of the project maturity. The used rate is developed based on the schedule and the tasks to be performed.
Security strategy	Measures the security strategy efficiency. The compliance of the current security procedures with the security strategy, and tests complexity for compliance.

Table 2 Effort multipliers description according to SECOMO

Category	Effort multiplier designation	Effort multiplier description
Product factors	Required security solution reliability	Measures the extent to which the solution must perform its intended function
	Required re-usability	Measures the additional effort needed to construct components intended when certain previous results have to be reused
	Required body authorization	Reflects the need for administrative procedures to get authorizations related to security needs.
	Acquiring security components	Reflects the need for engaging appropriate procedures to acquire security hardware and software needed in the implementation phase
Technical personnel factors	Team quality	Measures the knowledge and the experience of the team members in using the development platform and security tools
	Team capability	Reflects the design ability, efficiency of the team members, and their ability to cooperate and communicate
Project factors	Complexity	Quantifies the complexity of the security activities that constitute the security project
	Use of software tools	Measures the improvements level of the tools to develop the project, including capability, maturity and integration
	Risk assessment category	Reflects the category of risk assessment adapted in the security project: qualitative or quantitative.
	Required development schedule	Measures the schedule constraint imposed on the project team. Time constraints may increase the required time. Accelerated schedule tends to produce more effort.
Information system factors	Attack frequency	Measures the rate of attacks against the network. A high attack rate implies that many actions should be taken to fill in the numerous breaches
	Audit frequency	Measures the rate of audit operations that may impact the effort complexity
	Multi-site information system	Reflects the impact of geographical distribution on the effort
	Security levels	Measures the number of security levels within the secured network
	Very sensitive assets	Reflects the existence of very sensitive assets in the network
	Technology level	Reflects the technology level in the network

Additional Cost Parameters

We propose here eight additional parameters that influence the costs estimation of a security project.

At the organizational level, it is important to consider the organization size and the structure differentiation. In this way, an important size implies a multitude of diversified functions and intermediate levels of responsibilities. It follows that the organization must be regulated by a set of administrative and managerial procedures in order to achieve the operational and strategic goals of the enterprise. These procedures define the principal operations made on the enterprise assets, manage the human resources implicated in these operations and identify the fundamental types of control to carry out. The organizational procedures must be taken into consideration during the specification phase of a security project. Thus, the effort required to plan and conduct a security project is function of the complication level of these procedures. The structure differentiation is correlated to the organization size and indicates the number of specialized unities and departments created to respond to distinct aspects of the environment. This differentiation involves the allocation of responsibilities and attributions within the organization and requires trust management procedures to ensure that only authorized entities can interact with available assets. Trust management is established, based on the checking of the validity of credentials, and on conducting a real-time supervision of the user profiles where the level of confidence can vary with respect to the changing policy to access the service and the history of accesses of the user.

At the managerial level, four cost parameters are indispensable to take into account: the rivalry intensity, the supply chain network structure, the strategic goals schedule, and the risk assessment. The rivalry intensity indicates the competition pressure in the activity sector of the enterprise. This parameter increases the vigilance of the enterprise that must be doubly careful and, affects the number of control points, the sophistication of security solutions and the regularity of monitoring activities. It also shows how damaging the threats targeting the enterprise activity can be. The supply chain network structure includes the number of the trading partners involved in the supply chain deployment, the structural dimensions of the network, and the process links. If this number is important, special focus must be placed on security issues at the same time as it is on determining security solutions design in order to allow for more efficient supply chain integrity. The strategic goals schedule measure the remained deadlines for the enterprise to achieve its strategic goals. Urgent deadlines raise the needed effort of monitoring as well as the availability of required protection. The risk assessment is related to the dynamic aspect of all parameters included in the estimation of a security project cost. It reflects the residual risk linked to the variability of these parameters depending on time or context such as the evolution of attack severity, increased competition pressure and decreased trust level assigned to the employees.

At the human level, two cost parameters are important to integrate in the cost estimation of a security project: employees' awareness and development of new skills.

Employees' awareness is related to the necessity to enhance employees' security consciousness by means of education and training during the setting up of a security project. In fact, managers and technical personnel mistakes, such as social engineering, human errors, abuse of privileges and trust, would bring unexpected damages to the networked enterprise. The last human parameter deals with the need of the acquisition of new knowledge and skills essential to the implementation and operation phases of a security project. It is important in this setting to distinguish two types of implicated personnel: technical staff and decision-makers. The first group includes monitoring personnel such as an incident response team and exploitation personnel such as the system administrators. For this first group, increased size influences the cost estimation of a security project. The second group comprises the managers that can operate daily action susceptible to affect the required security level. These managers are asked to provide a greater amount of flexibility in the practices and services they provide according to security imperatives. In addition, they should develop efficient mechanisms of communication and coordination with the technical staff.

At the empirical level, two modes of measurement can be used to quantify the aforementioned parameters in the estimation of security project cost. For both of them, the set of value assigned to each parameter is based on the expert judgment.

In the first class, numeric values can be assigned an interval of the form {0, 1,....10} to the measured parameter. The second class contains parameters that do have values equal to any integer. The parameters in the second class contain mainly the risk assessment. Indeed, the risk results on loss. Therefore, the measurement scale must be large and even infinite. To illustrate, further than a certain threshold of risk, additional risk can multiply the losses and exceed even the company capital. The number of control points can also be integrated in this category of scale. All the other parameters should belong to the first class.

Cost Models Management

It is acknowledged that a particular enterprise has its own set of technical and organizational specificities, and that the cost model for a particular enterprise may involve particular parameters and criteria. Our attempt here is to present two general models based on the aforementioned parameters, and then the expert and decision-maker could adjust the general model to determine the final cost model.

Based on the enterprise size, on the perceived risk and on the dependence level of the enterprise activities with its information system, we distinguish two versions of cost model, basic and advanced.

The basic cost model can be applied to enterprises having a little size, a low dependence level of their activity on the information system they use, and evolving in a stable environment. Thus, we have considered in this model only the factors that are significant to the enterprise activity; meaning that the missing factors are not expected to change during enterprise activity. The advanced cost model can be applied to enterprises having an important size, a high dependence level of their

Table 3 Cost parameters classification

Cost parameter designation	Effort multiplier	Scale factor
Organization size		x
Structure differentiation		x
Rivalry intensity	x	
Supply chain network structure	x	
Strategic goals schedule	x	
Risk assessment	x	
Employees' awareness		x
New skills development		x

activity on the information system they use, and operating in a dynamic environment. This model integrates all factors classified based on the Table 3 and the factors studied by SECOMO (Tables 1 and 2).

Based on the above description, we have opted for an exponential-based approach in estimating the effort and duration like in related technical works (e.g. SECOMO). The expressions of effort and duration equations related to the basic version are:

$$E = \lambda_1 \times A_1 \times e\ \beta_1 B_1 \qquad (1)$$
$$D = \alpha_1 \times E^{\delta}{}_1 \qquad (2)$$

For the advanced cost model, the equations will have the form:

$$E = \lambda_2 \times A_2 \times e\ \beta_2 B_2 \qquad (1)'$$
$$D = \alpha_2 \times E^{\delta}{}_2 \qquad (2)'$$

Where λ_i, α_i and β_i are constants, A_i is the product of all multiplier factors occurring in the Tables 2 and 3, B_i is the sum of the scale factors occurring in the Tables 1 and 3 and δ_i is the sum of the scale factors occurring in the same tables.

It is worth to notice that D is computed in terms of men/months. Therefore, our proposed model encompasses technical issues as well as management factors that have a countable effect on the project cost.

The initial computation of the constants and factors, as well as their updating, used in both equations can be estimated using the traditional method based on: (1) an a priori model that determines initial values of constants and factors with the help of experts only, and (2) an a posteriori model that updates the estimation of the constants and factors using statistics, handled by the enterprise, related to the security projects conducted within the enterprise.

Conclusion

The research aim of this paper was to determine the cost factors related to security projects. More specifically, one objective was to identify managerial and organizational parameters and determine the extent to which these parameters affect security project cost. Another objective was to provide cost models to the managers in order to assist critical decisions in security projects and avoid the high costs and risks associated to such projects.

Future research aiming to collect data information security projects for various types of organizations and business activities would help in gaining better adjustment of the proposed cost models and build an accurate cost estimation based on these models. We are now conducting a questionnaire based investigation with Tunisian SMEs to provide numerical values for the formulas developed in the previous section.

References

1. Yeo, K. T. (2002) Critical factors in information system projects, *International Journal of Project Management* 20: 241–246.
2. Stewart, R. A. (2008) A framework for the life cycle management of information technology projects: *ProjectIT*, *International Journal of Project Management*, 26: 203–212.
3. Raymond, L. and F. Bergeron (2008) Project management information systems: An empirical study of their impact on project managers and project success, *International Journal of Project Management*, 26: 213–220.
4. Liang, C. and Q. Li (2007) Enterprise information system project selection with regard to BOCR, *International Journal of Project Management*, article in press.
5. Henry, R.M., McCray, G.E., Purvis, R.L. and Roberts, T.L. (2007) Exploiting organizational knowledge in developing IS project cost and schedule estimates: An empirical study, *Information and Management*, 44: 598–612.
6. Whelan, E. and F. McGrath (2002) A study of the total life cycle costs of an E-commerce investment. A research in progress, *Evaluation and Program Planning* 25: 191–196.
7. Boehm, B. W., C. Abts, et al. (2000) Software Cost Estimation with COCOMO II, Prentice Hall, Englewood Cliffs, NJ.
8. Boehm, B. W., R. Valerdi, et al. (2005) COCOMO Suite Methodology and Evolution, *CROSSTALK The Journal of Defense Software Engineering*, 20–25.
9. Krichene, J., and N. Boudriga (2007) Network Security Project Management: A Security Policy-based Approach, *IEEE International Conference on Systems, Man, and Cybernetics*, Canada.
10. Krichene, J., and N. Boudriga (2008) Managing Network Security Projects: Classification models and Scale Effect, *The International Conference on Information & Communication Technologies: from Theory to Applications*, Damascus, Syria.

Measuring Data Quality When Applying Data Swapping and Perturbation

G. Canfora[1] and C.A. Visaggio[2]

Abstract Preserving data privacy is becoming an urgent issue to cope with. Among different technologies, the techniques of perturbation and data swapping offer many advantages, even if preliminary investigations suggest that they could deteriorate the usefulness of data. We defined a set of metrics for evaluating this drawback and carried out a case study in order to understand to which extent it is possible to enforce data security, and thus protect sensitive information, without degrading usefulness of data under unacceptable thresholds.

Introduction

Due to the number of personalized web-based services, such as e-government, e-commerce, e-health, e-banking, and so forth, a relevant quantity of sensitive and confidential information is becoming accessible [1], by exploiting mechanisms which can be mastered also by not experienced people.

The user's desire to control personal data is often undermined [2] because of many reasons:

– Data are collected by different devices in different sessions and stored permanently;
– Data are increasingly being collected without any indication about the "when" and the "how"[3].

Thus, successful management of data privacy policies is becoming an urgent challenge to face. Different techniques [4] have been proposed in order to manage and control data privacy policies, such as: hippocratic databases [5], P3P [6], cryptography [7], and anonymization [8]. Our study focuses on two techniques: perturbation and data swapping. Perturbation [9] alters individual data in a way that the summary statistics remain approximately the same.

[1]Università degli Studi del Sannio, Benevento, Italy, canfora@unisannio.it
[2]Università degli Studi del Sannio, Benevento, Italy, visaggio@unisannio.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_19, © Springer Physica-Verlag Berlin Heidelberg 2010

Data swapping [10] swaps entries within a single field in a records set so that the individual record entries are unmatched, but the statistics are maintained across the individual fields. On the one hand these algorithms could be very effective with a low cost of implementation. On the other hand, they could deteriorate the usefulness of the data, since they modify the presentation of data, although the informative content is kept the same. Data usefulness is intended as the extent to which a protected table allows required analyses or queries to be made. As a consequence, when a query is sent to a protected database, the returned result could be flawed, in different regards:

– The number of tuples produced by the protected database could be smaller than the one produced by the original database;
– The gathered information could be so poor to be useless: this happens when a high percentage of the records' fields contains a protected value;
– The result could be completely wrong with respect to the actual one; this could happen especially when the query must return an exact value, e.g. a number or a string.

We defined a set of metrics for measuring these kinds of data usefulness degradation and carried out a case study aimed at comparing the two techniques by using our metrics.

Data Usefulness Measures

The queries sent to a protected database may return a result set different from the one produced by the original database. This effect is the cause of the data degradation which is measured with four indicators.

The usefulness index evaluates the quality of the adopted data privacy policy. It measures the percentage reduction of tuples in the result set returned by the protected database, normalized on the total set of queries sent.

As the two algorithms modify the form of the data item stored into the database, the information loss measures the quantity of information which is definitely corrupted.

The partial matching measures the percentage difference between the two result sets. The alteration of a query's result could be observed also on statistical queries, i.e. when the result set is a number. With regard to this case, the Interval Query Index evaluates the percentage difference between the obtained number and the expected one. Table 1 collects all the four indicators.

Related Work

Kifer and Gehrke [11] introduce a formal approach to measure utility. The authors propose to inject additional information into anonymized tables. The main purpose is to increase the utility and maintain the levels of anonymization. Xu et al. [12] propose a model for utility based anonymization. They used a metric which

Table 1 Metrics used for measuring data usefulness

Metric	Definition	Description
Usefulness index	$\sum_{q \in Q} \frac{1}{Q}\left[\frac{\Delta q(\Pr DB)}{q(OriginalDB)}\right]$	q is a single query belonging to the Q set of queries.Pr DB is the protected database and OriginalDB is the original database
Information loss	$\frac{PT}{NT} * 100$	PT is the number of corrupted data fields.NT is the total number of data fields required by the query.
Partial matching	$\frac{(TOrig - T\Pr)}{TOrig} * 100$	TOrig is the number of tuples returned by the Original DatabaseTPr is the number of tuples returned by the Protected Database
Interval queries	$\frac{(NOrig - N\Pr)}{NOrig} * 100$	NOrig is the number returned by the Original DatabaseNPr is the number returned by the Protected Database

captures two aspects: the information loss caused by the anonymization and the importance of attributes, namely the weighted normalized certainty penalty.

Their method aims at minimizing this metric. Ghinita et al. [13], try to overcome some drawbacks of anonymization techniques, such as: information loss metrics are counterintuitive and fail to capture data inaccuracies inflicted for the sake of privacy; the technique of l-diversity introduces further inaccuracies.

They propose a framework for efficient privacy preservation that addresses these deficiencies. They focus on one dimensional quasi identifiers, and study the properties of optimal solutions, based on meaningful information loss metrics. A variety of information loss metrics have been proposed. The classification metric [14] is suitable when the purpose of the anonymized data is to train a classifier. Each record is assigned a class label and information loss is computed based on that adherence of a tuple to the majority of its group. The Discernability Metric [15] measures the cardinality of the equivalence class. Loukidas and Shao [16] present a metric which attempts to capture data usefulness and privacy protection quantitatively. The metric allows the required level of data usefulness and privacy protection to be considered and balanced during the generation of a k- anonymization. The same authors propose [17] a distance-based measure that captures both utility and protection and can handle attributes of any type uniformly. Their experimentation verified that the method produces anonymisations with a good trade-off between data utility and protection, and often outperforms methods which specifically optimise one of these two requirements.

Privacy Enabling Technologies

Different technologies have been proposed to preserve data privacy. The W3C Consortium developed the P3P [18], which is becoming a de facto standard in web transactions. It synthesizes the purposes, treatment modes and retention period for data, but it does not guarantee that data are used accordingly to the declared policies. Consequently, it may be used only in trusted environments. Researchers of IBM proposed the model of the Hippocratic database [19]: it supports the management of information sharing with third parties, relying on ten rules for data exchange. This solution could degrade performances, as purposes and user authorization must be checked at each transaction. Memory occupation is a further matter, as it entails the use of metadata whose size could grow up fast. The fine grain access control (FGAC) [20], is a mechanism designed for a complete integration with the overall system infrastructure. The mechanism can be used only when the number of constraints on data is small. Other technologies to assure data privacy aims at establishing a trusted environment to exchange data. These solutions, like EPAL [21], verify trust by the exchange of credentials or permissions to perform a certain action on data. Trust is a key component of data protection. Pallickara et al. [22] ideated a trust model which extends the inter-service security infrastructure to the end-to-end trusted relationship between the user and the physical resource. Evaluation of trustworthiness is a central, but still unsolved, issue. Squicciarini et al. [23] presented a system for trust negotiation specifically designed for preserving privacy. It provides support for P3P policies, and different credential formats. The system lets to adopt the best strategies by balancing efficiency, robustness and data privacy enforcement. Further mechanisms to manage the privacy policies consist of organizing infrastructures for authentication and authorisation, as the reference model proposed by Schlager et al. [24]. Anonymization techniques [25] let organizations retain sensible information, by changing values of specific table's fields. These techniques could affect seriously data quality and may leave the released data set in vulnerable states. Cryptography is the most widespread technique for securing data exchange, even if it entails some drawbacks: high costs for governing distribution of keys, and low performances in complex and multi-users transactions.

Case Study

The case study aims at comparing the effects on data usefulness produced by data swapping and perturbation; the research goal is: Analyse Data Swapping and Perturbation with the purpose of comparing with respect to data usefulness degradation from the point of view of data manager.

Characterization

Experimental vitro. A database containing medical data was reproduced in the lab computers. For privacy sake, original data were replaced with fake ones, but schema and number of records were preserved. The experiment focused on two tables: 'Anagrafica', which includes twelve fields, and 580 records; and 'Diagnosi', which includes four fields, and 567 records.

Rationale for sampling. As the tables belong to an existing system, the sample of queries consisted of: a set of the actual data requests provided in the use scenarios, and describing different applications accessing the original database; and a set properly arranged for the current experimentation.

Preparation of the protected databases. The data provider is able to protect against linking an individual to sensitive information within or outside a table T, by using some identifying attributes, called virtual identifiers (VID).With regards to perturbation the used VIDs were composed as follows: VID-1 includes three attributes of 'Anagrafica' table, VID-2 includes five attributes of 'Anagrafica', and VID-3 includes five attributes of 'Anagrafica' and two attributes of 'Diagnosi'.

With regards to suppression, specific values to ban were identified for nine attributes of the two tables.

Data collection. Data were collected by the tool Morgana, which was developed in the authors' labs.

Data Analysis

Tables 2 and 3 show the descriptive statistics of the partial matching and interval queries effects.

It emerges that when the number of attributes included in a VID increases, a certain phenomenon happens: the returned result set is larger than the exact one, thus, the information the user looks for is dispersed in the obtained information. As a result, the partial matching and interval queries effects are more severe when the number of attributes in the VIDs increases, i.e. the level of protection. With regards to the information loss, data swapping provides for results better than the ones provided by the perturbation, as showed in Table 4.

Table 2 Effects of perturbation

Perturbation	VID-1		VID-2		VID-3	
	Partial match	Interval queries	Partial match	Interval queries	Partial match	Interval queries
Min	−14,250	−772	−28,250	−772	−56,600	−11,240
Max	79	0	92	0	76	0
Mode	0	0	0	0	0	−11,240
Mean	−749.9	−129.9	−1,150.3	−129.3	−3,076.9	−3,935.2

Table 3 Effects of data swapping

Data swapping	VID-1		VID-2		VID-3	
	Partial match	Interval queries	Partial match	Interval queries	Partial match	Interval queries
Min	−14,250	−772	−28,250	−772	−56,600	−11,240
Max	88	73	92	73	92	73
Mode	0	0	0	0	0	−11,240
Mean	−552.8	−119.9	−750.7	−119.9	−1,915.5	−2,844.2

Table 4 Effects of perturbation and data swapping on info loss

	VID-1		VID-2		VID-3	
InfoLoss	Perturbation	Data swapp	Perturbation	Data swapp	Perturbation	Data swapp
Min	0	0	0	0	33.3	19.8
Max	75	54.2	100	62.5	100	72.4
Mode	33.3	0	33.3	0	66.6	55.3
Mean	39.9	25.8	47.3	29.9	77.3	42.5

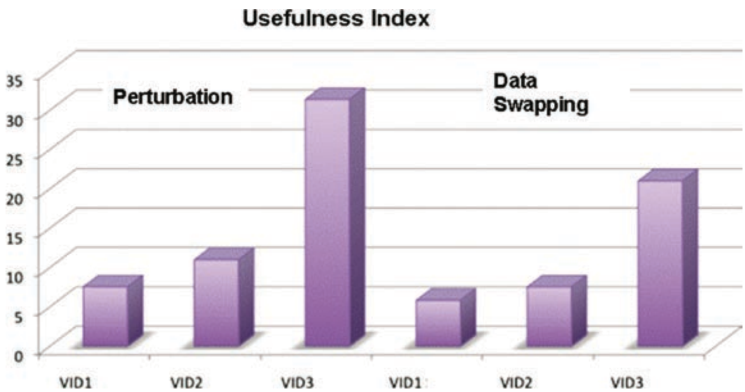


Fig. 1 Effects on usefulness index of perturbation and data swapping

Figure 1 illustrates how the Usefulness Index varies in dependence of the VID's size. In both the algorithms, there is not a perceivable difference between VID1 and VID2. Such difference sensitively grows when we pass to the VID3. In overall, Data Swapping is preferable to Perturbation.

Conclusions

By summarizing, data swapping seems to outperform perturbation as it affects less the data usefulness. However, the protection usefulness is enhanced by higher levels of privacy; for this reason, protecting a database when using perturbation or data swapping is a trade off between preserving privacy and assuring an acceptable level of data usefulness.

Bibliography

1. Rosenblum, D. (2007) What Anyone can Know: The Privacy risks of Social Networking Sites, *Security and Privacy Magazine*, 5 (3): 40–49.
2. Sackman, S., Struker, J. and Accorsi, R. (2006) Personalization in Privacy-Aware Highly dynamic Systems, *Communications of the ACM*, 49(9): 33–38.

3. Langheinrich, M. (2005) Personal Privacy in Ubiquitous Computing –Tools and System Support, *PhD. Dissertation, ETH Zurich*.
4. Bertino, E., Ooi, B.C., Yang, Y. and Deng, R.H.(2005) Privacy and Ownership Preserving of Outsourced Medical Data, *proc. 21st Int'l Conference on Data Engineering*: 521–532
5. Agrawal, R., Kiernan, j., Srikant, R. and Xu, Y. (2002) Hippocratic Databases, *proc. Of the 28th Int'l Conference on Very Large Database (VLDB):* 143–154.
6. Platform for Privacy Preferences (P3P) Project, W3C, http://www.w3.org/P3P/ (last access on January 2007).
7. Maurer, U. (2004) The role of Cryptography in Database Security, *proc. of SIGMOD int'l conference on Management of Data:* 5–10.
8. Sweeney, L. (2002) k-Anonymity: A Model for Protecting Privacy, *International Journal on Uncertainty, Fuzziness and Knowledge Based Systems*, 10: 557–570.
9. Li, X.B. and Sarkar, S. (2006) A Tree-Based data Perturbation Approach for Privacy – Preserving Data Mining *IEEE Trans. On Software Engineering*, 18(9): 1278–1283.
10. Gomatam, S. and Karr, A. (2003) Distortion Measures for Cat Egorical Data Swapping, *Tech. Report 131, US Nat'l Inst. Statistical Sciences.*
11. Kifer, D. and Gehrke, J. (2006) Injecting Utility into Anonymized Datasets, *proc. of SIGMOD 2006:* 217–228.
12. Xu, J., Wang, W., Pei, J., Wang, X., Shi, B. and Wai- Chee Fu, A. (2006) Utility-Based anonymization Using Local Recoding, *proc. of KDD'06*: 785–790.
13. Ghinita, G., Karras, P. , Kalnis, P. Mamoulis, N. (2007) Fast Data Anonymization with Low Information Loss, *VLDB'07*: 758–769.
14. Iyengar, V.S. (2002) Transforming data to satisfy privacy constraints, *proc. of the 8th ACM SIGKDD Int'l Conference on Knowledge Discovery and Data Mining*: 279–288.
15. Bayardo, R.J. and Agrawal, R. (2005) Data Privacy Thorugh Optimal k-Anonymization, *proc. of 21st Int'l Conference on Data Engineering*: 217–228.
16. Loukidas, G. and Shao, J. (2007) Capturing Data Usefulness and Privacy Protection in K-Anonymisation, *proc. of the 2007 ACM symposium on Applied computing*: 370–374.
17. Loukidas, G. and Shao, J.(2008) Data Utility and Privacy Protection Trade-Off in k-anonymisation, *proc. of the 2008 International Workshop on Privacy and Anonymity in Information Society*: 36–45.
18. Platform for Privacy Preferences (P3P) Project, W3C, (last access on January 2007).
19. Agrawal, R., Kiernan, J., Srikant, R. and Xu Y. (2002) Hippocratic Databases, *Proc. VLDB 2002*: 143–154.
20. Agrawal, R. Bird, P. Grandison, T., Kiernan, J., Logan, S. and Rjaibt, W. (2005) Extending Relational Database Systems to automatically Enforce Privacy Policy, *proc. ICDE'05*: 1013–1022.
21. Ashley, P., Hada, S., Karjoth, G., Powers, C. and Schunter, M. Enterprise Privacy Authorization Language (EPAL 1.1), IBM Reserach Report. (available at: http://www.zurich.ibm.com/security/enterprice-privacy/epal – last access on 19.02.07), 2003.
22. Pallickara, S., L., Plale, B., Fang, L. and Gannon, D. (2006) End-to-End Trustworthy Data Access in Data-Oriented Scientific Computing, *proc. CCGRID'06*: 4.
23. Squicciarini, A., Bertino, E., Ferrari, E., Paci, F. and Thuraisingham, B. (2007), PP-Trust- X: A System for Privacy Preserving Trust Negotiations, *ACM Transactions on Information and System Security 10 (3).*
24. Schlager, C., Nowey, T. and Montenegro, J., (2006) A Reference Model for Authentication and Authorisation Infrastructures Respecting Privacy and Flexibility in b2c eCommerce, *proc. ARES'06*: 709–716.
25. Fung, C., M., Wang, K. and Yu, S.P. (2005) Top-Down Specialization for information and Privacy Preservation, *proc. ICDE'05*: 206–216.

Measuring RFId Benefits in the Supply Chain

E. Ugazio[1] and F. Pigni[2]

Abstract RFId systems show great potentials enhancing supply chain performances. Some of the major retailers in the World (Wall Mart, Metro Group, Tesco) made sounding campaigns promoting the benefits they were able to attain. Despite the increase in the number of researches on RFId benefits, a study investigating their measurement in the supply chain context is still lacking. This paper aims at identifying and measure RFId benefits by designing three tools: (1) an RFId oriented Performance Measurement System for the identification of all RFId related supply chain performance indicators on the base of the SCOR Model. (2) A benefits-processes-measures matrix linking the benefits identified in literature with SCOR model process to identify supply chain measures impacted by the RFId system implementation. (3) A reference framework summarizing benefits measures.

Introduction

Since their early adoption in retailing RFId systems have shown great potentials for supply chain and warehouse management. The first studies in this field contributed to the exploration of both hardware and functional requirements of the technology and the possible impacts on logistics and operations "inside the four walls of the facilities" [1]. It's only when the MIT started to develop the idea of low cost, high volume tags that RFId inter-organizational application were finally addressed.

The related development of the EPC architecture [2] made its first appearance in the retail market. The well know example of Wall-Mart and Gillette [3] collaboration, showed the real potential of the technology producing significant impacts on the performance of the supply chain reducing the stock outs and over stocks, increasing collaboration and coordination between supply chain partners,

[1]Università Carlo Cattaneo – LIUC, Castellanza (VA), Italy, eugazio@liuc.it
[2]Università Carlo Cattaneo – LIUC, Castellanza (VA), Italy, fpigni@liuc.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_54, © Springer Physica-Verlag Berlin Heidelberg 2010

and generally providing a higher service level to the final customer. The success of the Wall-Mart initiative raised the question of the replicability of the results both in the same and in different contexts. The need for a reliable assessment of the return on investments in RFId technology has then become compelling. In literature, several models have been proposed to support the development of the feasibility study concerning RFId projects [4–8], however, despite the relevance of the issue, the estimation of benefits is still more approximate and qualitatively based than the costs one [1]. This issue relates both to RFId benefits characteristics and to the lack of a reference framework for their evaluation. The studies published to date mainly assess the qualitative impacts of RFId on both the activities of the single firm or of the entire supply chain [1, 6, 9]. Others concentrate on a specific supply chain, e.g. the printing industry [4], but neglect to generalize their findings.

With this paper we aim at proposing a general framework for the measurement of RFId benefits within the context of a supply chain, supporting supply chain manager in translating each operative impact of this technology into “hard dollar return”. The idea at the base of the methodology adopted in this study is straightforward: to associate the predicted qualitative impact of the technology to a supply chain performance measure/indicator through the development of an RFId oriented Performance Measurement System (PMS).

The paper is arranged in three sections. The next paragraphs present the research model and, after a brief discussion on the general issue of measuring, describe the assumption at the base of the methodology. In section two we detail the approach[3] and the attained results.

From Qualitative Benefits to Measures

In literature the published assessments of RFId benefits measurement within supply chains mainly consist of papers suggesting or testing general qualitative “lists” of impacts resulting from RFId systems implementation (like the increased speed of order preparation or the improvement of quality management). These analyses adopt a qualitative approach without exploring the development of methodologies or procedures for a quantitative assessment of the impacts identified. This reflects the wider problem of measuring benefits in the IS context [10], and is only made worse by the lack of business cases on RFId technology [11]. A measure can be defined as the quantitative result of a measurement process, and consists in a symbol used to evaluate an attribute [12]. Thus, a measure provides the quantitative dimension to a benefit, and has to be associated to an indicator. In order to develop our framework we relate these indicators (numbers or ratios) to the efficiency and

[3]Only the main references used in the development of the framework are reported in this paper. The complete list is available upon request to the authors.

effectiveness of a particular business process. In a supply chain, then, these indicators refer to the environment of analysis. Thus, we decided to adopt the SCOR model as the reference supply chain process framework.

Methodology

The methodology used to develop the research framework is built around three main research questions:

1. Which benefits are found to be generated as a result of RFId systems adoption?
2. How performance is measured in the supply chain context?
3. How the impacts on supply chain performance of RFId can be measured?

The identification of RFId benefits from the analysis of literature is functional to the identification of the possible process impacted by the adoption of this technology. By establishing a link between the benefits and supply chain process on the base of the widely adopted SCOR model, it is then possible to associate an impact to a process performance measure. The next sections detail the research steps to develop the proposed RFId benefits reference framework.

The Benefits of RFId Adoption

In literature several studies on RFId provide useful indications for the assessment of RFId benefits. We reviewed 30 paper published between 2004 and 2008 describing the different approaches used in assessing RFId impacts and emerging benefits. We categorized these papers according to their focus and contribution in four categories: methodologies, real implementations, qualitative benefits, and literature review [13]. In particular, only three studies [1, 14, 15] provided an assessment of a *Methodology* to discover and classify the RFId impacts on firm operations, whereas several *Real implementations* [14, 16–18] accounted the experiences of cross-section application of RFId in heterogeneous contexts including air baggage handling and fashion retailing. Other works effectively approached the problem of the measurement of RFId benefits [4, 8, 19–22], but their scope was generally limited. Hou and Huang [4], for example, identify the possible supply chain performance indicators influenced by introduction of RFId system within the Taiwanese print and paper supply chain and they gathered "quantitative values" of performance. Nevertheless this work shows some limits in terms of generalizability: the model is concentrated only on Taiwanese print and paper industry, and the methodology adopted for identifying the indicators is not declared or explained. Tellkamp [21], presents a mathematical model to show how RFId systems are able to reduce stock out, and level of overstocks but disregards other possible effects different from stock level reduction. The studies concentrating on *Qualitative Benefits* generally provides the description of the impact without providing any associated measure (i.e. reducing stock out, increase speed and accuracy in sku/pallet preparation, fast item/sku/pallet identification, safety stock reduction, stock turnover improvement) [3, 6, 13, 23–25]. However, by summarizing and categorizing these findings we were able to identify 42 different classes of impacts resulting from RFId adoption. By associating the benefits produced by RFId adoption with supply chain process as defined in the SCOR model we were able to effectively develop an articulated Performance Management System (PMS) oriented at the assessment of RFId applications.

Measuring Supply Chain Performance

A PMS is a "..set of metrics used to quantify both the efficiency and effectiveness of actions" and its metrics/indicators are linked each other by several internal relationships [26]. In particular, concerning the development of PMS in supply chains, literature offers contribution both regarding the PMS structures, and the development of suitable indicators. Shepherd [27] provides a taxonomy of metrics specifically in the supply chain context and develops a PMS structure categorizing "the indicators according to their applicability to the five supply chain processes defined in the supply chain operations reference (SCOR) model (plan, source, make, deliver and return or customer satisfaction)". Accordingly, we designed the PMS RFId identifying and analyzing SCOR model process and performance indicators (Model settling).

Identification and Analysis of SCOR Process

The SCOR model is one of the most common, reliable and fast tool to explore and analyze every supply chains. By describing supply chains using these process building blocks, the model can be used to describe supply chains that are very simple or very complex using a common set of definitions (SCOR version 6.0). We define the structure of the PMS framework and the indicators on the base of the SCOR model process. The SCOR model divides the supply chain into five primary management processes of Plan, Source, Make, Deliver and Return each composed of three levels of process detail, describing the supply chain till its activities.

Following the model structure, for each level we listed the processes with their descriptions and highlight the ones immediately affected by RFId system implementation. Gathering all the processes, we points outs two interesting SCOR model features functional to design a performance system generalized and capable of considering supply chain operative aspects.

First of all the second detail level of source, make, and deliver presents alternative process that represents the different types of supply chain. Moreover this model gathers also the enable processes that ".. prepare, maintain, or manage information or relationships on which planning and execution processes rely"(Quick Reference SCOR 8.0). For our scope the enable processes, belonging to the management information domain, are essential because RFId systems dramatically increase the ability of suppliers to acquire and share a vast array of data regarding the location and properties of any entity that can be physically tagged. The supply chain map obtained by the SCOR model can be completed with the performance indicators associating to each sub-process the relative metrics.

Identification of Process Performance Indicators (Model Settling)

Performance indicators functional to the proposed RFId oriented PMS are based on the SCOR Model Version 6.0 containing the list of metrics for each process, and Shepherd's [27] review of supply chain. Both these works present a set of indicators associated to supply chain process. After matching them we identified 42 indicators for the "plan" processes, 27 for "source," 49 for "make," 51 for "deliver," 33 for "return." This result allows to consider the features of each indicator [28] and the framework of the RFId oriented PMS.

Measuring RFId impacts on Supply Chain Performance

Finally, RFId benefits can be associated to supply chain metrics defining a link between performance indicators and the SCOR processes. The association is possible selecting all PMS processes impacted by an RFId system and the benefits previously identified in the review of PMS supply chain processes (a middle-intermediate association). We consider that a modification in a process is reflected in a change of its performance metrics, so the middle-intermediate association process-benefits enable the association of benefits to metrics. For instance, the qualitative benefit "Fast item/sku/pallet identification" is linked to the SCOR model sub-processes "Receiving and verifying material inbound and outbound" belonging to source, make, deliver and return first level SCOR model process.

Each benefit can then be associated to the most suitable metric defined in the SCOR model to the analyzed process. According to the previous example "Fast item/sku/pallet identification" is a benefits belonging to Source "Receiving and verifying material" process and can be measured as a decrease of source cycle time. The associated measure is "the days elapsed between order release and the receipt of goods at manufacturing or distribution center". The detail of the activities provides a further indication of possible impacts of RFId technology. This approach allows the translation of the qualitative benefits identified in the literature review into process performance measures. This association represents the final output of our research.

Limits of the SCOR Model in Measuring RFId Benefits

The proposed association of benefits and metrics, despite being extensive, is still limited. We identified four main categories of benefits impacting the supply chain posing hardly referable to a SCOR process.

1. *Point of sales benefits:* Shoplifting control and theft reduction, for example, are typical RFId benefits arising at the point of sale but the SCOR model doesn't cover this part of the supply chain.
2. *Non operative benefits:* The SCOR model identifies only operative process whereas RFId impacts other competitive dimensions like:
   - Image improvement: a company image is an intangible asset and the marketing function can use the introduction of RFId system in order to increase visibility and brand value of the firm.
   - Parallel distribution control and reduction: its nature is not immediate measurable, nevertheless can be similar to SCOR process "Order Tracking and Genealogy" because the tracking of goods allows to have update information on its state and the parallel distribution can be more limited.
3. *Tracking and traceability benefits* are among the most reported impacts of RFId adoption because they affect the entire supply chain. In order to measure it we advance two possible solutions. The first limits the analysis to a single family of SCOR operative process. The availability of information about position and state of item in real time allows scheduling the activities of all chain actors with greater efficiency, thus impacting the effectiveness of planning that can be measured. The second to consider them related to the "enable" processes linked to information management.
4. *Information flows benefits* RFId technologies effectively create a lean information flow easy to share with supply chain partners. The SCOR model and consequently the PMS designed on its base, consider this aspect by identifying some enabling process. In fact the second detail level of plan, source, make, deliver and return comprises Manage Plan Data Collection, Maintain Source Data, Manage Make Information, Manage Deliver Information, and Manage Return Data Collection. We associated to these process three main indicators: accuracy, timeliness, and availability. RFId systems allow supporting every operative activity with data always accurate, available and updated. All these benefits are measured by indicators created ad hoc, because the SCOR model lacks this dimension. The RFId oriented PMS highlights all the measures designed in order to quantify the impacts on the supply chain.

Conclusions and Discussion

RFId is considered a revolutionary technology for improving the supply chain performance. However, the measurement of its impacts has not yet through enough in literature. This study proposes a framework to help supply chain managers to measure the RFId benefits within the supply chain context. The framework is designed to define supply chain performance measures and associate them to the benefits stemming from RFId systems adoption. The proposed framework is focused on specific operative processes of a supply chain that represents the span of the SCOR Model. Thus it inherits its scope: sales and marketing (demand generation), product development, research and development, and some elements of post-delivery customer support are disregarded. Despite we aimed at generalizing of our findings the RFId oriented PMS doesn't provide a measure of the strategic benefits of RFId adoption. Their evident unpredictable nature and context related nature make general measurement activities practically futile. In order to consider this aspect we suggests to add specific Balance Scorecards designed by each supply chain manager to understand which measure should be checked with particular attention.

Despite its limits, this research represents a starting point for defining the quantitative measures of RFId benefits offering a simple tool able to report the measure of RFId impacts. At the same time, it represents a first attempt to frame RFId value generation in the supply chain and in the interorganizational context. On its basis researcher could deepen the understanding of business cases for RFId and support the finding of patterns or dynamics of adoption. The process approach at the base of the framework effectively enable its generalizability and allows its application in every supply chain supporting the "measurement process" of the changes brought by this new technology to supply chains. Further research could empirically test the framework surveying a significant sample of supply chains verifying the effective reliability of the measures identified.

References

1. Laubacher R, Kothari SP, Malone TW, Subirana B. (2006). What is RFID Worth to Your Company? Measuring Performance at the Activity Level. A research and education initiative at the MIT Sloan School of Management, 1–30.
2. Leong KS, Ng ML, Engels DW. (2004). EPC Network Architecture. Presented at Auto-ID Labs Research Workshop, Zurich, CH.
3. Smith AD. (2005). Exploring radio frequency identification technology and its impact on business systems. *Information Management and Computer Security*, 13(1), 16–28.
4. Hou JL, Huang CH. (2006). Quantitative performance evaluation of RFID applications in the supply chain of the printing industry. *Industrial Management Data Systems*, 106, 96–120.
5. Hodges S, McFarlane D. (2005). Radio Frequency Identification: technology, applications and impact. In White paper series -Edition 1: Auto-ID-Labs.
6. Chuang M, Shaw WH. (2005). How RFID will impact supply chain networks. *IEEE Computer Society*, 231–235.

7. Veeramani D, Tang J, Gutierrez A. (2008). A framework for assessing the value of RFID implementation by tier-one suppliers to major retailers. *Journal of Theoretical and Applied Electronic Commerce Research* 3(1), 55–70.
8. Jeong B-K, Lu Y. (2008). The impact of radio frequency identification (RFID) investment announcements on the market value of the firm. *Journal of Theoretical and Applied Electronic Commerce Research*, 3(1), 41–54.
9. Chopra S, Sodhi MS. (2007). Looking for the Bang from the RFId Buck. *Supply Chain Management Review* 11:34–41.
10. Seddon P, Greaser V, Willcocks L. (2002). Measuring organizational IS effectiveness: An overview and update of senior management perspectives. *The DATA BASE for Advances in Information Systems*, 33(2), 11–28.
11. Curtin J, Kauffman RJ, Riggings FJ. (2007). Making the “Most” out of RFID Technology:a research agenda for the study of the adoption, usage and impact of RFID. *Information Technology and Management* 8(1), 87–110.
12. Mari L, Lazzarotti V, Manzini R. (2008). Measurement in soft systems: Epistemological framework and a case study. *Measurement* 42:241–253.
13. Pigni F, Astuti S, Buonanno G. (2004). An evaluation framework for RFId Adoption. In AICA 2004 XLII Annual Congress. Benevento, Italy.
14. Bertelè U. 2006. RFId alla prova dei fatti I risultati 2006 dell’Osservatorio RFId: Politecnico di Milano
15. van de Wijngaert L, Versendaal J. (2008). Business IT Alignment and technology adoption; The case of RFID in the logistics domain. *Journal of Theoretical and Applied Electronic Commerce Research*, 3(1), 71–80.
16. Xiao Y, Yu S, Wu K, Ni Q, Janecek C, Nordstad J. (2007). Radio frequency identification: technologies, applications, and research issues. *Wireless Communications and Mobile Computing*, 7(4), 457–472.
17. Loebbecke C, Huyskens C. (2008). A Competitive Perspective on Standard-Making: Kaufhof’s RFID Project in Fashion Retailing. *Electronic Markets*, 18(1), 30–38.
18. Zhang T, Ouyang Y, He Y. (2008). Traceable air baggage handling system based on RFID tags in the airport. *Journal of Theoretical and Applied Electronic Commerce Research*, 3(1), 106–115.
19. Spivey Overby C. (2004). Revealing RFID’s Benefits in Consumer Goods, Forrester Research, Cambridge, MA.
20. Koh CE, Kim HJ, Kim EY. (2006). The impact of RFID in retail industry: issues and critical success factors. *Journal of Shopping Center Research*, 13(1), 101–117.
21. Tellkamp C. (2006). The impact of Auto-ID technology on process performance – RFID in the FMCG supply chain. *Dissertation of University of St. Gallen, Graduate school of business Administration*.
22. Munoz A, Clements MD. (2008). Disruptions in information flow: a revenue costing supply chain dilemma. *Journal of Theoretical and Applied Electronic Commerce Research*, 3(1), 30–40.
23. McFarlane D, Sheffi Y. (2003). The impact of automatic identification on supply chain operations. *The International Journal of Logistics Management*, 14(1), 1–17.
24. Michael K, McCathie L. (2005). The Pros and Cons of RFID in Supply Chain Management. *International Conference on Mobile Business*.
25. Hilger A, Ghijsen P, Semeijn J. (2007). Antecedents of logistics performance and economic performance: the case of Radio Frequency Identification (RFID). *International Journal of Business Research*, 7(6), 57–66.
26. Neely A. (2005). The evolution of performance measurement research. Developments in the last decade and a research agenda for the next. *International Journal of Operations and Production Management*, 25(12), 1264–1277.
27. Shepherd C, Gunter H. (2006). Measuring supply chain performance: current research and future directions. *International Journal of Productivity and Performance Management*, 55(3/4), 242–258.
28. Tangen S. (2005). Analysing the requirements of performance measurement systems. *Measuring Businness Excellence*, 9(4), 46–54.

Mind the Map: The Role of Shared Awareness in Effective User-Centered Design

C. Calefato[1], R. Montanari[2], and F. Tesauri[3]

Abstract This paper is focused on the importance of collaboration during the parallel phases of a design process. A User Centered Design (UCD) chain is usually led jointly by interaction designers and software developers teams. In order to make this chain efficient and effective, both teams must share a common view of the project, allowing to keep parallel processes, aware of each other's needs and aims. A study is reported here, aimed at pointing out stages and features that can reinforce and improve the effectiveness of groups of designers coming from different backgrounds at work. The objective was to apply UCD in a critical way, in order to give to some concepts a more precise meaning and to increase its power.

Introduction

This paper describes the importance of the *shared situation awareness* in a team design process following UCD principles. To obtain an effective UCD chain it is important to harmonize the collaboration between graphic designers who realise the Human Machine Interface (HMI) layout and engineers who develop the artefact functions. The importance of this collaborative approach is described through a practical experience. A workshop was set up with students of the University of Turin (Italy), aimed at verifying which are the minimum requirements for sharing goals, results, questions, ability, developments proper of a design process involving teams that focus on different components of the same project (e.g. graphic designers and software developers). The primary aim of the workshop was to define in which way time employed in information negotiation among groups could be limited, thus improving the overall design process.

[1] Università di Torino, Torino, Italy, caterina.calefato@di.unito.it
[2] Università di Modena Reggio Emilia, Reggio Emilia, Italy, roberto.montanari@unimore.it
[3] Università di Modena Reggio Emilia, Reggio Emilia, Italy, francesco.tesauri@unimore.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_57, © Springer Physica-Verlag Berlin Heidelberg 2010

Background: Basic Definitions of the UCD Methodology

The standards and the literature give the definition of UCD practices from different viewpoints.

The standards focus on the quality of the final product, that is on usability. For instance, product usability is defined in ISO 9241 [1], while ISO 13407 [2] describes how to apply a human-centred design process to make systems usable. Finally, ISO 13407 specifies the steps to be followed to develop an interactive system, but it does not demand nor recommend particular techniques or methods [3].

UCD literature focuses on the way to obtain usability. Several authors, e.g. Norman [4, 5], propose practises, methodologies and heuristics. Citing [4]: *User-centred design emphasizes that the purpose of the system is to serve the user, not to use a specific technology, not to be an elegant piece of programming. The needs of the users should dominate the design of the interface, and the needs of the interface should dominate the design of the rest of the system*.

Findings from several studies, e.g. [6], showed that effective involvement in system design yields the following benefits:

1. Improved quality of the system arising from more accurate user requirements.
2. Avoided costly system features that the user did not want or cannot use.
3. Improved levels of acceptance of the system.
4. Greater understanding of the system by the user resulting in more effective use.
5. Increased participation in decision-making in the organization [7].

The starting point of the UCD design approach can be summed up by three steps [8]:

1. To define the problem space;
2. To analyze good and poor performance;
3. To trace the information processing flow.

Once the user context has been defined, the early design can start. From the early design specifications a prototype is built and user test are leaded [9]. Finally the user documentation is produced.

What is missing in most part of the UCD literature are indications to organize the work among design teams, overall among designers who face different aspects of the same development process. In this paper we focus on the so-called shared Situation Awareness SA, also known as team SA [10].

The Workshop

The objective of the workshop was to realize the HMI and the functions of an indoor navigator. After a little explanation about the use of indoor navigators, participants were split into two groups: the HMI group and the functions group. The former had to draw the HMI graphic and behaviour, realising a low-fidelity prototype. The latter had to decide the functions the navigator had to implement and describe the menu system they attended to. Groups shared only the general purpose of their project; after that, they worked separately, without interactions. We expected to detect gaps in information and coordination which would affect the overall design output.

Indoor Navigator Project Description

It is a common experience to visit a museum searching for a particular piece of art and to not find any sign that points you to the desired object. You try to ask a museum attendant for help but you receive only a long and complicated sequence of directions. Also using a map of the museum could be frustrating: it could be difficult to locate yourself on the map and the landmarks surrounding you could not seem to correspond to those indicated on the map [11].

This is the typical scenario that could happen whenever people try to find a particular place, person, or object in an unfamiliar or complex environment.

Starting from the depicted scenario students worked on the design of an indoor real time navigator that navigates users towards a sequence of evolving directions pointing to the desired destination. A navigation compass is not only. The technological assumptions the students worked with were:

- Handheld devices.
- Location sensing technologies, allowing powerful handheld computing devices pinpoint the physical position [12, 13, 14] and orientation [15] of mobile devices with respect to a predefined coordinate system.
- A suitable map of the surrounding environment.

Graphic Design of the HMI

The graphic layout is similar to that one of a mobile phone, in order to suit the user habit in handling this kind of device. The design is based on the commands of a common portable device: a back and confirm button on the top below the screen, four directional arrows between the buttons and an alphanumeric keyboard.

The home page is composed of five areas:

1. The header, containing static information (event logo, date and hour, location name).
2. The tabs area, showing the navigations topics and functions.
3. A search area.
4. A menu on the left showing the items belonging to the selected section (the tab).

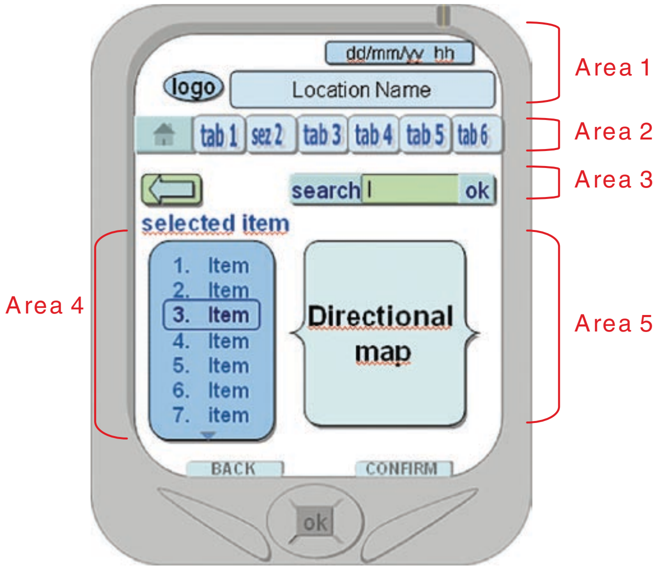


Fig. 1 First HMI concept for the indoor navigator

5. A directional and interactive map of the location on the right side of the screen.

In Fig. 1. the structure of almost all pages of the navigator is shown below.

The Menu Design

The functions group had accomplished a task analysis and a function allocation [16] in order to design the navigator menu system. The starting point is the user mental model and his/her expectations [14] about the menu system functioning. The user mental model is composed by four phases:

1. Searching an information.
2. Understanding the proposed alternatives (from the menu items).
3. Doing a choice.
4. Waiting for an appropriate answer from the system.

In order to respect UCD principles, the group was asked to maintain consistent:

- The navigator content with the user expectations.
- The user conceptual relationship among items and the menu system organisation decided by designers.

The design of the system menu continues with a top-down functions clusterisation. The allocation of function is performed identifying categories and subcategories. At the end of the process a function tree of the navigator is obtained. In the following we report the starting items of the tree:

1. **New destination**

    1.1. Insert name

        1.1.1. Confirm destination

    1.2. Select from a list

        1.2.1. Confirm

At the same level of the tree, we find the task alternatives.

Heuristic Evaluation and Re-design

Once the two groups had finished their work, they were involved in a mutual heuristic evaluation of their projects. Only in this moment they saw the other group's work and share information, doubts and solutions in the discussion that followed the heuristic evaluation.

A heuristic analysis is an inspecting method that concurs to diagnose the main usability problems of a system interface without involving the final user. It is a judgment expressed by usability experts on the ability of an interface to adhere to a series of usability principles (heuristics) [17].

In our experiment, each group was aware of its proper difficulties and patterns, so each one founded easier the drawbacks of the other group's project and the points that didn't fit well with the other elements of the project.

After this discussions some evidences came up: firstly, the HMI group found difficult to fit the system menu instead of the functions group, as we expected. The possible explanation is that the initial information about the indoor navigator and the handheld device and their expected HMI were sufficient enough to let the functions group to accomplish a more logical and theoretical work: that is, the task analysis and the following menu system design. Secondly, the same information about the indoor navigator and the handheld device and their potential functions were not sufficient to allow graphics designer to draw a consistent and efficient HMI. More information has to be shared among teams to match the functions implementation of an artefact with its user interface.

Some of the most important observations about the inadequacy of the HMI are the following:

1. The HMI had a inadequate subdivision of the space dedicated to the functions assigned to the navigator. There were too many blanks between areas and some decoration elements reduced an already restricted space.
2. The HMI had a poor consistency [4]: the navigation modality of the pages changed in relation with the selected functions. Submenus were organized

vertically or horizontally, changing the interaction model for the user and reducing the adherence to the general menu system.
3. There were no indication about the interaction modality with the directional map.

These observations were translated into a re-design of the HMI. With reference to the first solution (Fig. 1), the major modifications are listed below:

1. Available space optimization: the screen had been split in five horizontal areas:
   (a) Header
   (b) Global navigation area
   (c) Search and back area
   (d) Secondary navigation area (for the items belonging to the function selected in the global navigation area)
   (e) A wider area for the directional map
2. HMI consistency improvement: a common navigation model for each page and function
3. Each sub menu is organized horizontally
4. Graphic affordances are applied (e.g. the underlining of the cursor position
5. Usability improvement of the interaction modality with the map (Fig. 2).

Participants' Comments and Impressions

Participants declared that the most interesting aspect of the workshop was the experience of a team design process they picked up. The heuristic evaluation of the work let people to be designer and evaluator in the same project, allowing discussions aiming at solving problems together. This is an empiric proof of the need to involve all teams in a general collaboration in each aspect of the project.

In fact, students noticed that difficulties arose about the integration of the menu system and the interface, because the first one was based on conceptual considerations and the second one on aesthetic and graphic features, without any feedback from a side to the other. Despite of this, a solution for this divergence came up from the collaboration filled by the groups in the heuristic evaluation.

Conclusions and Future Work

Shared Situation Awareness (SA) is defined as the degree to which team members have the same awareness of information requirements for team performance.

This work aims at demonstrating through a practical experience which benefits a shared situation awareness approach could induce in the design phase of a user-oriented system developed following a UCD approach.

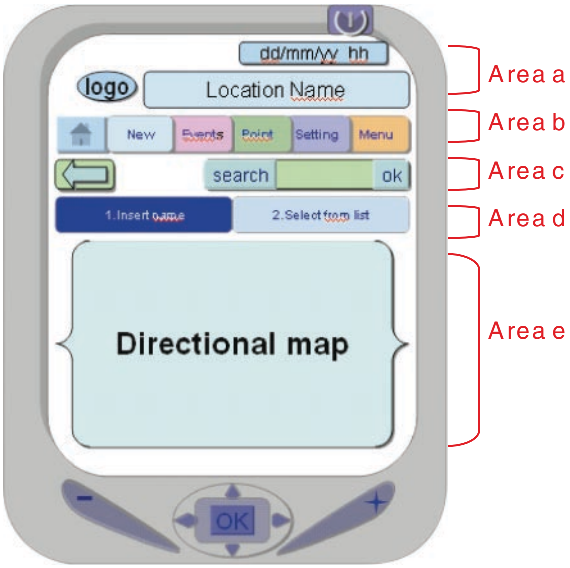


Fig. 2 The HMI concept after the heuristic evaluation

The design of such a system usually involves team members with different backgrounds, from engineers to ergonomists; even if they conduct different activities, they are involved in a common overall project.

In the experiment we carried out, each team was not aware about the outcomes of the other until the heuristic evaluation phase; then, the lack of shared information among members moved the highlight of inconsistencies and design errors at the end of the design process, where the design cost changes, in terms of times and money, are higher.

By introducing a shared SA design issues could be avoided before the final evaluation of the system (then saving design change costs and time), thanks to a harmonized communication among involved members, where only relevant requirements are overlapped in order to reduce awareness gaps and to conduct coordinated actions.

A shared situation awareness approach, in fact, allows each team to be aware of what the other teams are carrying out, then avoiding possible uncoordinated behaviour in the development of the final system.

This approach requires to define which information each team should share and in which way, according to the skills of the other teams and to the information considered relevant for a coordinate completion of the design process.

In further steps of this activity we will repeat the same experiment by involving two teams, one following a shared situation awareness approach and the other one without a pre-assigned situation awareness strategy. It is expected that the latter, due to the lack of cooperation and shared requirements among team members, will point out more design issues than the former in the evaluation phase.

References

1. ISO 9241-11 Ergonomic requirements for office work with visual display terminals (VDT)s – Part 11 Guidance on usability (1998).
2. ISO 13407 Human centred design processes for interactive systems (1999).
3. Bevan, C.: Planning and Implementing User-Centred Design, *CHI'99 Adjunct Proceedings*, Pittsburgh, 15–20 May 1999. ACM (1999).
4. Nielsen, J.: Designing Web Usability: The Practice of Simplicity, New Riders Publishing, Indianapolis (2000).
5. Norman, D. A.: Cognitive engineering. In D. A. Norman and S. W. Draper (eds) (1986).
6. Priyantha, N., Miu, A., Balakrishnan, H. and S. Teller. The Cricket Compass for Context-Aware Mobile Applications. *In Proceedings of 7th ACM MOBICOM Conf., Rome, Italy*, July (2001).
7. Damodaran L.: User involvement in the systems design process - a practical guide for users. In: *Behaviour & Information Technology*, 1996, VOL. 15, NO. 6, 363–377 (1996).
8. Robey, D. and Farrow, D.: User involvement in information systems development: a conflict model and empirical test, *Management Sciences*, 28, 73–85 (1982).
9. Gulliksen, J., Göransson, B., Boivie, I., Blomkvist, S., Persson J., and Cajander, Å.: Key principles for user-centred systems design. In: *Behaviour & Information Technology, November–December 2003*, VOL. 22, NO. 6, 397–409 (2003).
10. Kaber, D. B., Riley, J. M., Tan, K., Endsley, M. R.: On the Design of Adaptive Automation for Complex Systems. In: *International Journal of Cognitive Ergonomics, 5(1)*, Lawrence Erlbaum Associates, Inc. Centered Systems Design (Hillsdale, NJ: Lawrence Erlbaum Associates Inc.) (2001).
11. Miu, A. K. L.: Design and Implementation of an Indoor Mobile Navigation System, Master's thesis, Massachusetts Institute of Technology, Jan. (2002).
12. Bahl, P. and Padmanabhan, V. N.: RADAR: An In-Building RF based User Location and Tracking System. *In: Proceedings of IEEE INFOCOM 2000, Tel-Aviv, Israel, March (2000).*
13. Harter, A. and Hopper, A.: A New Location Technique for the Active Office. *In: IEEE Personal Communications, 4(5)*, 43–47, October (1997).
14. Norman D. A.: The Psychology of Everyday Things, Basic Books, Publishers, New York (1988).
15. Priyantha, N., Chakraborty, A. and Balakrishnan, H.: The Cricket Location-Support System. *In Proceedings of 6th ACM MOBICOM Conf., Boston, MA*, August (2000).
16. Harrison M., Wright, P.: Allocation of function: scenarios, context and the economics of effort, *Int. J. Human-Computer Studies* 52, 289–318 (2000).
17. Nielsen, J., and Molich, R. (1990). Heuristic evaluation of user interfaces, *Proceedings of ACM CHI'90 Conf. (Seattle, WA, 1-5 April)*, 249–256.

Network Outcome as Trigger for the Evolution of a Design Network: Coordination Processes Between Actors and Objects

F. Bolici[1,2] **and F. Virili**[3]

Abstract This paper sets the basis for a research project focused on collaborative social network's genesis and dynamics. It introduces a research framework for the empirical investigation of a network focused on the design of a shared artifact, the so-called "Web services architecture." Our hypothesis is that network artifact's characteristics, seen as the final outcome of a collaborative process, influence and drive the genesis and the structure of the social network that is designing it. We embraced this view in order to avoid a limitation of the traditional perspectives that consider the network structure as exogenous and stable. Instead, in our perspective, we consider the reciprocal influence between the artifact and the social network structure, with a phase in which the desired artifact may shape the network genesis and a phase in which the emergent network's structure may drive the artifact design.

Introduction

This paper sets the basis for a research project focused on collaborative social network's genesis and dynamics. This work aims at the empirical investigation of a network collaborating in the design of a shared artifact, the so-called "Web services architecture" (WSA).

We named "design networks" those social networks that exist in order to design an artifact, like technical standard or open source software. We are interested in verifying whether the characteristics of the network artifact, seen as the final outcome of a collaborative process, may influence the genesis and the structure of the design network that is producing it. The traditional causal relationship between network structure (often seen as the independent variable) and network outcome (often seen as dependent

[1]Università degli Studi di Cassino, Cassino (NA), francesco.bolici@eco.unicas.it
[2]Syracuse University, Syracuse, NY, USA
[3]Università degli Studi di Cassino, Cassino (NA), francesco.virili@eco.unicas.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_10, © Springer Physica-Verlag Berlin Heidelberg 2010

variable) may be reversed in design networks: in our case, the (desired) characteristics of the artifact (WSA) may influence the genesis, the structure and the activities of the collaborative network. We therefore hypothesize that one important factor in the genesis of a design network is its fit with the designed outcome (i.e. the network artifact).

The network artifact that we have investigated is the WSA, a rapidly emerging standard architecture recently defined by the W3C standardization consortium for distributed componentized software applications over the Web [1]. The WSA is a set of guidelines enabling any system to remotely access and use software components as "Web services." The "Web services" concept is a relevant innovation, attracting significant investments in the software industry. The use of the Web services makes it possible to assemble a software application with several independent parts (software components), each accessible over the Web. Using Web services, programmers can compose a "virtual" software application like a puzzle, by accessing the different pieces (Web services) over the Web, independently of their physical location. In principle, many different (and incompatible) implementations of Web services may be possible: standardized architectural guidelines are therefore crucial to ensure true compatibility and interoperability of systems based on Web services by different vendors.

Within the W3C consortium, more than 40 different companies all over the world collaborated for a 2 year period toward the definition of this artifact, with weekly teleconference meetings, mailing lists and conferences. The company experts collaborated not only to harmonize different technical specifications, but also to actually face difficult technical issues including not only compatibility, but also security, privacy and reliability of the overall system. The entire standardization process is therefore in the same time a negotiation process (aiming at finding a common definition) and a design process (aiming at solving complex technical issues and devising innovative use scenarios).

With the help of social network analysis techniques and tools, we are here interested in exploring the complex web of network relationships between the actors during negotiation and design of the artifact "WSA." More specifically, we are interested in verifying whether the characteristics of the final outcome of the collaborative process, may actually influence the structure of the network that is producing it.

In comparison with the mainstream literature on social network analysis, this study has two main peculiarities: (1) it is focused on design networks, i.e. social networks aimed at the production of an artifact like open source software or standard technical specifications; (2) it is investigating the influence that the network outcome could have on the network genesis and structure (and not only the opposite relationship as traditionally analyzed by literature).

Theoretical Background and Contribution

Traditional social network analysis (SNA) was originated in Social Psychology, and then applied to several different fields and levels of analysis, including for example inter-firm relationships, using categories and concepts like centrality, structural equivalence and clique analysis [2]. Typically, SNA investigates how the characteristics and the structure of the network may influence the organizational or economic outcomes. For example, some organizational studies discuss the role of relationships in generating innovation [3] and competitive advantage in markets [4]; others focus on the influence of social networks on knowledge creators and spreaders [5]. In Granovetter's works [6,7] a thorough analysis is proposed on social networks, and why and how they may influence economic outcomes like hiring, prices, productivity and innovation. The same interest emerges from several economic studies, both theoretical, like [8] and [9], and empirical, like [10], showing the effects of social networks on employment and wage inequality or [11], discussing the role of social and economic networks in international trade. We recognize that the traditional perspective "network structure drives outcome" is crucial for the understanding of the network relevance and effects, but we also suggest that – particularly in design networks – the outcome itself (i.e. the artifact) may play a key role for the emergence and the genesis of the network structure of a successful collaborative project.

The debate about the endogenous or exogenous nature of the changes in the structural network's characteristics is still open. The attention of the researchers have been captured by the intangible aspect of the relationships between nodes and had not investigated any influence that the object itself, often only considered as the results of the network activities, could have on the network dynamics. Instead, our perspective, though recognizing the influence of the network structure on the outcomes, is based on the idea that the network artifact can influence the network genesis and dynamics, especially for creative design activities. This approach not only aims at throwing new light on antecedents of social network emergence and dynamics [12–15]; it is also an answer to a call for more research focusing on IT artifacts and on their direct influence on organizational processes [16].

In order to give a contribution to this emergent research area, we will address the following research question: does the desired outcome of a specific design project (i.e. the artifact) influence the genesis and the structural characteristics of the network? In particular, we are asking: how do the characteristics of the artifact influence the design process? How do they eventually shape the actors positions, roles and relationships in the network? Answering to these questions would mean not only showing how the artifact could shape network structure and dynamics, but also covering some ground towards, showing how the artifact itself may play a crucial and central role in the overall coordination of the design process.

The contribution of this paper is thus twofold: it shows the role of the working standard definitions (the social network outcome) in influencing the genesis and structure of a design network; it sets an empirical ground for further analysis of artifact-centered coordination processes in design networks.

Methodological Set-Up

In the W3C consortium, there is an "activity" for each technology being standardized. For each activity there may be several workings groups, each one focused on the production of a technical specification. Our analysis is focused on the WSA Working

Group, which has the objective to define the technical specifications of a standard architecture for the Web services activity. Every working group has one or two leaders. There are two modalities of interaction: mailing list or group meetings – they can be either face to face (F2F) or distributed (technology mediated). The charter document specifies that "to be effective every working group should have from 10 to 15 active participants." The F2F meetings don't have a predetermined frequency; they are settled by the group leader according to the matters to be treated, to the deadlines and the opportunities of co-location of side events (e.g. conferences, other W3C meetings). The distributed meetings are scheduled at least once a week (twice when required by the deadlines). The participation to the F2F meetings is limited, on invitation of the group leader. Guests or external experts may be occasionally invited.

Data Set Description

All these forms of discussion and negotiation (mailing list, F2F meetings and teleconferences) are recorded, and the scripts are publicly accessible via the working group Web site. This collection of documents, integrated with external information sources like specialized press articles and news, has been the data source for our analysis.

The available data sources for the WSA activity are: deliverables, meeting records, mailing lists and the external sources (like technical magazines and newspapers). The published deliverables include: the WS Architecture and the supporting documents (requirements, glossary, usage scenarios, service life cycle, and ontology). For each document all the previously published releases are accessible, together with the list of the modification intervened. For example, the first official version of the WSA was published in November 2002, followed by two major updates in May 2003 and February 2004. The editor copies are also available: the first editor copy of the WSA is dated June 2002, and was followed by updates in August 2002, March 2003 and July 2003. There are about fifty meeting records per year (on average the meetings were held once a week); they are usually written or edited by a scriber nominated for each session. The working group mailing list, during the period from February 2002 to February 2004 (25 months), collected 6,895 messages, with an average of about 276 messages per month. The two "hottest" months were July 2002 (546 messages) and January 2003 (516 messages); the "coldest" were November and December 2003 (32 and 86 messages, respectively). Moreover, the working group created two temporary task forces that produced proposals on specific issues. The Management task forces produced four deliverables; the Security task force produced one deliverable. The task forces mailing lists are also available for consultation.

Exploratory Data Analysis

The strategy for initial data analysis was the following: (1) selection of an appropriate data sample for text analysis; (2) exploratory analysis of the relationship network-artifact, based on initial text labeling.

Sampling. The document sample initially selected for this preliminary analysis, was formed by the weekly teleconference scripts for the first year of activity of the working group. It is about 45 scripts, dating from February to December 2002, representing about half of the whole standardization period, focusing on the initial phases design giving birth to the first four drafts of the standard architecture. At the end of this year the standard was already at an advanced stage of design.

Labelling and first exploration. The very first information we looked for was about text size and text authorship for the discussions documented in the scripts. To this aim we had to label more than 4.500 text passages, assigning an author name to each of them. The textual labelling was done with the software "NVivo" version 2.0 [17].

Text size can be measured as number of text passages, or as number of characters, words, etc. The distribution along time of text sizes, measured as number of text passages is shown in Fig. 1.

The graph illustrates the evolution over time of the textual discussion reported in the scripts of the weekly teleconferences and of the four face to face (F2F) workshops in April, June, September and November. The four peaks of the F2F meetings are due not only to the higher number of participants, but also to the length of the conferences (2–3 days of a F2F conference against 1–2 h of a teleconference). Moreover, considering the distribution of the authorship in the sample data set, grouped per company, it is quite evident that some companies (and some subject) like Sun (26% of total communication) or WW Grainger (11%), participated in the process much more intensively than others, like Oracle (4%) or Chevron (5%).

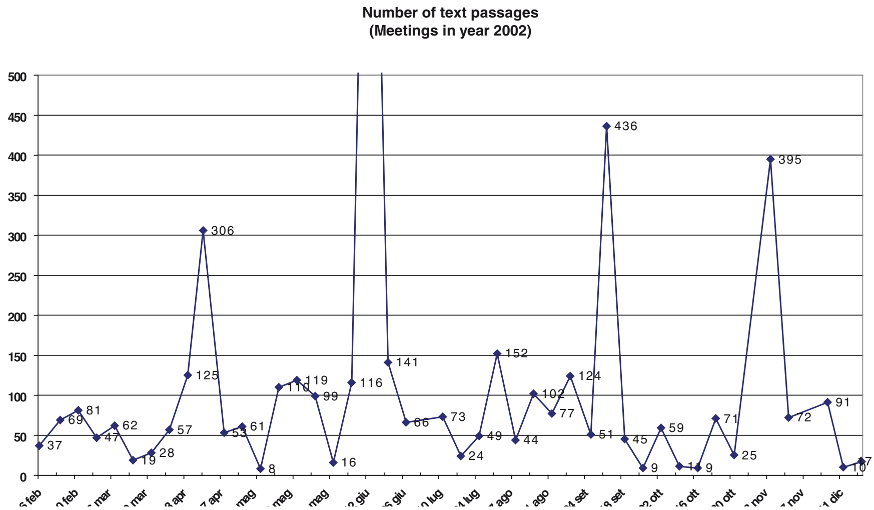


Fig. 1 Number of text passages for weekly teleconferences and face to face (F2F) workshops in year 2002

Strategy and Issues for Further Analysis

Author-based text labeling is useful to give an overall picture of the data set. The subsequent steps would be: (1) drawing the social network; (2) exploring the relationship between the social network structure and the characteristics of the artifact. Both these steps present crucial methodological issue to be faced.

Social network analysis is often based on detecting and representing the number of direct communications (links) between actors (nodes). However, in our research domain, also the simple task of defining and representing direct communication presents intriguing problems. How do you consider a teleconference? Is it a discussion one-to-many or many-to-many? Is it enough to take part at the meeting to be considered a node of the network (the actor is supposed to receive the communication coming from the others) or the actor should be active? A discussion is often triggered by the intervention of one actor, with responses by one or several actors that may not be immediately and automatically connected to the original one. Methodologies for automatic detection of the network are under study; the alternative option would be to manually trace down the flux of conversation for selected episodes that, as we have seen, presents still intriguing problems.

Another relevant empirical issue is how to investigate the relationship between the characteristics of the artifact to the structure of the network. Which characteristics might be relevant? How to detect and measure them? To start the exploration we decided to classify the artifact (the WSA) according to its main separate components, one for each separate deliverable. We consider different sub-outcomes: (a) the architectural document; (b) the use cases, (c) the glossary, (d) the architectural requirements.

Within each of these parts of the WSA artifact, we classified some subcomponents and the related activities, labeled by using Grounded Theory Analysis of the available scripts.

A first step would be to investigate the differences and similarities on network structures that emerge around each object. We may expect to identify differences in the network structures according to differences in the designed outcome/artifact. At the mean time we should notice a similar network structure for those objects that present similar characteristics.

Data analysis and Discussion

The WSA case consists in a network of actors (116 persons belonging to 46 companies) collaborating for the design of the Web service Architecture standard in the W3C environment. According to our hypothesis we expect that different networks will emerge according to the specific characteristics of the (sub)artifact that they aim to develop.

In the WSA case, the general network of actors designing the new standard is decomposed in several sub-networks, each one working on a specific part of the

Artifact/Actor	3	5	8	11	13	16	17	18	19	21	22	30	32	33	41	43	51
A	7	0	10	10	23	1	20	0	3	13	3	0	0	0	1	0	21
B	45	14	8	3	0	38	11	0	0	0	0	0	1	0	0	13	12
C	18	0	4	6	7	9	12	0	7	18	6	0	0	0	10	3	22
D	2	0	6	1	3	57	3	4	0	0	0	1	13	0	0	1	7
E	27	2	3	2	10	8	8	0	0	9	0	0	20	17	0	1	0

Fig. 2 Communication matrix

artifact (i.e. architectural document, use cases, glossary, architectural requirements). We expect that similar artifacts will drive the emergence of similar network (both in its genesis and structure) and that objects that strongly differ for their characteristics will lead to different network dynamics.

A preliminary overview of the web service example shows that the most active artifacts (those with a high number of communications between actors) present different network structure. We are able to report at this stage an exploratory matrix, accounting for the number of text passages attributed to each actor and relative to a specific category (Fig. 2). We select the first five artifacts for number of communications: artifact A (architectural document; 164 messages); B (goal requirements; 160); C (architectural document; 147); D (goal requirements; 119); E (architectural document; 115).

The artifact rows with similar characteristics (A, C, E and on the other side B and D) have been highlighted with different colors. Actor #16 was very active for the artifacts B (28% of all the communication about the artifact) and D (48%) but he was less active for the other artifact (only 15% of his communication has focused on artifact A, C and E). Artifacts B and D seem to be driven by the activity of few persons compared with artifacts A, C and E. In details, if we consider the amount of communication between the most active actor for every artifact we have that they represent the 26% for A; 51% for B; 27% for C; 59% for D and 40% for E. So, the communication for artifacts B and D result to be much more concentrated than for the others.

Summing up the contribution, we can consider this paper as a first attempt to analyze a well known phenomenon (social networks) from a different perspective. We embraced this challenging path in order to avoid a limitation of the traditional perspectives that consider the network structure as exogenous and stable. Instead, in our perspective, we consider the reciprocal influence between the artifact and the social network structure, with a phase in which the desired artifact may shape the network genesis and a phase in which the emergent network's structure may drive the artifact design. These two phases may be iterative along a collaborative project life. Further investigation may uncover relevant patterns and factors of the process, advancing our knowledge of design networks and contributing to new methods and perspectives in social network analysis.

References

1. Alonso, G., Kuno, H., Machiraju, V., and Casati, F. (2003) *Web Services: Concepts, Architectures and Applications* , Springer.
2. Grandori, A., and Soda, G.(1995) Inter-firm Networks: Antecedents, Mechanisms and Forms, *Organization Studies* (16:2), 1995: 183
3. Ahuja, G. (2000) Collaboration Networks, Structural Holes, and Innovation: A Longitudinal Study, *Administrative Science Quarterly* (45:3): 425–455
4. Gulati, R., Nohria, N., and Zaheer, A. (2000) Strategic networks, *Strategic Management Journal* (21): 203–215.
5. Singh, J. (2005) Collaborative Networks as Determinants of Knowledge Diffusion Patterns, *Management Science* (51:5): 556–570.
6. Granovetter, M.S. (1973) The Strength of Weak Ties, *American Journal of Sociology* 78(6): 1360.
7. Granovetter, M. (2005) The Impact of Social Structure on Economic Outcomes, *Journal of Economic Perspectives* 19(1): 33–50.
8. Rees, A. (1966) Information Networks in Labor Markets, *The American Economic Review* 56(1/2): 559–566.
9. Montgomery, J.D. (1991) Social Networks and Labor-Market Outcomes: Toward an Economic Analysis. *The American Economic Review* 81(5): 1408–1418.
10. Calvo-Armengol, A., and Jackson, M.O. (2004) The Effects of Social Networks on Employment and Inequality, *American Economic Review* 94(3):426–454.
11. Rauch, J.E. (2001) Business and Social Networks in International Trade, *Journal of Economic Literature* 39(4): 1177–1203.
12. Carugati, A.e F. Bolici (2006) Knowledge Creation as an ISD Goal: an Approach Based on Communities of Practice, *ECIS'06 (European Conference on Information Systems)*, Göteborg, 12–14 Giugno.
13. Bolici, F. (2007) Coordinamento e Apprendimento Organizzativo. Gestione delle interdipendenze in domini ad elevata complessità cognitiva, ARACNE, Roma.
14. Virili, F. (2008) *Come NASCE UNO STANDARD – IL MERCATO DELLE REGOLE*, McGraw-Hill, Milano.
15. Virili, F. (2003) Design, Sense-Making And Negotiation Activities In The "Web Services" Standardization Process, *MIS Quarterly Special Issue Workshop on Standard Making.*, Seattle (USA).
16. Orlikowski, W. and C. Iacono (2001) Desperately Seeking the "IT" in IT Research – A Call to Theorizing the IT Artifact, *Information Systems Research* 12(2): 121–134.
17. Gibbs, G.R. (2002) *Qualitative Data Analysis: Explorations with NVivo*. Buckingham: Open University Press.

Operations Strategy of Small Software Firms Using Open Source Software

B. Glatt[1], A. Sillitti[2], and G. Succi[3]

Abstract Open Source software is becoming very common in many business activities. In particular, the software development sector can take advantage from this development model and modifying the way software is produced and commercialized. The worldwide rising interest in Open Source is pushing companies to use and produce it. Some companies have to use it because the market requires it; others invest in this sector because they perceive it as a potential profitable area. Therefore, even with a free exchange of source code and/or the free availability of a program on the web, a company has the possibility to compete in the market and make money. With the growth of Open Source, market niches came up, new strategic areas have been found and new business models are emerging. Such models are creating new possibilities to offer products and services to customers, thus to generate revenue. We conducted an empirical study to investigate the current situation related to Open Source in 14 small software companies. The main research question was how much the Open Source model has been applied inside a company and how they behave in their market.

Introduction

To analyze the firms' current situations a questionnaire has been designed. Its objective was to find out relevant data about a company related to Open Source software. A reason to keep software closed source is to sell it, however 95% of the software produced within a company is not intended for sale [1]. We wanted to know if there are companies that release their source code and why they do it. The difficulties of Open Source business models are in the generation of direct sale values [2]. There must be other reasons than the simple availability of source code to offer Open Software, for example the positive collaboration with the Community.

Beside the development sector, the usage of Open Source is relevant. Getting some information about the installed applications let us understand their advantages

[1] Libera Università di Bolzano, Bolzano, Italy, bernhard.glatt@unibz.it
[2] Libera Università di Bolzano, Bolzano, Italy, alberto.sillitti@unibz.it
[3] Libera Università di Bolzano, Bolzano, Italy, giancarlo.succi@unibz.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_14, © Springer Physica-Verlag Berlin Heidelberg 2010

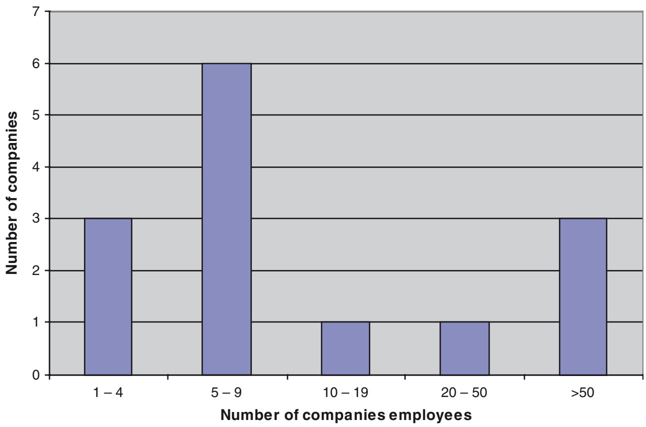


Fig. 1 Investigated companies and their respective number of employees

and disadvantages. In addition, the services provided and the effort spent for training the developers provide further information about the business model of the firms.

We choose small software firms for our analysis since they are the majority of the European industry. Nine of 14 investigated companies have less than ten employees, only two firms are in the range of 10–50, and three companies have more than 50 people (Fig. 1).

Structure of the Investigation

The study reveals which is the role Open Source in the firm daily activities. On one side we investigated the usage of software in the company including the products used for internal activities, the ones used for development, and their opinion about Open Source. On the other side we investigated the development activities including the applied techniques, the Open Source projects carried on and the related licenses. Furthermore, we investigated the cooperation and usefulness of the community and their business models.

The questions focused on personnel and process analysis. 14 companies have been chosen, mainly from the software development sector. Figure 2 provides an overview about the amount of time a company is working with Open Source. More than half of them started before the year 2000, which indicates a certain experience in the sector. The interviews have been held with managers of each company.

The Questionnaire

Most questions are open to give the possibility for short and precise answers. Three ranges could be filled, namely personnel, the analysis of one specific product, and the general processes within a firm.

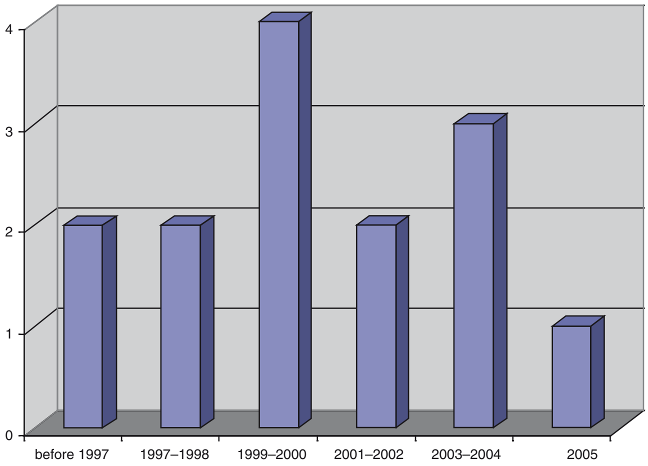


Fig. 2 Number of companies related to the year they started working with open source software

In the first part, we asked for education, training, experience and qualification of a company's software developer.

The second part analyzes the largest project they have related to Open Source. The collected data focus on the development effort, the collaboration with the Open Source community, the applied licenses and the services that are offered on top of that software.

The collected information is used to analyze the firm activities which are reviewed in the third part. It contains mainly process analyses, basically the costs for personnel, software, hardware and training, again a general analysis of the community, and a part about the earnings and investments of the firm. Moreover, we collected data about their market with a classification of the existing customers and competitors, and possible market niches.

The original version of the questionnaire got some updates to improve the possibility to give specific answers. These answers were written down in digital format and sent back to the companies. After a positive confirmation the data was used for the elaboration.

Results Analysis

Personnel

In this section a collection of information about the developers took place. While in very small companies (with less than ten employees) frequently half of them develop or work with Open Source software, in larger companies less people work in this area. Later in the analysis we found out that often for small firms Open Source is the main business, while bigger companies use it as an additional leverage.

The education levels of the developers are very wide. In some case, people with a completely different background have attended some short courses to be able to work in the software development area. Especially the Java programming language is very interesting for many of them. However, 85% of the managers explained that the best training is the development itself. The costs for training depend on the size of the company and vary from 2,000 Euro to 80,000 Euro per year. Figure 3 shows the number of firms able to estimate their costs and relate them to a segment.

The costs include the most used training material like magazines or the web. Three companies organize periodical meetings with external consultants. Far behind are visits at exhibitions or planned training courses.

Software Development

The core part of the investigation has been the internal process analysis of each company.

Everyone has different motivations for using or not Open Source software for development. The main ones are characterized by the unrestricted visibility of the source code, the possibility to reuse packages and components, and the possibility of entering a market with limited initial capital (particularly interesting for small companies).

For example, four companies could use an existing Open Source project, integrate and add their new functionalities to publish a new product. An interesting example is the company whose program is based on 99% of packages from the web and the remaining 1% of effort they had to spend was to combine these components together to build the full product. This product is their core business. The

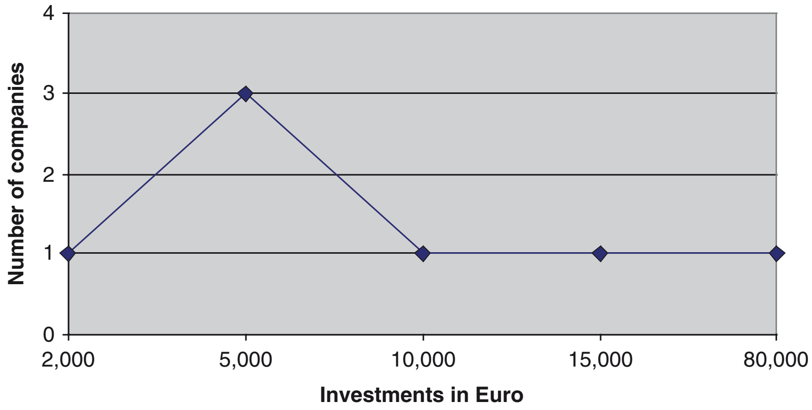


Fig. 3 Number of companies related to the sum of investments for training over 1 year

advantages now seem obvious: less development effort reduces times and costs, and the customer can take advantages of it.

One director explains that 10 years ago the investments to start a business have been much higher than they are today with Open Source.

However, also negative aspects have been enumerated. The documentation of projects is often badly structured and difficult to understand. Workstations with Linux as desktop operating system are not widely used, since users experience different kinds of difficulties. Moreover, difficulties arise also when a company tries to get help from the Community to enhance their product. There is an additional effort behind to succeed.

Four companies of the 14 are using Linux (Fedora or Ubuntu) on their personal computers, while the others work with Microsoft Windows. However, the tools used for developing are very similar and mostly Open Source. There is no business that works without Open Source software. The 4 Linux firms basically use only Open Source software and only if no other possibilities are available, a proprietary application is used. In general, when a program is chosen, the needed functionality, the efficiency, and the simplicity of use are the most important factors. The costs do not enter as a big coefficient, it is sufficient when a good cost/performance factor is reached. The point that no one searches specifically for Open Source software but at the end many times chooses this kind of tools indicates a positive standing of Open Source. Every second company uses Linux for their servers, which highlights the trust in Open Source. One manager summarizes this part with the following phrase: “To cope with success, independence and productivity have to be coCbined.”

Open Source Community

The contact to the Open Source Community can appear in three different ways. Six companies explain that they do not have any relevant contact to the community and three of them produce Open Source software. One manager declares that their domain is too specific for the public, therefore he preferred to build a cluster with other companies for their product. Another firm has developed an internal management system, but it is strongly coupled with their business activities, therefore no open version and contact to the community exists. One firm has developed a small Open Source tool without public help, and the other three companies declare that they need the community only sometimes to find possible solutions.

Another group builds the companies that try to interact with the worldwide community people. These interactions basically consist in the exchange of information in forums, to give and get feedbacks or new ideas, or to report errors in programs. The managers consider these points as plus and about half of these five companies release projects as Open Source software. The only missing point for them is to active interaction from outside programmers, practically the exchange of source code for their programs. This is a big barrier that is not easy to pass. Some stated that it is not enough only to release a project, but you have to assist it at the beginning to spark the interest of the community.

In the foreground stand three companies which succeeded in this aspect.

One company gets regular updates and corrections for their project from a few people in the form of implemented source code. Another supervisor can even count on two or three external programmers that help him developing his software. He had difficulties at the beginning to inspire someone to help him, but with the right online-marketing he could succeed. Now the project has an official manager which coordinates the teamwork.

The third company had a great success with the community. Even after initial problems they released an old version of their proprietary application as Open Source. Today they have 50 people all over the world participate at this project. A moderator structures the online work, and the maintenance and updates of the program are done solely by the community. In conclusion, the company itself can now concentrate on new projects.

Why Open Source?

The answers to this question are rather different. Some companies look very convinced of this liberal software development model. They argue with the achievement of a full system with good quality, or the possibility to use technologies available only on the Open Source market.

There are companies that are satisfied with Open Source, and their ideology is the Open Source model, as well as companies that hope to succeed in the future when offering Open Source.

There are also firms that use Open Source software very much, but their own projects are not released under an open license. The explanation for this is that the user already is advantaged through the shorter development time and for him the license type does not matter, he wants just working software.

One manager states that in general with Open Source problems can be solved fast and without big costs. The money saved can be invested for internal know how.

Services Offered

In this section, five main points have been considered. Installations, consultancy and analysis, maintenance and support, schooling and courses as well as personalization are the services offered at the 14 companies.

Increasingly offered services are: maintenance and support (24%), training, courses and personalization (23%).

Fewer services are offered for installations and support and analysis with 15%.

The experiences of the companies indicate that schoolings are not used very much, while maintenance is required very often. In general, a rise of requests of services is observable. Customers wish software for their special requirements, and therefore personalization.

Strategic Position

Many of the companies that offer Open Source software act on the basis of a service-oriented model. The earning possibilities result from the personalization of existing Open Source solutions, the consultancy and maintenance function, as well as the assistance round the clock. These are the most wanted services from the customers, which coincide with the services offered from our firms. 80% of the analyzed firms use the service model.

Three of them try to fulfill all the requirements of their customers completely. It does not matter if a problem gets solved with or without Open Source software. The customer should know, that with every problem he has, company A can find a solution for him. And therefore with every problem he should come to that company A. To cope with success, providing a combination of services and development is a good way.

Great results are also achieved by another company using the so called “software model.” For their software, they offer two versions: a full version with all functionalities is sold under a closed license, while an old version gets released and is maintained by the Open Source community.

One company points on the “hardware model”: they offer their application as Open Source, but earn on the hardware that is sold with the program.

Another middle-sized firm, for which Open Source is only an additional range, produces marketing material of Open Source software to attract customers. Open Source can be used in many ways to add value to the work done for a customer, but it is also used for marketing purposes.

Three of the companies present international distribution of their services and products. Two of them have less than ten employees and are strongly coupled with Open Source, therefore release an open product for the market. The third is another middle-sized company, which uses Open Source, but in general sells proprietary applications. Subtracting three companies from the 14 which do not have selling activities, 55% of the firms offer their services on the local market, additional 27% sell within the national area, and 18% can name international customers.

Results Analysis

Figure 4 gives an overview about the company activities regarding Open Source software. The result unveils that three of four firms using Linux release Open Source projects, and five of ten firms using Windows offer an open application. Therefore, eight firms can demonstrate at least one developed Open Source program.

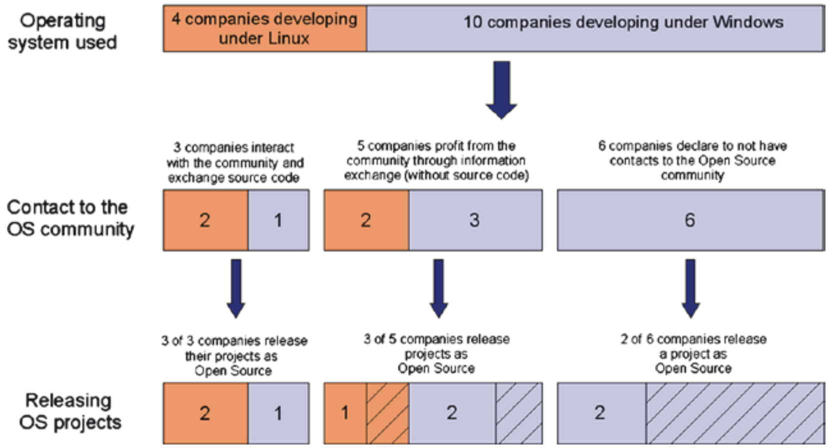


Fig. 4 Overview of the open source activities

The usage of Open Source software depends on a balance between advantages and disadvantages. Partly a firm's ideology or strategic standing takes influence on this decision.

A good reason to use Open Source software is the less needed starting capital to begin business activities. Dropping license costs is profitable, as well as the protection from the so called "vendor lock-in," where a change from one system to another is associated with high expenses.

The availability of free packages that can be included in own projects reduce the development times, and therefore the development costs for a company and the customer. The most requested jobs from customers are personalization and maintenance. Thus, to be successful when offering Open Source software the appliance of a service oriented model is advisable. The support through the Open Source community can go further than the simple utilization of free source code or the assistance in forums. But to take real advantages from it, at least some marketing effort and a project manager for the online coordination is needed for each project.

Even if the analysis base with 14 companies was slightly small, the information has been collected from directors and managers directly involved in Open Source business activities. The significance of this point let us understand the true situation of these small companies. The covered aspects illustrate the firm operational areas, and reveal perhaps interesting concepts for others.

Conclusions

This paper has presented an overview of the strategies of small companies using Open Source software. This preliminary research has pointed out the number of different approaches to Open Source even in small companies. However, a further investigation is needed to point out in a clearer way the relationship between such business models and the revenues generated.

References

1. L. Gläßer (2004). Open Source Software. Publicis Corporate Publishing, Netherlands
2. E.S. Raymond (1999). The Cathedral and the Bazaar. Oreilly & Associates, Sebastopol, CA
3. L.J. Krajewski, L.P. Ritzman (2002). Operations Management. Prentice Hall, Upper Saddle River, NJ
4. J. Feller, B. Fitzgerald (2002). Understanding Open Source Software Development. Addison-Wesley, London
5. G. Marbach (1996). Le Ricerche di Mercato. London, Chapman
6. J.M. Converse and S. Presser (1986). Handcrafting the Standardized Questionnaire. Newbury Park, CA: Sage Publications

Patterns of Technochange Management in ERP Multisite Implementations

A. Carugati[1], C. Gibson[2], and L. Mola[3]

Introduction and Theoretical Framework

Research and practices have focused on IT related project execution techniques for a long time and have produced very promising results in specifying methodologies for the inclusion and involvement of people and organizational factors into technical change processes. The methodologies that have had the biggest impact can be briefly resumed by the English born tradition of sociotechnical change (e.g. [1, 2]) and the Scandinavian born tradition in participatory design (e.g. [3]). Despite the extreme value in IT project management of these techniques – and their derivates – there continue to be severe problems in getting business results from pervasive IT-related "technochanges." Technochange [4] refers to big, technology-driven, technology-dependent change seeking significant strategic benefits and requiring significant organizational change. From the management point of view these projects differ from smaller scale ones for their strategic dimension expressed in a need for alignment between technical and organizational changes and need for coordination across multiple projects active at the same time. The feeling is that while sociotechnical and participatory techniques are apt to confined projects – this can be evinced from the settings from which these techniques evolved – for technochange projects other techniques should be used. At the same time looking at which IT projects are undertaken by both large and medium corporations today we see a predominance of large scale projects like ERP implementations, BRP initiatives, integrations initiatives connected with mergers, etc. Sometimes the failure is acute, visible and public, as reported in the press: e.g. Socrate project in France [5], Taurus project at the London Stock Exchange in UK [6], more often the failure is chronic and may drag on and drag down business performance undetected for years. The importance of new techniques for project management is further underlined by the monetary amounts concerning these projects. A survey of cost

[1] Århus School of Business, University of Århus, Denmark, andreac@asb.dk
[2] MIT Sloan School of Management, Boston, Massachusetts, USA, cgibson@mit.edu
[3] Università di Verona, Verona, Italy, lapo.mola@univr.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_65, © Springer Physica-Verlag Berlin Heidelberg 2010

structures for large scale projects suggests that the hardware and software costs are less than 20% of the total costs of implementation, small in comparison to installation and testing (45%) and, most significantly, deployment or actually achieving effective use of technology (36%). Douplaga and Astani [7] in a survey conducted among companies of various size to discovered the major issues concerning ERP implementations, show that the major problem for organizations of all sizes was the lack of ERP training and education. Moreover, according to SAP, the leader vendor in ERP industry, it is possible establish an average ratio of 1 to 5 between the costs for the software and the costs needs for consultancy, customizations and training.

This study focus therefore on the knowledge and training issues in multisite ERP implementations and proposes a contingent approach to implementation strategies in accordance to the level of knowledge possessed by the company in the ERP technology.

Research Method

This study is based on two cases of multisite ERP implementations in two large American and European enterprises. The companies are manufacturers and have been operating for many decades. These companies were chosen because of their similarities (both manufacturers, multinationals, long tenure) and because they have been going through major successful technochange efforts in the recent past. The choice of the company with multiple sites fits the needs of this study because it can be expected that these companies have gathered experience with ERP implementation over time. Another reason to chose these companies is that the American one decided to carry out the ERP implementation completely on their own while the European one decided to carry out the ERP implementation using consultants. This is interesting because similar observations will increase the external validity of the results. The case studies are based on observation and interview to highlight the similarities in activities and processes in the implementations of the two technochange projects. We focus the study on the history of the implementations starting from the reasons and then following the sequence of events, tactics, and methods applied until the end of the two projects. This method follows the practice based research carried out by Levina [8]. The data has been analyzed in order to identify major decision, methods and processes chosen. The results of this part will be presented in the case studies below. Then the cases have been analyzed to highlight recursion of practices. Finally the practices have been arranged in a sequence taking also input from existing theory.

Case Study 1: Dow Corning Corporation [9]

Dow Corning (DC) was established in 1943 specifically to explore the potential of silicones. Today DC is a global leader in silicon-based technology, offering more than 7,000 products and services with the majority of annual sales outside the

United States. In 1995 DC was in serious trouble, after fifty years of growth, the $2.2 billion company was experiencing increasing global competition for its broad silicone-based product line. More pressing was the infamous breast implant situation since thousands of recipients were lining up for jury trials. With increasing pressure on earnings the CEO of DC led his operating committee through a strategic review. The business strategy that had evolved and served the company well was to be left intact but they hat to change the business processes and use IT as a significant enabler of change. Such a strategic role for IT was new for DC. An earlier project initiated by IT to create a global order entry system, called the GOES project, was not successful.

The executives assessed that the risk of success for IT-enabled operational change was very high. In the GOES effort it had been impossible for the analysts to get consensus among autonomous regional business units on systems requirements. While employees supported management in the current crisis situation, they had never experienced major IT-driven changes. Management knew the DC culture was characterized by long job tenure and employee loyalty, but they had to make a case for transformational change. Management made two key decisions: the first was to appoint a new CIO in direct contact with the CEO; the second was the decision to accept the CIO recommendation to implement SAP R3 ERP.

The CIO called the change program "Project Pride." It unfolded in four distinct phases in 1996–1999. Each phase was characterized by different risks and DC management had to adapt different styles of project management. In phase one the CIO, in order to ensure employees would accept changes, decided not to use consultants, but to build capability and commitment having the work done in house. The CIO asked and received 40 of the best, most respected middle managers from operations around the world and made them the full-time implementation team. Few had IT experience, but they worked closely with IT. Employing a typical DC project management approach, consensus-oriented and with flexible milestones, the team began to learn SAP and to design work process changes to match SAP without modifying it.

Phase two of Project Pride began during the first year as the CIO reacted to what he saw as the limitations of the consensus-learning project style. While creative learning was certainly occurring, and the team of 40 became deeply committed to understanding SAP, little progress was made on redesigning processes. Employees in the field, aware of the executive pronouncements that big change was coming, were beginning to question the lack of firm milestones and signs of progress. The CIO took two important actions. First, he changed the project manager from one relatively comfortable with technology to a highly respected, result-oriented plant manager. Second, he tightened project planning to become more rigid: deadlines were set and expected to be met for a pilot implementation. At the same time he still left the Project Pride implementation team in charge of how they used their resources to meet the deadlines. This project approach led to a successful pilot implementation. The pilot was a full cutover to SAP for virtually all operations of a recently acquired autonomous business in Europe. The success of the pilot soon resonated throughout the DC culture as a symbol of top management determination and the capability of the project Pride team.

With the pilot done, the CIO recognized that he was in a new phase. There was a need for a change in project management to enable the worldwide implementation of SAP. The global scope and urgency of the project drove the risk and kept it high even though a climate of employee receptivity had been created. He modified the project style by strengthening the authoritative nature of his leadership and that of his lieutenants, while still permitting flexibility at the ground level. In the crucial period from 1997 into 1998, he led a relentless and unprecedented change effort at DC. He traveled extensively to spread the word and rally the project teams implementing SAP. He personally negotiated with and pressed his executive colleagues and old personal friends to adhere to their commitment to make changes. A key change came in 1998 when the CEO agreed to make project implementation one of the significant performance goals for the senior levels of line management. It was a strong statement of support for Project Pride.

At this point the fourth and final phase was underway. Although there were several pockets of reluctance, they were generally employees trying to maintain good customer relations and meet their operational goals: a positive form of resistance. The CIO and the teams picked up the pace and tightened and made rigid deadlines for site-specific sub-projects. Senior management stressed the new goals. Implementation time for sites went from 18 months after the pilot to 4 months in late 1998. In 1999 the installation of SAP was essentially completed. DC became the largest successful single-database installation of SAP R3 at that time, providing global integration for the company.

Case Study 2: Gruppo Manni HP

Gruppo Manni (GM) was established in the 1945 to recycle iron and steel. It was created by a single entrepreneur and developed its business by providing services to building yards becoming middleman between the steelworkers and final users. GM carries out industrial activities in steel-working division and in prefabricated steel elements, and components and structural systems for plants. They have a revenue of 492 m per year and employ 800 employees in eight operative companies and 15 production and distribution centers.

In the 1996 the CEO became aware that the growth of the group, in value and volumes was not supported enough by the existing IT. High costs of maintenance, due to the high customization; functional bugs and architectural limits were some of the aspect that worried GM managers. In order to identify the weaknesses of the information systems a task force was created composed by the CIO, the project manager who developed the system in use and two external IT consultants. These employees founded together with GM a consulting company called Ratio with the specific purpose to aid the technochange initiative.

A first assessment underlined the emergent needs of the group: centralization of the business decision processes common to the whole company; establishment of operational standard and common procedures among all the companies belonging to the group; optimization of marketing tools; integration with suppliers; real time connection among all the companies of the group; centralization and standardization of the IT infrastructure. The solution found for all these problems was to implement a group wide ERP which could cover all core and support processes. Ratio consultant decided, given the requirements identified to adopt a multisite ERP, called Diapason developed by Gruppo Formula.

Ratio consultants decided for a gradual rollout per module and per site. They also went into a partnership with Gruppo Formula for the implementation project. Ratio personnel was involved in Formula's ERP implementation Project as observers in order to create a Ratio's internal group of consultants able to run a ERP implementation project from the both the technical and the managerial side. The initial phase while involving consultants had the same goal as in DC: learning first in the single site module by module and then move to multiple sites. They decided to implement the ERP system modules starting with finance followed by sales, manufacturing, and procurement.

The original timetable of the gradual rollout project was as follow: September '97 Project start up; January 98 Finance in the Holding Go live; April '98 Controlling in the Holding GO live; January '99 Sale, Procurement and Manufacturing Go live in two Companies of the group as pilots; January '00 Procurement and Manufacturing Go live in all the company of GM. During 1998 in response to the successful implementation of the finance and controlling modules the CEO and CIO of GM asked for a profound change in the philosophy of the project. Rather than a gradual rollout, as originally planned, they asked for a "big bang" approach for the Sales, Manufacturing and Procurement modules in all sites. In January and February 1999 the tuning phase involved all personnel of GM.

Framework Development

The initial GOES effort and implementation of ERP (Project Pride) in the DC and the analysis and design in GM can be distilled to a cyclical process of strategy setting, risk assessment, and choice of appropriate execution style. All this activities appear, in the two companies to be centered on a relentless search to find in each situation the right learning style to decrease risk. This might not be evident at first glance but from the passage from risk assessment to execution there is an explicit or implicit effort to increase learning. The learning issue appears more clearly in phase one where the effort – learning ERP (SAP R3 for DC and Diapason for GM) with a limited use of external consultants – is explicit but returns in the other phases as well when the pilot projects are used to show – i.e. teach – the company ability to pull of these kinds of projects. This is a key element in multisite ERP implementations because after the first implementation there is the need to convince others to follow suit. In other words the top managers at DC and GM were intuitively mindful that strategic direction, risk and learning style and execution style where tightly coupled and their accurate choice was key to success. In each phase they implicitly

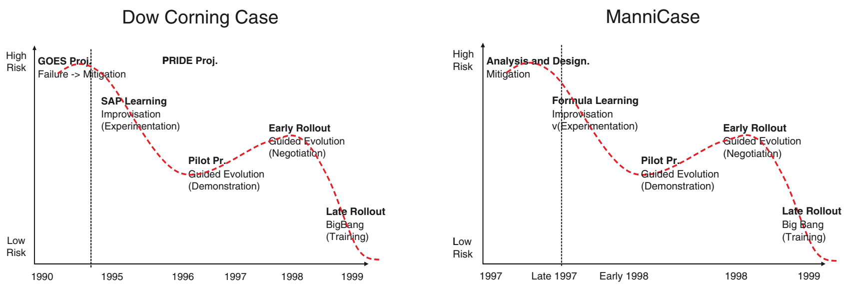


Fig. 1 Risk profile and management/learning style adaptation at DC and GM

or explicitly adjusted their strategy, conducted change risk assessments, used different learning styles to mitigate risks, and adjusted the method of project management to cope with remaining risk. The path followed by the projects in DC and MG can be seen in Fig. 1.

An interesting observation is that in the two companies they seemed to have grasped the concept that risk is not an absolute value. What is risky – or in other words difficult – can become straightforward when you know enough about the problem. By using different learning styles they were able to mitigate risks not by changing the nature of the problem but by changing their approach to it.

The second observation is that throughout the Pride project there was a continuous active participation of the highest levels of management. This seems to be necessary and mandatory for technochange processes. Top management involvement is necessary because of the large array of methods used. Only top management could accept the slow pace of the first phase of experimentation in the same way that only top management could change the reward structure to include project implementation in the performance goals for the senior levels of line management. Finally only top management could use the iron fist in the latest phase of the project when SAP was rolled out with a Big Bang style at record speed.

A third interesting point is to observe the wave pattern of the Pride project. Risk is not always decreasing because the nature of the problem changes. In 1998 the CIO had to engage in complex negotiations to assure the buy-in of the other sites in view of a smoother implementation later on. This part of the project – quite typical of technochange – is very different from before but could not be carried out without the knowledge previously created. The strong knowledge base obtained in phase one and two provided solid arguments that reasoned well with the local plant managers and line managers. In this delicate phase the CIO adopted a Top-down Coordination method of project management, with an authoritative style accompanying his traveling and convincing, but allowing for flexibility in timetables for particular projects.

Summarizing the observation of the DC case can be translated into a framework for the execution of technochange processes. The framework focus on the three macro activities: strategy setting, risk assessment and execution style, and conscious management of knowledge. The framework presents three phases, connected by guidelines for assessment and use. The three frameworks and guidelines are three steps in an iterative process for assessment and execution.

First, providing and understanding of the strategy, vision and context for programs and projects and checking progress of the program and project in their contexts over time. In this step initially the business case for the technochange program or project is created: covering the specific metrics of intended business success and the broad outline of the technical solution. We refer to these as the direct business technochange efforts: achieving cost savings, creating new revenue-producing service offerings, meeting a mandated requirement such as Y2K, or other business results. This first step also advocates separating these direct types of programs and projects from indirect efforts. Indirect programs or projects are those aimed at enhancing the capability of the enterprise. Indirect activities may include such goals as achieving an enterprise-wide IT architecture, changing the work culture, creating a learning organization, and the like. The business case in this step leads to a specification of the nature of the project in terms of its inherent difficulty, apart from the organization's capability to succeed with it.

Second, conducting a diagnosis of the capability to carry out the particular technochange program defined in step one. Given the description and status of the program/project from step one, this step assesses how well leaders and stakeholders can build and install technology, make organizational changes, and address problems of alignment and coordination. The sequence in this step is a risk assessment of these capabilities, then a classification of the type of "learning" required to deal with the contextual level of risk, the approach to learning, and the nature of the execution. Taking inspiration from the DC and the GM cases and from Gibson [10], we offer and explain three styles of program and project management for execution. For high risk and experimental learning, an improvisational approach; for low risk and straightforward learning (such as traditional "training"), a "big bang" approach; and for moderate risk and for demonstrative or negotiated learning, either an "evolutionary" or a "coordinated" approach.

Third, execution of the approach using appropriate techniques and mechanisms. For example, an improvisational approach will typically require mechanism to support intensive, focused, experimental learning by key individual stakeholders such as users of a new system or developers using a new technology. On the other hand a big bang approach could require mechanisms for widespread organizational communications and elaborate planning for coordinated cutover.

The three steps are repeated iteratively, with each cycle ending up with a review from the strategic level based on the success and issues with the previous execution phase. In technochange the reviews are an important component with new risk assessments as the effort progresses, and changes in the execution approach as required. The way in which evaluation takes place is shown in Fig. 2.

The diagnosis phase is carried out investigating the capability of the company leadership and of the other stakeholders. If both leadership and stakeholders have proven capabilities to carry out a given technochange process then the process is low risk and the learning required is of direct transfer of information – training like. If both leadership and stakeholders are incapable of carrying out such change then

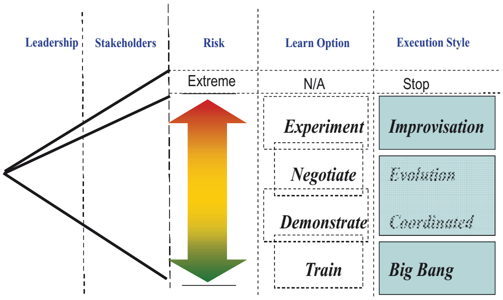


Fig. 2 Framework for Technochange Execution

the risk is extreme and the options are either to redefine the problem differently or to engage in intensive learning of the experimental kind as carried out at DC in the first phase of Pride project. In case of mixed capability we end up in a grey zone where negotiation is required. We have put the leadership to the left giving it more importance in driving the risk factor because both in the DC and in the GM cases the type of decisions related to technochanges required first of all leadership understanding.

References

1. Mumford E., 2003, Redesigning Human Systems, Idea Publishing Group, Hershey, PA
2. Checkland P., Scholes J., 1999, Soft Systems Methodology in Action, Wiley, Chichester
3. Mathiassen L., 1999, http://www.cs.auc.dk/~larsm/rsd.html (visited in February 2003)
4. M.L. Markus, Technochange management: Using IT to drive organizational change. Journal of Information Technology. 19, pp. 4–20, (2004)
5. Mitev, N.,N., (1996) More than failure? The computerize reservation system at France railways Information Technology and People 9(4):8–19
6. Drummond, H., (1998) Riding a Tiger: Some lessons of Taurus, Management Decision, 36(3):141–146
7. Duplaga, E.A., & Astani, M. (2003) Implementing ERP in Manufacturing, Information System Management, 20(3):68–75
8. Levina, N. (2005), Collaborating on Multiparty Information Systems Development Projects: A Collective Reflection in Action View, Information Systems Research, Vol. 16, No. 2, Pp. 109–130
9. Ross, JW, "Dow Corning Corporation A, B, and C: Business Processes and Information Technology", MIT Sloan Center for Information Systems Research WP No. 298 and 305, copyright 2001, MIT.
10. Gibson C, 2003, IT-enabled Business Change: An Approach to Understanding and Managing Risk , MISQ Executive, September 2003, Vol. 2, No. 2

Semantics in the Age of the Data Deluge

G. Vetere[1]

Abstract Semantic technologies are usually considered as a key factor for dealing with the huge amount of data available today (also called "Data Deluge"). However, there are analysts who say that the availability of massive data volumes gives boost to statistical analysis in a way that will make semantics (as well as theories in general) useless. This paper is a brief refutation of this point of view. Meanings are important, and there is not a statistical way to capture their essence. On the other hand, the slow progress of the Semantic Web and the success of semantic-less engines like Google, support semantic scepticism someway. This paper argues that semantics is not an easy matter, and most of computer scientists have not taken it seriously enough so far. Nonetheless, semantics is there and plays a crucial role. More focused research can help leveraging few but important things that we know about meanings, to drive the development of better information systems at the age of the Data Deluge.

Introduction

In a recent, high impact article, Chris Anderson (editor in chief of *Wired*) has claimed that the huge amount of on line data available today (also called "Data Deluge"), along with Google's (or like) mathematical analysis, will make semantics (as well as models, ontologies, and theories in general) useless [1]. For instance, automatic translation will become possible without knowing what sentences mean, just by gathering enough evidence of the correlation between expressions of source and target languages. As the global data base grows, says Anderson, new mathematical evidence emerges, making statistical approaches more effective. Thanks to data volumes, rather than being the answer to new challenges of information management, semantic technologies would become worthless. Anderson mixes semantic scepticism to mathematical positivism to provide a vision that is radically different from W3C's Semantic Web, and very close to Google's business philosophy.

[1] IBM Italia, Center for Advanced Studies of Rome, Roma, Italy, guido_vetere@it.ibm.com

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,

DOI 10.1007/978-3-7908-2148-2_48,

Taking this scepticism as a starting point, this paper is a brief discussion around the question: is semantics (as a discipline) of any help at the time of Data Deluge?

There are many arguments against Anderson's point of view. For instance, one could consider how, as Heisenberg has shown, the observer always plays a role when examining evidences. But semantic scepticism, after all, has not been theorized by *Wired* for the first time, nor invented at Google Labs.[2] Moreover, semantics has been regarded to with a great amount of naiveté by most of the Semantic Web community in the last decade. In any case, this paper takes up a different point of view by asking: is there something we know about semantics that could be useful for developing better information systems at the time of the Data Deluge?

What we (don't) Know About Semantics

Semantics is (the study of) a function that maps expressions in a given language with things or facts in a given world. Things and facts can be altogether viewed as (logical) objects in a set usually called "domain of discourse." Pairs <expression, object>, which lie beneath the semantic function, are called meanings, or signs.[3] Many authors have followed the logician Tarski by considering the meaning of English sentences like "the cube is above the sphere" as the conditions that make the sentence true [3]. Unfortunately, very few sentences of natural language can be associated with obvious truth-conditions (in Fig. 1, would the cube be "above" the

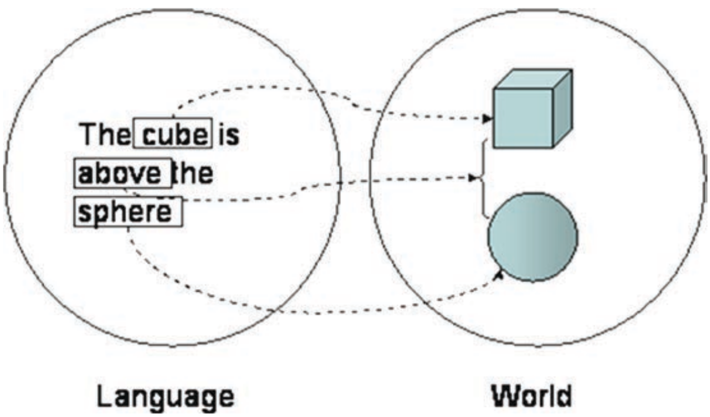


Fig. 1 linguistic meanings

[2]Actually, semantic skepticisms roots in ancient Greek philosophy (e.g. Pyrrho).

[3]I refer here to the notion of sign as (reified) relation between 'signifier' and 'signified' in De Saussure [2].

sphere if it were at the distance of 1 km?), which puts the effectiveness of the notion of truth in question and causes semantics to be very far from trivial.

We know for sure that human communication works pretty well (otherwise, you would not be reading this paper); we don't know, however, why we normally understand each other [4]. In other words, the phenomenon of (successful) human communication is still quite obscure. Even if machine-to-machine communication is based on explicit symbols and controllable processes, obscurity of human communication affects networking information systems as well, since humans, as users or programmers, are constitutive parts of these systems, the only parts, by the way, which exhibit feelings, will, and intentions.

While there are few discussions about what an expression could be, it is not clear what kinds of objects should be included in the domain of discourse where expressions are interpreted. For standard linguistics (e.g. De Saussure [2]), it is normally accepted that expressions map to concepts, that is, roughly, "mental objects." Then, presumably, there's a relation between concepts and real world entities. This relation, however, is subject of a never-ending philosophical debate, and is out of the scope of most of linguistic research. Semantics of formal logic, on the other hand, is totally agnostic with respect to the content of the domain of discourse, as well as to the concrete meaning of constants and predicate symbols. Logicians require the domain set to be denumerable, and the meaning of atomic symbols to be given before any statement. Then, they provide rules for calculating the meaning of any well formed logic expression, based on the meaning of their parts, according to the formal functioning of logical operators.

The problem of the ontological status of objects in the "domain of discourse" is one of the biggest philosophical questions of every time. Classic issues revolving around the realism-antirealism debate are still open today. Are concepts grounded in some inter-subjective reality or rather socially constructed? Do concepts exist somehow independently of linguistic practices? There are many theories of meaning in which answers to these questions are outlined, but none of them has the same wide acceptance as, for instance, Darwin's theory of evolution, or Newton's theory of gravitation. Aristotle's semantic realism, consisting in the idea that meanings root in natural kinds which are the same for everybody, has been criticized by modern linguists and philosophers (e.g. Wittgenstein [5]) who stressed the arbitrary and conventional nature of linguistic signs. In the second half of the last century, Quine [6] has developed a relativistic vision in which every communication process is seen a set of "radical translations": for agents (persons or automatic systems) that exchange information through linguistic protocols, ontologies of other agents are basically inaccessible, and understanding amounts at turning semantically opaque expressions into their own ontology, without other guarantees than the practical success of communication. Davidson, on the other and, has proposed a quite different theory, in which understanding is seen as the intuition of truth conditions that others would assign to sentences, based on the assumption that agents are fair in their linguistic behaviours [7]. We cannot provide here a complete survey of all the meaning theories developed in philosophy in more than twenty centuries. However, we observe that most of the Semantic Web research has largely ignored the whole matter, taking meanings as obvious, granted realities, and their spread among different agents as a smooth and natural process. On the contrary, as a phenomenon, signification is very far from being fully understood, and system designers who work in information management should be at least aware of the main problems behind it.

We know, with Chomsky, that observable evidence is not enough to explain languages. As we can't learn syntactic structures just by observing word sequences, we can't learn the concrete meaning of the words 'marriage' and 'divorce' (e.g. how the process denoted by the latter is related to the process denoted by the former) just by counting how many times the two words co-occur. The idea of modelling human realities by observing behaviours (behaviourism), has been experimented in linguistics during the last century, and eventually abandoned. This idea has not been criticized because of demanding large experimental bases, but for the inherent lack of explanatory capabilities [8]. In this respect, the Data Deluge will hardly give behaviourism another chance.

We know that, regardless of how it is grounded and how it actually works, semantics is there, and cannot be ignored or reduced to something else. The open philosophical problem of explaining it does not demote the role of semantics in communication processes. Also, those who have practical experience in the IT field can witness how semantics matters when designing networking information systems, in terms of understanding and merging business models, integrating databases, classifying documents, and so on. Thus, the problem is: how to leverage semantic representations to improve information systems, without a clear understanding of how semantics works?

What Semantics can do for Us, Anyway?

Would an effective exploitation of a uniform representation of their meaning be of any help for managing huge amounts of data, such as those the Data Deluge is throwing at us? This is a rhetorical question; the obvious answer is "yes." The problem of porting data from a system to another, for instance, has a difficulty which is directly related to their semantic opacity. Data portability, on the other hand, is of crucial relevance for the success of new paradigms of "cloud computing," which are needed to scale our information systems up to the dimension of petabytes. Injecting semantics into data records is what the Web 3.0 is all about. As a general rule of software engineering, there is much value in taking conceptual models away from the shadow of obscure, uncontrollable computational processes, when developing, maintaining and managing complex information systems. However, the long-term debate on whether we can leverage a solid body of a priori semantic knowledge, or develop that knowledge case by case, or rather leave semantics emerging from users' attitudes, or even left it implicit by using mathematical methods, is still ongoing. By the way, this debate has a concrete counterpart, since many different approaches have been – and still are – extensively experimented in concrete information retrieval and knowledge management systems, where different dialectic pinpoints very often coexist. On the other hand, as the Data Deluge rapidly approaches, getting to some conclusion is perceived as more and more urgent. Under the pressure of increasing needs, there is the risk of turning Google's success into an unjustified and unsafe semantic scepticism. Google's business success should not be taken as a proof of soundness of purely mathematical approaches to information management, much like the success of Windows as an operating system cannot be taken as a proof of its technical supremacy.

Besides Google's success, semantic scepticism roots in some frustration around the Semantic Web. However, the Semantic Web research has researched everything but concrete semantics, so far. The idea of having complete and uncontroversial conceptualizations (ontologies) shared on the Web with the purpose of providing information systems with solid semantic foundations, which was at the basis of the early Semantic Web vision, turns out to be hardly feasible, if not impossible. It seems that, once again in the history of human though, rationalism has failed to keep its promises[4]. Ironically, one of mayor weakness of ontologies around the Web is their very little ontological import. In fact, ontologies mostly look like what Quine would have rather called "ideologies," that is: collections of arbitrary and intrinsically vague predicates embodying cultural abstractions. Concepts (i.e. predicate symbols) of Web ontologies have been naively regarded to as if they were like natural kinds, whereas they mostly are cultural artefacts full of social (economical, political, etc.) biases [9]. This flaw is likely to be a consequence of how research has been directed since the Semantic Web has been envisioned. The Ontology Web Language development has focused on expressiveness, tractability, and computability, and (in the tradition of formal logics) has left concrete semantics as an exercise to the reader. Formal Ontology has provided formativeness criteria based on meta-level properties [10], but has paid little attention to the problem of characterizing ontological commitments in contrast with linguistic predicates. An instance of this flaw is visible in the famous *wine ontology*[5] provided by W3C as a reference example: concepts such as 'substance' and 'wine' although of the same logical kind (the latter is included in the former) are indeed very different in their semantic import, 'substance' being a (meta) physical status, 'wine' being just a matter of taste. Foundational Ontology, which aims at providing categories to be concretely exploited when modelling or integrating information systems is still underdeveloped, and the few serious proposals worked out so far are very little known [11].

In these years, Web development practices and new technological platforms provide a lightweight approach to semantics, which seems to outline a new perspective. Little meaningful HTML fragments can be captured by standard representation patterns (microformats[6]), annotators based on open platforms such

[4] In their most naïve conception, Web Ontologies recall the Leibniz's project of a *Scientia Universalis*, i.e. a complete logical description of the World, which, however, has never been accomplished.
[5] www.w3.org/TR/owl-guide/wine.rdf.

as UIMA[7] are demonstrating the ability of extracting simple atomic facts, without venturing in full text understanding. Geo-referenced systems leverage a shared notion of space, which both humans and machines can understand; events are straightforwardly collocated in time, which is presumably the same for everybody on the Earth. With little or no awareness of formalities, people start talking about fragments of shared knowledge in an interoperable way. Maybe this reveals how, spontaneously, user communities are focusing on the ontological core of their communications, based on plainly shared ideas such as space-time locations, concrete entities, and events. This new trend, which could be called "modest but honest," is emerging within user communities where semantic a priori knowledge is concretely used in form of a minimal core of intuitive properties conveying clear ontological commitments. Well focused research could do a lot to support and speed up these spontaneous processes, and to help exploiting huge amounts of explicit (albeit basic) knowledge with new powerful solutions. Of course, events, concrete entities and spatial-temporal properties are not the only things we happen to encode and to search into documents. Also, vagueness is not a defect of natural language, but rather an inherent feature of human communication, thus we won't get rid of it anyway. For this reason, a-semantic methods based on statistics will continue playing a relevant role. But, generally speaking, there is no reason to drop what we can effectively handle of the relationship between certain expressions and certain concepts, in favour of blind mathematical methods. As a matter of facts, despite we fail in providing full featured, all encompassing ontologies for any source of knowledge, we keep on speaking of entities, locations and events (i.e. what should be the core for any ontology) in a structured way.

To conclude, concrete semantics, rather than eliminated, has to be taken seriously into account by information management research, now more than ever. Separating a core of ontological commitments from the obscure mass of "ideology" coming with natural language, within the limits in which this is actually feasible, would be of great help when integrating different information systems, and would be a crucial move to come up with more solid and valuable solutions. Maybe, the Data Deluge will help us to retain the best of our knowledge and practices about semantics, as the Universal Deluge resulted in keeping the best living specimens.

References

1. Anderson, C.: The End of Theory: The Data Deluge Makes the Scientific Method Obsolete, *Wired Magazine*, issue 16.07 June 2008.
2. De Saussure, F.: Cours de linguistique générale, ed. C. Bally and A. Sechehaye, with the collaboration of A. Riedlinger, Payot, Lausanne and Paris 1977.

[6] http://microformats.org/.
[7] http://incubator.apache.org/uima/.

3. Tarski, A.: The Semantic Conception of Truth, Philosophy and Phenomenological Research 4, 1944.
4. Taylor, T., Mutual misunderstanding: Scepticism and the theorizing of language and interpretation, Duke University Press, Durham and London, 1992.
5. Wittgenstein, L.: Philosophical Investigations, Basil Blackwell, Oxford, 1953.
6. Quine, W.V.O.: Word and Object, Harvard University Press, Cambridge, MA, 1960.
7. Davidson, D.: Inquires into Truth and Interpretation, Oxford University Press, Oxford 1984
8. Lyons, J.: Introduction to Theoretical Linguistics, Cambridge University Press, Cambridge, 1968.
9. Santini, S.: An Oddly-Positioned Position Paper on Context and Ontology. *Proceedings of IEEE International Conference of Semantic Computing* 2008: 307–314
10. Guarino, N., Carrara P., Giarretta, P.: An Ontology of Meta Level Categories, In D. Joyle, E. Sandewall and P. Torasso (eds.), *Proceedings of the Fourth International Conference on Principles of Knowledge Representation and Reasoning*, Morgan Kaufmann, San Mateo, CA, pp. 270–280
11. Masolo, C., Borgo, S., Gangemi, A., Guarino, N, Oltramari, A.: Wonderweb deliverable D18 – final report. Technical report, National Research Council – Institute of Cognitive Science and Technology, 2003.

Service-Based Networked Collaboration

D. Bianchini[1], V. De Antonellis[2], and M. Melchiori[3]

Abstract Collaboration in distributed systems have experienced more and more interest over the time. Traditional distributed systems are featured by resource sharing among a fixed/limited number of different partners, with a-priori knowledge about each other, mainly obtained through mediator-based architectures. Recently, the collaboration paradigm evolved towards collaborative P2P distributed systems, with an increased number of enterprises, acting as peers on the network, looking for possible partners that can provide relevant knowledge in a given domain, without a-priori knowledge about each other. In this paper, we propose a comprehensive framework for networked collaboration in P2P environments based on service sharing and discovery. In particular, we consider two meaningful scenarios in which peers search for other peers providing similar or additional functionalities and discuss a framework that supports these scenarios.

Introduction

Collaboration in distributed systems have experienced more and more interest over the time. According to a traditional approaches, distributed systems are featured by resource sharing among a fixed/limited number of different partners, with a-priori knowledge about each other, mainly obtained through mediator-based architectures. In this scenario, collaboration constraints change quite rarely and partners are statically connected one to another.

Recently, the collaboration paradigm evolved towards collaborative P2P distributed systems, where enterprises, acting as peers on the network, look for possible partners able to provide relevant resources in a given domain, without a-priori knowledge about each other.

Collaborative P2P systems try to meet the requirements for very flexible collaboration models only relying on resources provided by partners to implement the

[1]Università degli Studi di Brescia, Brescia, Italy, bianchin@ing.unibs.it
[2]Università degli Studi di Brescia, Brescia, Italy, deantone@ing.unibs.it
[3]Università degli Studi di Brescia, Brescia, Italy, melchior@ing.unibs.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_23, © Springer Physica-Verlag Berlin Heidelberg 2010

collaboration. These models support virtual organizations and teams that collaborate for short time and where involved partners can not rely on pre-existing infrastructures [1].

In such a scenario, partners that loosely connect one to another can join and leave at any moment, that is, collaboration constraints may frequently change (dynamic collaboration). In this respect, a semantic agreement between networked enterprises is required for effective resource sharing. In particular, for collaborative P2P distributed systems, agreement must be reached under dynamic requirements and in a multi-knowledge scenario, where each peer refers to its own knowledge representation and a single shared global view becomes impossible. Furthermore, semantic agreement must be reached dynamically and emerges from local interactions between collaborative entities [2, 3]. Ontologies and Semantic Web technologies like semantic resource description and matchmaking are adopted as key solutions to actually define the fundamental components of semantic collaborative platforms. Meaningful examples of such components are semantics- and context-driven data and service discovery [4–6].

In this paper, we discuss collaboration scenarios based on service sharing and discovery, where collaborative partners share part of the functionalities of their Information Systems to support interactive business collaboration or to define and build flexible cooperative processes.

We consider two meaningful scenarios according to different collaboration perspectives. In the first one, a service provider receives a service request, but services provided locally are not currently available or are not able to guarantee the required QoS. In this case, the peer starts a collaboration with other providers to find services that are functionally equivalent to the local ones, but ensure better QoS features (not discussed in this work). In a different collaboration scenario, a provider receives a service request, but services provided locally are not able to completely satisfy the request. In this case, the peer starts a collaboration with other providers to find services that add functionalities to those provided locally.

To support these service-based collaboration scenarios in P2P environments, we have developed a comprehensive P2P-Semantic Driven Service Discovery (P2P-SDSD) framework [7]. The framework adopts an unstructured architecture without constraining to global ontologies/registries or mediation-based architectures. In particular, we propose the construction of a *service semantic overlay* over the P2P network, that is, a conceptual dynamic model of peers that provide similar services and constitute synergic service centres. Each peer maintains local knowledge about its own services and network knowledge about peers that provide similar services. In particular, network knowledge is incrementally built through on-the-fly local interactions among peers and is constituted by semantic links towards similar services published on different peers.

In the following sections, we firstly discuss the peer knowledge infrastructure to support the networked collaboration. Then, we explain how the network knowledge can be dynamically and incrementally built according to a probe collaboration model. Finally, we describe how the semantic link infrastructure, that is a P2P semantic overlay, enables collaborative service-based scenarios.

Peer Knowledge Infrastructure for Networked Collaboration

Peer knowledge is constituted by: (1) semantic description of services the peer advertises on the network (*peer local knowledge*); (2) mappings towards other peers on the network (*peer network knowledge*). In particular, these mappings, called *inter-peer semantic links*, are used to link peers that provide similar services on the collaborative network, also called *semantic neighbors*.

Peer local knowledge is constituted by: (1) a taxonomy of *Service Categories*, extracted from standard classifications (e.g., UNSPSC, NAiCS), to categorize services the peer advertises on the network; (2) a *Service Message Ontology*, whose concepts are used to annotate service I/O parameters; (3) a *Service Functionality Ontology*, providing concepts to semantically annotate service functionalities (operations); (4) an *UDDI registry* in which details for localizing and invoking services are maintained.

In Fig. 1a, a portion of peer local knowledge is shown taken from experimentation done in the context of TEKNE Italian Project[4]. We consider here a peer specialized in home furniture. In particular, the peer provides a service that allow e-commerce of electric appliances. The operation, representing service functionality, and I/O parameters of the service are obtained by its WSDL description (linked to the service UDDI record). Service Functionality Ontology provides concepts that describe the meaning of service operations. Similarly, Service Message Ontology concepts provide meaning to service I/O parameters. Both these semantic annotations allow semantic comparison of services as explained in the following.

For evaluating service similarity, we apply an ontology-based semantic matchmaking algorithm, namely FC (FunctionalCompatibility)-Match, that combines a

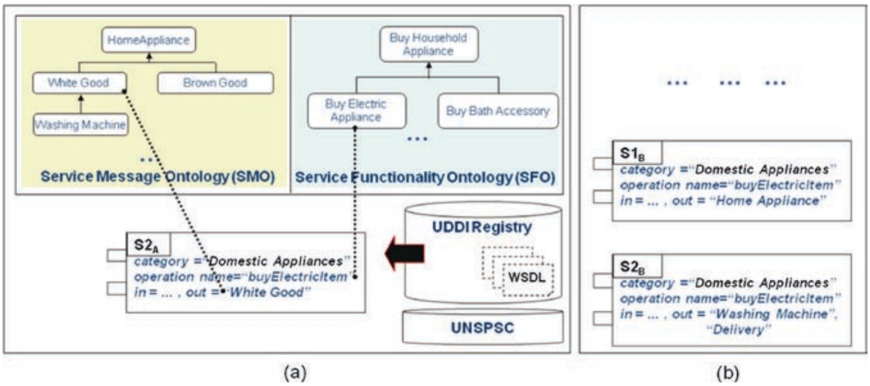


Fig. 1 Examples: (**a**) local knowledge of a peer P_A; (**b**) services in another peer P_B

[4]TEKNE (Towards Evolving Knowledge-based interNetworKed Enterprise) Project Home Page: http://www.tekne-project.it/.

deductive and a similarity-based approach to find out two kinds of matching information [8]:

– The *kind of match*, to qualify the match between services and to assert that: (1) they correspond to the same functionalities and elaborate equivalent I/O parameters (total match); (2) functionalities and I/O parameters of the first service are included by functionalities and I/O parameters of the other one (extend match); (3) they have partially overlapping functionalities or I/O parameters (partial match); (4) they do not match at all (mismatch)
– The *similarity degree*, to quantify how much services are similar from a functional viewpoint, obtained applying properly defined coefficients based on the correspondences between names of operations and I/O parameters.

Similarity degree varies in the range [0,1] and its evaluation is actually required if a partial or extend match occurs, in the other cases it is set to default values (i.e., 1 if the match is total, 0 if there is a mismatch).

In Fig. 1b, service $S1_B$ has an extend match since it offers a more general service output (Home Appliance) with respect to the service $S1_A$ represented in Fig. 1a (White Good) and $S2_B$ has an intersect match $S1_A$ since it offers an overlapping (more specific) output (Washing Machine) and an additional output (Delivery).

Semantic Dynamic Collaboration

For semantic P2P dynamic collaboration, we have defined a probe collaboration model. Local interactions among peers allow to identify peers that offer related services, establishing inter-peer semantic links that are exploited to implement collaboration scenarios. According to this model, a probe service query is submitted by a requesting peer P_A. The query contains descriptions of local advertised services and is sent to peers that are connected to peer P_A in the P2P network. A peer P_B that receives the probe service query matches it against its own service descriptions on the basis of its own peer local knowledge. On the other hand, peer P_B forwards the probe service query to other peers to discover other possible partners. P_B collects matchmaking results and sends them back to peer P_A with corresponding matching information (kind of match and similarity degree). An inter-peer semantic link is established from P_A to each peer that answered to the probe service query, that we call *semantic neighbor* of P_A. The semantic link is labeled with the reference to the similar services on the semantic neighbors and the corresponding matching information. In this way, semantic neighbors that can provide relevant knowledge with respect to a given target request are linked. Through semantic links it is possible to reach peers with relevant knowledge even if they have a high distance from the requesting peers, that are aware of a small portion of the logical network.

The dynamic nature of the semantic overlay requires to keep it updated with respect to the services and peers available on the network over the time, that is, the semantic overlay has to meet requirements that ensure its consistent updating. Once

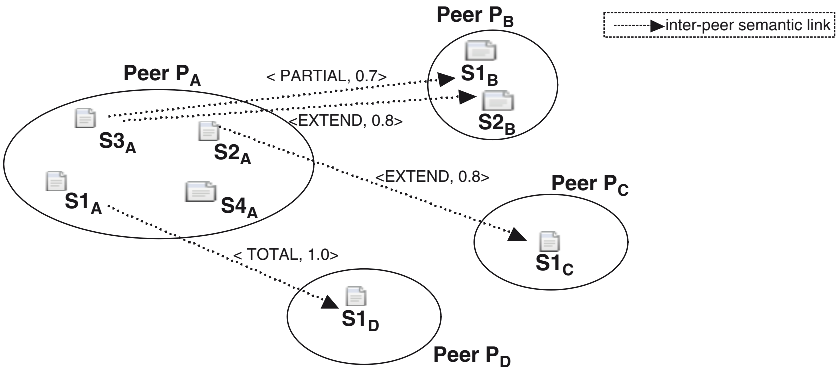


Fig. 2 Example of P2P semantic links constituting the semantic overlay (network knowledge of P_A)

new peers have been identified, the probe collaboration model can be exploited to update the service semantic overlay.

For example in Fig. 2, semantic links are established by peer P_A to the peers P_B, P_C and P_D as a consequence of the probe mechanism in particular: (1) the total match between $S1_A$ and $S1_D$ indicates that P_A and P_D offer the same service; (2) the extend match between $S2_A$ and $S1_C$ indicates that P_C offers a service that adds functionalities to $S2_A$; (3) the partial match between $S3_A$ and $S1_B$ indicates that P_A and P_B offer two services with partially overlapping functionalities.

Service-based Collaboration

In this section, the service-based collaboration scenarios presented in the introduction are detailed and discussed with reference to service discovery. Service discovery allows for finding required functionalities in the collaborative network and is implemented through forwarding policies. Such policies define the rules for navigating the service semantic overlay, in the following way:

– The forwarding policy establishes *when* to forward the request: (1) the request is always forwarded to the other collaborative peers on the network or (2) the request is forwarded only if it is not completely satisfied by the current peer.
– The forwarding policy establishes *what* are the collaborative peers to which the request must be forwarded: (1) the request is forwarded only to semantic neighbors that provide additional functionalities with respect to local services; (2) the request is forwarded to all the semantic neighbors of the current peer; (3) the request is forwarded to all the peers connected to the current one on the P2P network, regardless their semantic neighborness.
– The forwarding policy limits the *number* of allowed propagations of the request in order to avoid cycles and further reduce network overload; this is obtained by

means of a TTL (Time-To-Live) mechanism; each time a peer forwards a request, the TTL is decreased by 1; when TTL is 0, the request cannot be further propagated.

These rules can be combined to form different forwarding policies, depending on the collaboration scenario to be considered.

Scenario 1: Searching for Similar Functionalities

Let consider an enterprise that provides a set of services in the domain of home furniture supply. The provided services range from those to order single pieces of furniture (e.g., beds, desks or electrical appliances for kitchens) to services for ordering a whole kitchen or living-room suite, with or without discounts for big commissions. The collaborative enterprise corresponds to the peer P_A connected in a P2P network, where other peers (that is, enterprises) that provide similar services are linked as semantic neighbors through inter-peer semantic links.

When a request for a home furniture service is sent over the network and reaches the enterprise P_A, the request is compared with locally available services to find out the suitable ones. If all the services locally found are not available (for example, because they are serving too many requests or do not respect the QoS user's requirements), other services with similar functionalities must be found over the network. Moreover, this scenario could take into account an additional constraint: the search for similar services over the network should avoid the network overload due to the propagation of service requests. According to this further constraint, we distinguish two cases, that are supported by two distinct forwarding policies.

If the goal is to find similar functionalities apart from the influence of request propagation on the network overload, a *full* forwarding policy is applied: the original service request is always forwarded to the semantic neighbors labeled with total and extend match, that provide at least the functionalities already provided on P_A. Matching functionalities will be filtered out according to non-functional criteria (e.g., QoS).

On the other hand, if similar functionalities should be searched over the network without decreasing its performances, a *top k* policy is applied: semantic neighbors labeled with total and extend match are ranked according to their degree of similarity; the first *k* semantic neighbors in the ranked list are selected; the request is forwarded to the selected semantic neighbors.

Scenario 2: Searching for Additional Functionalities

Let consider the enterprise introduced in the previous scenario. The enterprise now receives a service request for a home furniture service that should also include

Table 1 Forwarding policy selection criteria

		Network overload	
		Low	*Normal*
Collaboration scenario	*Searching for SIMILAR functionalities (total, extend)*	TOP K	FULL
	Searching for ADDITIONAL functionalities (extend, partial)	MINIMAL	MINIMAL

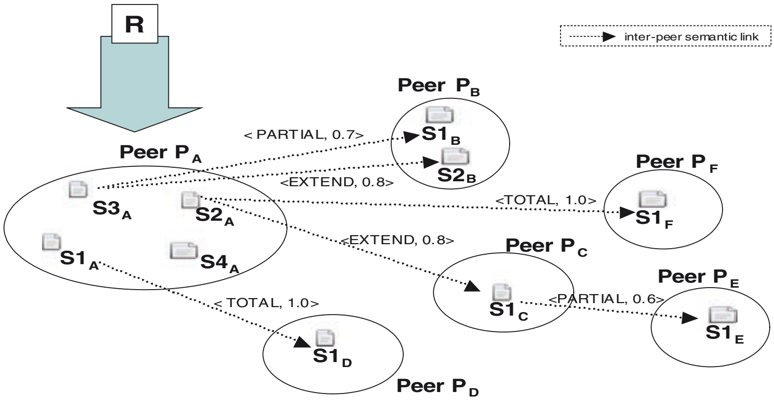


Fig. 3 Example of request forwarding according to full, top k and minimal policy

home delivery facilities. Even if P_A provides several services that are similar to the required one and all suitable services are also available and respect QoS user's requirements, there is not a local matching service that completely satisfies the request. The enterprise P_A starts a collaboration with other enterprises on the network that provide services that are related to the ones that match locally, but also that add functionalities with respect to those already provided locally (extend and partial match). In this case, a *minimal* forwarding policy is applied: only semantic neighbors towards remote services that are labeled with extend and partial match are selected; the request is forwarded to the selected semantic neighbors.

In this collaboration scenario the minimal forwarding policy also ensures low network overload.

Table 1 summarizes the three considered forwarding policies (*full*, *top K* and *minimal*), according to the collaboration scenario and the constraints on the network overload.

As an example, with reference to the semantic overlay in Fig. 3, a request R submitted to the peer P_A and that matches the locally offered services $S1_A$, $S2_A$ and $S3_A$ is forwarded to different sets of semantic neighbors of P_A according the established policy: (1) to P_B, P_C, P_F and P_D (full), (2) to P_B, P_C and P_E (minimal) and (3) to P_D and P_F (Top K with K = 2).

Conclusions

In this paper, we have presented a framework for P2P collaboration based on service sharing and discovery, focusing on two collaboration scenarios. We have presented different policies to manage the distributed service discovery process. Experimentations is being performed to evaluate the performance of the framework with respect to network overload and precision/recall of retrieved services. The aim is to better understand how different collaboration models ensure an acceptable trade-off between minimization of the network overload due to request propagation and maximization of the precision of the search results. In particular, network overload will be investigated also with respect to the probe collaboration phase, that could affect system performances depending on the considered collaboration scenario.

References

1. Hauswirth, M., Podnar, I., Decker, S. (2005) On P2P Collaboration Infrastructures. *Proc. the 14th IEEE International Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprise (WETICE '05)*, Washington, DC, pages 66–71.
2. Halevy, A., Ives, Z., Suciu, D., Tatarinov, I. (2003) Schema Mediation in Peer Data Management Systems. *Proc. of the 19th International Conference on Data Engineering (ICDE'03)*, Bangalore, India, pages 505–516.
3. Aberer, K., Cudre-Mauroux, P., Hauswirth, M. (2003) The Chatty Web: EmergentSemantics Through Gossiping. *Proc. of the 12th International World Wide Web Conference*, Budapest, Hungary, pages 197–206.
4. Benatallah B, Hacid MS, Paik HY, Rey C, Toumani F. Towards semantic-driven, flexible and scalable framework for peering and querying e-catalog communities. *Information Systems.* 2008;31(4–5):266–294.
5. Schmidt C, Parashar M. A Peer-to-Peer Approach to Web Service Discovery. *World Wide Web Journal*. 2004;7(2):211–229.
6. The ESTEEM Team (2007) Emergent Semantics and Cooperation in Multi-Knowledge Environments: the ESTEEM Architecture. *Proc. of the VLDB Int. Workshop on Semantic Data and Service Integration (SDSI'07)*, Vienna, Austria, pages 1–12.
7. Bianchini, D., De Antonellis, V., Melchiori, M., Salvi, D. (2008) A Semantic Overlay for Service Discovery Across Web Information Systems. *The Ninth International Conference on Web Information Systems Engineering (WISE 2008)* Auckland, New Zealand, pages 292–306.
8. Bianchini D, De Antonellis V, Melchiori M. Flexible Semantic-based Service Matchmaking and Discovery. *World Wide Web Journal*. 2008;11(2):227–251.

Simulations, Case Studies and Role Playing: From Cognitive Technologies to the Creation of New Learning Environments. The Experimental Proposals by Telematic University Guglielmo Marconi

G. Venturoli[1]

Abstract The pervasiveness of the network and the versatility of multimedia tools have profoundly changed the way the academic world performs its primary functions: Transmission and Construction of Knowledge. These are functions which are continuously subject to exploration by didactic researchers with the purpose of overcoming standard formulas, because the "super-speed" of our time implies a premature ageing of the scientific literature, and because it is also continually necessary to outstrip the relativity of cognitive path. In this paper we will illustrate two case studies ("Criminal Procedure" and "Art and Surroundings") very different one from the other as far as the didactic design, educational objectives and content fruition are concerned. Although very different, those two multimedia learning paths could be considered as a possible interpretation of the concept of 'simulation'; the concept itself might be finally considered on an interpretative line moving toward the concept of 'representation' and must be understood as:

– "Schematically simplified view" of real environments.
– Content "figurative representations". The two case studies that will be explained in this paper might therefore be identified as multimedia experimental projects that have implicitly altered theories and cognitive models, in order to generate new semantic features.

Introduction

The didactic design activities and educational development of Telematic University Guglielmo Marconi among its multimedia-training courses pay always a great attention to multimedia learning in its cognitive, metacognitive and

[1] Università Telematica Guglielmo Marconi, Roma, Italy, venturoli@unimarconi.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_33, © Springer Physica-Verlag Berlin Heidelberg 2010

emotional-motivational components, by adopting theoretical models which include different variables and their mutual relationship [1].

Case studies, role playing and simulated representations of reality are some from among the genders of simulation experienced through Marconi didactic objects in order to supply with a lecture-key of the multimedia learning centred on learner's knowledge, competences and behaviours. The mentioned learning objects, in particular "Criminal Procedure" and "Arts and Surroundings", although based on theoretical and methodological sound foundation, have implicitly altered theories and models, tools generally used in the pre-cognitivist didactic approach [2]. As a result, a variety of creative designs has been developed (sometimes even unconsciously) through the activation of motivation, and better qualifying the strategy of simulation and role-playing games in order to generate new semantic features. The presentation of those two different types of educational multimedia paths listed above, will better clarify the permanent willingness in the field of didactic design and multimedia development to balance and integrate the need to move from a situation of traditional learning, typically more stable and planned, to a situation of online learning which is by its nature more volatile, and able to promote contact with the new study opportunities offered by technology [3].

The Theoretical Background

The processes of synthesis that constitute the ground of multimedia structural cognitive tools have created difficulties to linear processes of learning and also made possibly outdated the traditional teaching aids [4].

The online learning paths presented in this paper aim at offering fluid and light solutions, but at the same time affect the learner's curriculum – both explicit and implicit [5].Through these example we might argue that not all educational theories can be implemented in a multimedia learning environment format. However, there are several educational perspective that must be considered and in most cases not only one theory is right, but it could be better saying that a combination of different theoretic approaches could be the right solution. Here are some of the theories considered to design and develop the two multimedia learning environments:

- *Multiple Intelligence* devides learning styles as dealing with words (verbal/linguistic), questions (logical/mathematical), pictures (visual/spatial), music (music/rhytmic), socializing (interpersonal), and personal insight (Intrapersonal) (Gardner, 1993).
- *The Learning Style Inventory*: describes learning styles on a continuum, running from concrete experience, through reflective observation, to abstract conceptualization, and finally active experimentation (Kolb, 1984).
- *The Gregorc MindStyle and Style Delineator* use the following main components: abstract-sequential, abstract-random, concrete-sequential, concrete-random (Gregorc, 2006).

– *The Learning Style Model* of Felder-Silverman situates the learner's learning style within a four-dimensional space: sensing learner vs intuitive learners; visual learners vs verbal learners, active learners vs reflective learners, sequential learners vs global learners. (Sun et al., 2005).
– *Schnotz* and Lowe categorize multimedia into three different levels: the technical level (the technical devices that carry the messages, e.g. computers, networks); the semiotic level (the representational format of the message, e.g. texts, pictures); and the sensory level (the sensory modality of sign reception, e.g. visual, auditory). This suggests that research on the use of multimedia in instruction may either focus on a certain level or a combination of different levels (Schnotz, Lowe, 2003).
– *The 'cognitive load theory'* (Chandler and Sweller, 1991), that specifies that the working memory has a limited capacity as far as the amount of information that may be developed is concerned.
– *The Dual Coding theory* (Paivio, 1991) has quite specific predictions about how information in different media is stored, manipulated, and recalled. Different combinations of media are expected to have significant effects upon the recall and retention of information. This obviously may have important consequences in the design of on-line learning paths.
– *Multimedia principles and their effect on learning* (Clark and Meyer, 2003), represent a classification system that organizes graphics and multimedia elements according to how they support the six psychological events of learning: support attention, activate or build prior knowledge, minimize cognitive load, build mental models, support transfer of learning, support motivation.

First Case Study: Criminal Procedure

The "case study" for the course of Criminal Procedure in the Faculty of Law, is an example of Multimedia product that runs along an evolutionary line designing a new concept of 'simulation': the veracity of the traditional dialogue between the protagonists of the case-study is simulated through animated avatars that personify all protagonists: the chosen educational strategy has been that one to simulate through the role playing the juridical content needed to fix learning [6].

As didactic choice, the virtual tutor (represented by an avatar) intervenes upon the occurrence of whatever strategically relevant moment, as identified within the multimedia path.

The core of the situation which starts the case is a dispute between two car drivers. The virtual tutor describes what happened through a series of pictures, and summarizes in short and with an aseptic and impartial tune their most significant aspects. During the dialogue between the main players and their related lawyers, the learner can identify the moments which are strategically more important – and that possibly occur more often in the reality; he can underline exactly the normative, legal references to refer to, through appropriate explanations given by the same lawyers and adequate graphic supports (Figs. 1 and 2).

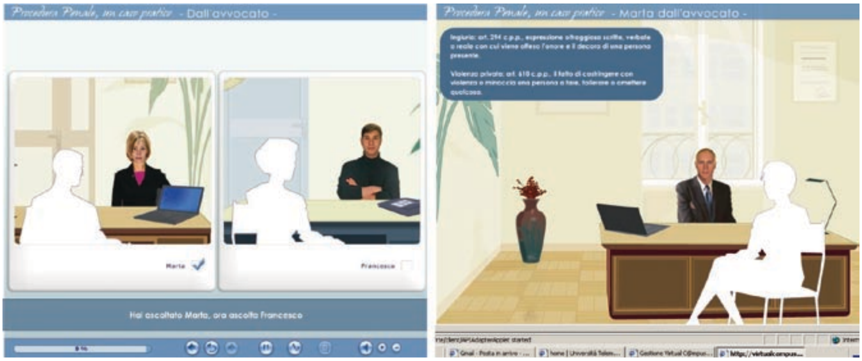


Fig. 1, 2 Criminal Procedure Case Study – The dialogue with the layers

Theoretical approaches which proved particularly useful while designing it, were the “Dual coding theory” (Paivio, 1991), since the use of characters (even animated characters) to represent notions and concepts in the legal field hardly and rarely represented so far, implied a better memorizing by the user, who was able to codify characters and animations not only visually but also verbally, thanks to the use of exercises of different grades of difficulty. (“[…] The concrete words, which recall mental images in a quicker way in comparison with abstract words, are better remembered […], Cornoldi and Paivio, 1982, in [4]).

In the design phase, particularly useful has also been the attention on the main aspects of ‘cognitive load theory’ (Chandler and Sweller, 1991, in [7]), thanks to which the Instructional Designer and the Subject Matter Experts paid great attention in the creation of all the dialogues, in order not to surcharge them with too many pieces of information and contents which are misleading in relation to the didactic objectives of the learning path.

Kolb’s pedagogical cycle helped a lot in the creation of the learner’s interface, in order to present the problem scenario to each role player, with any relevant content for their role, at that particular stage of the learning path: Experiencing, Reflecting, Conceptualizing, Experimenting.

In the same phase, we also tried to make sure that the learner’s attention was focused mainly on three sources of information: visual, auditory and verbal; alone or taken individually, they would have been incomplete or inadequate instead. [8].

This mental integration required a remarkable project design effort, to put together in a proper and efficient way all the texts and the multimedia elements necessary to the development of the whole educational project [9].

The presentation techniques that have been elaborated, and especially the use of animated avatars, illustrations, text and audio-visual comments, have tried to explain multimedia learning as the result of an “active” elaboration of contents which are shown in different formats. These multimedia experiment related to the juridical field, proved able to reconcile methodological didactic needs with the use of ICT only apparently very far from typically juridical contents.

It's a multimedia product that has shown how the virtuality of role playing in case studies, together with cognitive technologies, generally calls into play all the richness and complexity of the learning opportunities offered to the learner.

Second Case Study: Art and Surroundings

Another multimedia experimentation related the evolution of the 'simulation' concept is a project called "Art and Surroundings", a multimedia path around the world of Art, designed and supervised by Prof. Anna Baldazzi2 (Fig. 4).

This project has been thought to be a set of possible different educational routes, all characterized by a participatory and flexible nature.

At the base of each route, there is the need to 're-build' an ad hoc micro-world able to include, put in the proper context, expand and enhance the educational goal time after time [10,11].

From a graphic and at the same time a meta-communicative point of view, our access to the city of constituted micro-worlds is granted by the "ideal city": it calls the learner to consider himself at the centre of a knowledge and notions building process which does not imply only the exploitation of one's educational resources, but also of those one will meet during his virtual travel through the world of art.

At first in the Ideal City we can meet the "Exposition Hall" and the "Pavillions". At this point we can follow two different paths, which give access to two different

Fig. 4 Art and surroundings' homepage: the ideal city

[2]Prof. Anna Baldazzi is scientific consultant in Telematic University Guglielmo Marconi, Knowledge Management Expert and scientific editor of *Formamente* Magazine.

micro-worlds. In this paper we will illustrate, as an example, only part of the first of the two itineraries: the Exibition Hall.

First Itinerary: The Exposition Hall

The "Exposition Hall" is represented by a Contemporary Art Gallery, where three touchable elements give us access to itineraries related to the relation between *Art and Media, Art and Cinema, and Art and Literature* (Fig. 5).

From each of these three itineraries, the learner can move in the environment and choose in a personalized manner the further micro-worlds he's interested in.

Since learning theories and cognitive styles were discovered earlier than Learning management Systems, the very basic learning strategy that inspired "Arts and Surroundings" is the constructivist model [12], that acknowledges that learners' reality is constructed by his or her mind. The mind is filtering the information from the world, according with its subjective perspectives.

From the point of view of the visual communication, the objective of the project 'Art and Surroundings' is twofold: to plunge the user into an interactive environment, and at the same time to stimulate a more refined level of conceptual abstraction when compared to a real place "mimesis" [13].

It represents an original fusion of languages and interactions, a continuous exchange of codes (just think of the relationship between text and images, enriched in its effectiveness by musical elements) that, without disorienting surfing, allows the learner to keep active attention while interacting with the various environments [14].

Fig. 5 The exposition hall and hits three micro-worlds: arts and media, arts and cinema, arts and literature

It deals therefore with simulated environments where the simulation itself reaches objective high levels of realism, going in search of concepts and knowledge rather than solutions: in a word, aiming to gain knowledge.

Conclusions

The teaching strategies adopted to design and develop both "Criminal Procedure Case Study" and "Art and Surroundings", although very different one from the other, have been oriented towards a figurate representation of reality, where the real situation was appropriately identified and only in appearance exemplified. In the School of multimedia products, perhaps a step forward has been made if compared to the mere memorization and reiteration of actions; we managed to focus also and especially on cognitive functions: individuals need to perceive and store evidence, as well as be able to play the correct behaviour.

From those two examples, it seems more evident, therefore, that the concept of 'simulation' goes on moving toward the concept of 'representation' and must be understood as:

– 'schematically simplified view' of real environments, appropriately represented through the support of additional media (ex: movie).
– Content 'figurative representations' (ex: avatars) commonly explained mainly and only through text.

We might argue that the concept of simulation itself is in fieri: somehow it has been 'broken' and can be understood under different forms and nuances, that vary from the simulated representations of reality to the realization of virtual environments.

From a methodological and didactic point of view, these learning paths are therefore associated with the subsequent developments of the planned education (of the linear type, that is implying a predetermined sequence of steps, according to Benjamin Bloom's Learning for Mastery Method [15]), which takes into account not only behavioural but also cognitivist inspiration [17].

Multimedia didactic paths, case studies, role playing and simulated representations of reality are the result of a research and experimentation that changes and self-nourishes. The activity correspond to, and relies on the awareness that technological innovations are always directed to reaching a greater degree of teaching effectiveness with respect to the design of any learning environment.

Specifically, the virtuality of role playing and reality representations, together with cognitive technologies, generally calls into play all the richness and complexity of the learning opportunities for the learner; in a sense, the educational process has tried to conquer all the technological innovations and exploit their potential.

In particular audio-visual media successfully integrated with other codes and languages of sensorial/perceptual communication, offered a strong example of multimediality, and therefore of wealth and quality of incentives, to make them an excellent opportunity for learning.

It was therefore interesting to note how much technologies have influenced the user through virtual environments especially constructed where reasoned information and knowledge are available: the learning of knowledge becomes, as a consequence, a multidimensional and multimedia process, where the user draws the necessary information from the environment. The virtual learning environment thus provides an experiential context that allows the user to discover, re-discover, re-invent and re-build concepts, ideas, theories according to an active learning methodology.

The concept of simulation in the two examples of Multimedia Learning Paths became effective in terms of exploration and understanding of reality because, by simplifying the reality, it made it possible to grasp the elements that really matter and their relations ("[]…to say the truth, simulations does something different from simplifying: it allows to identify the contour of reality, allowing them to catch its essential aspects", in [18]). The fact that simulation is not reality, but it represents only its exemplified model, is the true strength of simulation itself.

The analysis of simulation models seems to bring the necessity to transform, even from a terminological point of view, the 'right to education' with the 'right to access in education', a sector where distance education may play a fundamental role.

In conclusion, in e-learning the concept of simulation is to be considered surpassed: it is no longer the final purpose, but it becomes one of the components of a more complex system where different codes interact. It is desirable that the proliferation of new technological tools does not prevail on the capacity of cognitive and pedagogical reflection they require. More than ever, it is essential to identify the cognitive variables which intervene in the learning process through technologies, and to understand how learning ca be improved though the introduction of technology.

References

1. Mammarella M., Cornoldi C., Pazaglia F. (2005), *Psicologia dell'apprendimento Multimediale*, Il Mulino, Bologna
2. Calvani A. (1998), *Costruttivismo, progettazione didattica e tecnologie*, in D. Bramanti (a cura di)Progettazione formativa e valutazione, Carocci, Roma
3. Carletti A., Varani A., *ICT come ambiente per una didattica costruttivista*, Informatica & Scuola, Dossier, anno IX, n.2–3
4. Calvani A. (a cura di), (2007), *Tecnologia, Scuola e processi cognitivi*, Franco Angeli, Milano
5. Domenici G. (1999), *Manuale della valutazione scolastica*, Editori Laterza
6. Vogel J., J. Bowers, K. Muse, M. Wright, (2006), *Computer Gaming and Interactive Simulation for Learning: A meta-analysis*, Baywood Publishing Company
7. Mayer, R. E., and Moreno, R., *Nine ways to reduce cognitive load in multimedia learning*, Educational Psychologist, 38(1). Maragliano R.(a cura di), (2004), *Pedagogie dell'e-learning*, Laterza

8. Santilli R. (2006), *Il mestiere dell'Instructional Designer*, Franco Angeli, Milano
9. Romiszowski, A.J. (1988), *The Selection and use of Instructional Media*, Nichols Publishing, New York
10. Gentner, Stevens (1993), *On the relation of dual coding and mental models in graphic comprehension*, Learning and Instruction, Volume 3, Issue 3
11. Mayer, R. (1989), *Models for understanding*, Review of Educational Research, V. 59, N.1 43–64
12. Winn, W. (2002), *Current trends in educational technology research: The study of learning environments*, Educational Psychology Review, 14(3) 331–351
13. Manouselis, N., & Sampson, D. (2002), *Dynamic knowledge route selection for personalized learning environments using multiple criteria*, Proceedings of the IASTED International Conference on Applied Informatics
14. Clark, R., Lyons, C. (2004), *Graphics for learning: proven guidelines for planning, designing, and evaluating visuals in training materials*, Pfeiffer, San Francisco, CA
15. Kulik, C., Kulik, J., & Bangert-Drowns, R. (1990), *Effectiveness of mastery learning programs: A meta-analysis*. Review of Educational Research, Vol. 60, No. 2, 265–299
16. Perkins D.N. (1991), *Tecnology meets constructivism: do they make a marriage?* Educational Technology, 31 5 18–23
17. Santilli R. (2002), Simulazione e apprendimento: un problema estetico, Roma

Socio-Materiality as Lens to Study IT Driven Change

A. Carugati[1], C. Morelli[2], and A. Giangreco[3]

Abstract This paper reports the findings of a research into change during the constitution of an IT Group. Our main findings show that when an IT company acquires two similar companies, IT becomes a central part of the change program, differing from other change cases where IT is considered a peripheral component. We use the scaffold metaphor by Orlikowski [1] as a framework to interpret the case study. Our study is a primer in the use of socio-materiality as framework for interpreting IT-driven change and shows that this framework can highlight the most common characteristics of change while remaining practical and synthetic.

Introduction

In recent times many companies have obtained great results basing their change programs on technology. However the advantages of technology driven change are however still open for debate and managers with strong IT skills are still very rare. While simple views on the role of technology in change, like the magic bullet [2], are now obsolete, the complexity and variety of today's environment call for studies that take seriously the role of technology as a predominant component of change. This role becomes more and more relevant as technology becomes pervasive in any commercial activity. The rate of failure of technology implementations and change processes is a sad reminder of the need for studies of change in situations where technology is pervasive. Our study takes on this call to understand the complex and persistent problem of the role of technology in change. To respond to this call we investigated technology driven change in a case where technology was a product, a source of revenue, and integral part of

[1]Århus School of Business, University of Århus, Denmark, andreac@asb.dk
[2]Università Amedeo Avogadro e Università Carlo Cattaneo, Italy, chiara.morelli@eco.unipmn.it
[3]IESEG School of Management, Catholic University of Lille, France, a.giangreco@ieseg.fr

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_51, © Springer Physica-Verlag Berlin Heidelberg 2010

work activities. We studied the emergence of an IT group from three software companies where the largest one produced, commercialized and used an enterprise system. After the acquisition the enterprise system was used to integrate the information flows and homogenize the activities and processes of the three companies

Among the many lenses that can be used to read a change case, given our specific focus on IT and its role in change efforts we have decided to use the sociomateriality perspective, a perspective that illuminates the material characteristics of technology as supportive of human actions. This perspective has been largely ignored in IS research [3] but in our view it will be useful to evidence the unavoidable characteristics of IT in change that are normally backstaged when change studies focus mostly on the social interpretation of technology and disregard the objective possibilities and limitations offered by IT in work practices.

Current Views on IT-Driven Change

The study of technology in change efforts has origins that go back in history. The magic bullet view of technology [2] has been used over time [4, 5] but this simplistic view has gradually given space to more variegated, interpretive approaches. In the last two decades we have observed multiple studies that shift the attention from prescriptive models to more organic ones [6–8]. In particular the research on the knowledge aspects of change has obtained more and more status. In this interpretive studies, it is stressed the importance of objective and subjective elements which enhance the uniqueness of the enterprise and of its evolution path [9, 10]. Culture, rather than rationality, takes up a major role because culture acts as a lens to interpret knowledge and artefacts [11] as well as it guides our actions [12, 13], and our sensemaking [14]. Therefore culture, knowledge, and sensemaking have become in recent years the main antecedents to understand the preconditions, enactments, and reactions to change process.

Organizational change and the study of technology in organization have relatively recently merged in studies of IT driven changes beginning with the milestone article by Marcus [15] that delineating the political aspects of IT implementation in fact set down an agenda for the next decades of studies of IT in organizations. For example Barley [16] discovered that the introduction of IT can be an occasion for restructuring an organization and that this restructuring is not deterministic. Rockart [17] stated that IT related change must take into consideration also the organizational context including culture, roles, organization, etc. Orlikowski and Hofman [18] find that IT driven change is not a linear rational path but the result of local adaptation and emergent behaviour where the interpretation of technology in the context is the key to its effects.

These studies have a common background or reason d’être: the rejection of the status quo and the rejection of the deterministic view as basic philosophy of the magic bullet. The paper of Orlikowski and Baroudi [19] became a manifesto for interpretive research and unwillingly decreed that everything in technology is the effect of interpretation or affordances. The corollary to this is that the material characteristics of technology became more and more backstaged in technology studies. One could not talk about technical possibilities without being tagged as a positivist and a determinist. But as time as passed – and IS researchers have forgotten about the material characteristics of IT [20] – the research community has begun to trace back the implications of these choices for our research domain and the results are not very comforting. First of all materiality matters for theories of technology and organizing because the material properties of artifacts are precisely those tangible resources that provide people with the ability to do old things in new ways and to do things they could not do before [3, p. 161]. Secondly and most importantly, considering materiality is not against interpretivism. The material characteristics of technology transform information and do not only offer affordances that change work practices; they often change the nature of the work itself. [3, p. 165]. So considering materiality does not make a researcher a positivist but rather offers a richer lens to observe the phenomenon of appropriation of technology by individuals and in organizations. To integrate materiality with a more voluntaristic stance requires that researchers attend directly to the specific ways in which the features of particular artifacts become entangled in the social practices of people at work [21, 22]. In addition to studying social dynamics such as perception and interpretation, this means paying attention to what a technology lets users do, what it does not let them do, and to the workarounds that they develop. In the following we will therefore use the socio-materiality lens to study the impact of IT in change programs.

Materiality: A Framework for Studying IT-Driven Change

In her 2006 article on socio-materiality of knowing, Wanda Orlikowski [1] quotes Latour to stress the importance of materiality in IT research:

> There exist no relation whatsoever between the material and the social world, because it is the division that is first of all a complete artifact. To abandon this division is to rethink the whole assemblage from top to bottom and from beginning to end [23]

In Orlikowski's view, the material characteristics of the world surrounding us are integral part of what we do and what we know and play a critical role in everyday practices and the knowledge embedded. Orlikowski presents a performative view of knowledge, a knowledge that is not static but a dynamic and on-going social accomplishment [1]. This view fits perfectly in the IT-driven change problem since during change we are interested in human action and changes in processes and knowledge. What Orlikowski adds to the discussion about knowledge is that knowing is not only emergent, embodied, and embedded in practice but also material. Material knowledge implies that everyday practices are "deeply bound up in the material forms, artifacts, spaces, and infrastructures through which humans act" [1].

In office settings like the one described in this article and in Levina and Vaast [24], the people are involved in a series of processes and activities that are somehow supported by technology and therefore it can be assumed that IT is for office tasks the material scaffold of actions and knowledge. As Orlikowski points out at the "level of conceptualizing and theorizing, we tend to disregard this knowing, and render our accounts of knowledge in organizations without attention to material matters." The problem of forgetfulness of materiality seems to be quite widespread since the nowadays dominating paradigm in ISD is human-centric focusing largely on human interpretation of actions while technology tends to take a backstage role [20]. Orlikowski offers the concept of "scaffold" as the mechanism for material objects to sustain practices. Scaffoldings have the following characteristics [1, pp. 461–462]:

Scaffolds are temporary – they are erected on a building site to support the construction of particular elements. They typically exist for the duration of the project, and are dismantled once the elements are completed or self-supporting.

Scaffolds are flexible – they are constructed in situ, adapted to fit the particular local conditions; as such, they may be erected in many different situations.

Scaffolds are portable – they are relatively quickly and easily assembled, modified, and disassembled, as needed, on different building sites.

Scaffolds are diverse – there are many different kinds of scaffolds, for example, scaffolds that allow people to walk along the outside of buildings, scaffolds that serve as structural columns to hold up slabs until the poured concrete is cured, and scaffolds that serve as reinforcing formwork that then becomes integrated into the final element being built.

Scaffolds are heterogeneous – they are composed of multiple different components, reflecting both the requirements of the element(s) to be supported, and the materials at hand.

Scaffolds are emergent – they are erected over time, changing in form and function, as needed to continue supporting the changing scale and scope of the element(s) being built over time. While in place, scaffolds afford a certain temporary stability to people, materials, and space bound together.

Scaffolds are dangerous – as temporary, emergent, and rapidly constructed assemblages, they are vulnerable to breakdown and failure.

Scaffolds are generative – they serve as the basis for other (creative) work, facilitating the performance of activities that would have been impractical without material augmentation.

Scaffolds are constitutive of both human activity and outcomes, shaping the kind of construction work that is possible, and the construction outcomes that emerge. As such we can imagine that a scaffold is also the right metaphor for an IT system used in an acquisition to integrate the acquired companies.

Research Method

The method used to carry out this research is longitudinal qualitative case study. The research started in 2002 when Axioma bought Dataware and Inforpragma.

The sampling of empirical material was carried out in two phases: at the beginning, in 2002 with interviews (10), and 2003 with questionnaires (85) and in a second period in 2008 with two additional interviews to the CEO and the executive director. Throughout the period we also collected secondary data (company data and press). The interview protocol used in 2008 is available from the authors and the questions are prompted by the relevant literature.

The data was analyzed performing content analysis of the interviews using the scaffold metaphor to identify temporary, emergent, flexible, etc. practices. We looked for work practices, both bottom up and top down, supported or connected to the use of technology [3]. We also looked for evidence of stable working practices as they may be the evidence of resistance to change. Finally we have triangulated the results of the content analysis with the results of the questionnaires to see if and how much overlap there was between the top management view and the employees view.

Axioma: A Brief History

Gruppo Axioma (Axioma) was been created in 1979 in Milan, Italy, by Mr. Maserati, a professor of informatics in the local state university. Axioma has grown to employ 330 employees in 2001 and has since then experienced the bouncing market conditions that have characterized the IT industry in the last years. The main products of Axioma regard a suite of modules for enterprise management: an ERP intended for medium size enterprises. Axioma is a full service provider that takes care of the engineering, production, development, sales and maintenance of the products. The development strategy of Axioma is to always adopt the most modern technologies to develop and support its products.

> In Axioma we have embraced all the new technologies that could give us an advantage. Here the operating system is one thing, the programming language is another, the database a third one. A radical change in culture and in competences for our programmers and consultants. This is because the technologies of the fourth generation are complex and specialised. (Axioma, CEO, 2008)

In the early 2000 Axioma when through a wave of acquisitions following the realization that in a country like Italy and for SME the market penetration was facilitated by local presence and local network. In the year 2001 Axioma acquired Dataware (25 empl. in Bologna) and in the year 2002 they acquired Infopragma (15 empl. in Verona). The two companies produced also ERP type systems but with older technologies respect to Axioma. The business plan behind the acquisition was to win the clients portfolios through an update of their applications with Axioma's products. Furthermore Axioma is itself a user of their ERP suite (called S/5) and the ERP solution was used to integrate processes and accounting practices inside Dataware and Infopragma. The change required therefore a double sided action: internal for the implementation of the ERP systems and external for the acquisition of the clients.

Axioma: IT as Scaffold for Change

In this case the introduction of complex IT systems has important consequences for company employees at all levels. The process was run top-down by Axioma and implemented by the companies' employees. The employees of the acquired companies had to assimilate new technical know-how and culture because, for example, the new technology was open rather than proprietary. They had to modify their behavior because Axioma's ERP technology was also used internally. In the following we will use the socio-materiality idea and the Scaffold metaphor to show different aspects of change focusing on both Axioma's ERP system (the new system) and the old systems found in Infopragma and Dataware.

Technology as temporary and emergent scaffold shows us the ERP technology as continuously under development so supporting change in an ever changing fashion. The old systems are more stable but are also a temporary scaffold for change as their destiny is to disappear. The change is therefore supported and unbalanced towards the new system.

Technology as a flexible scaffold for change shows us the affordances presented in the ERP technology [25] since different employees in the acquired companies can interpret it in different ways. For some actors the ERP technology is a simply a tool to work on, for others it is an obstacle to the use of their existing knowledge. Finally for some actors, and this includes the CEO of Axioma, the technology is a negotiation tool: the faster and the better one learns the new technology the faster one will concretize his or her position in the new company.

> We have applied the normal change tools that we use in Axioma and in some cases we have met resistance. So we have imposed the same software system (S/5) to everybody: for administration, control, and process management. We have met some resistance in the use of the software but within the year everybody was using it … they kept parallel systems … but everybody does that (Axioma, CEO).

Technology as portable scaffold for change shows us the ERP technology as a vehicle for the migration of practices from the original Axioma group to the new companies. The S/5 ERP system, as common for ERP systems, contains processes and practices. By implementing and using the S/5 suite in Infopragma and Dataware, the management of Axioma assured more than just getting acquainted with the tool. They assured that the new employees learned, just by using the system, the practices and the processes used internally in Axioma.

Technology as diverse scaffold for change shows us that the ERP system emerges as a different and unplanned tool for change. In the mind of Axioma management the main goal was the commercialization of the S/5 suite to a larger audience. The internal result of the use of S/5 was that the companies became unified more quickly due to the technology propagation rather than without.

Technology as a heterogeneous scaffold shows us that the different systems and knowledge domains of the employees involved in the merger were of different nature, at times building upon each other and at times being incompatible. Complementarity and compatibility have however to be seen under the light of the affordances offered by the technology as scaffold. For some employees the heterogeneity was a way to learn new techniques and therefore it became a help in the career while other employees saw mainly the incompatibility and therefore the new technology became a major element of resistance to new ways of working.

> For the new ones the switch from AS400 to Oracle is like going from night to day. Over there the operating system, the language, the database were one thing, here they are all separate. It is a radical change in culture, they could do everything with COBOL; here we do the GUIs in Java, the queries in SQL, etc. A massive change but that gives plenty of opportunities to those who take them (Axioma, CEO).

Technology as a generative scaffold shows us the S/5 suite as the glue bringing the Axioma merger together. It brought practices and knowledge around in the newly added companies and, being it also the product, it became a hard measure of success. If the ERP suite was not used inside the new knowledge would have taken much longer to permeate the discourse of the new employees.

Technology as dangerous scaffold shows us that the new construction with the merger created around the ERP suite is vulnerable to breakdown and failure. Failure in the short run may be result in resistance to change and turnaround for some employees. In the long run however if the scaffold is not used to stabilize the organization the group could encounter serious structural problems.

> Another important problem is that we have acquired a world living on AS400 … it may sound simple but we used a completely different language: for us a system engineer takes care of hardware and software; in AS400 a system engineer only does software. We have imposed a new vocabulary to all companies … maybe we should have been meaner … but anyway in some cases we made enormous changes and with different consequences: in Bologna no injured and no dead … in Verona some injured and some dead (Axioma, CEO).

With the socio-materiality lens we can observe both positive and negative attitudes towards change, top down and bottom up, static pictures and evolution. While this research is only at the beginning, this lens allows us to study change with more precision and less effort then other lenses like for example structuration used by [18] and with more structure than with no interpretive framework at all.

Conclusions

In this paper we use the notion of socio-materiality and the metaphor of scaffolding to identify the material qualities of an IT-driven change program led by an IT company, Axioma, when it acquired two other IT companies. In the paper we take, or try to take, a voluntaristic perspective on materiality therefore avoiding the collusion between materiality and determinism.

We have used the socio-materiality framework operationalised by Orlikowski [1] through the metaphor of scaffold to understand different aspects of IT driven change. This paper presents an initial attempt to do so and shows that the metaphor is valid to show different aspects of change that have been evidenced with simplicity and rigor. As further study the authors intend to further specify the framework in the hope to evidence yet unknown elements of IT driven change.

References

1. Orlikowski W.J. (2006) Material knowing: the scaffolding of human knowledgeability, *European Journal of Information Systems*. 15(5):522–524
2. Markus M.L., Benjamin R.I. (1997), “The Magic Bullet Theory in IT-Enabled Transformation”, *Sloan Management Review*, 38:55–68
3. Leonardi P.M., Barley S.R., (2008), Materiality and change: Challenges to building better theory about technology and organizing, *Information and Organization*, Vol. 18:159–176
4. Zuboff, S. and Bronsema, G. (1984), “The Expense Tracking System at Tiger Creek,” HBS Publishing, HBS Case No. 9-485-057, Boston, MA.
5. Zuboff, S. (1988), In the Age of the Smart Machine: The Future of Work and Power, Basic Books, New York, NY.
6. Argyris, C., & Schon, D. (1978) Organisational learning: A theory of action perspective. Reading, MA: Addison Wesley.
7. Senge, P. et. al. (1994) The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization, N.Y.: Doubleday.
8. Nonaka, I. and H. Takeuchi (1995). The knowledge-creating company. New York, Oxford University Press.
9. Nonaka I, Toyoma R. (2005), The theory of the knowledge-creating firm: subjectivity, objectivity and synthesis, *Industrial and Corporate Change*, 14(3):419–436.
10. Tsoukas, H., & Chia, R. (2002). On organizational becoming. *Organization Science*, 13(5): 567–582
11. Schein, E. H. (1985). Organizational culture and leadership: A dynamic view. San Francisco, CA: Jossey-Bass.
12. Czarniawska B., Joerges, (1995). Venti di cambiamento organizzativo: come le idee si traducono in oggetti e azioni, in Bacharach S.B., Gagliardi P. E Mundell B. (a cura di), Il pensiero organizzativo europeo, ed Guerini, Milano.
13. Czarniawska, B. (1997) Narrating the organization: Dramas of institutional identity. Chicago: University of Chicago Press.
14. Weick K.E. (1995), Sensemaking in organizations, Thousand Oaks, CA: Sage.
15. Markus, M. L. (1983), “Power, Politics, and MIS Implementation,” *Communications of the ACM* (26:6), pp. 430–444
16. Barley S.R., (1986), Technology as an occasion for structuring: evidence from observations of CT scanners and the social order of radiology departments, *Administrative Science Quarterly*, 1986 Mar 31 (1):78–108.
17. Rockart J.F. (1988), “The line takes the leadership”, *Sloan Management Review*, 29:57–64.
18. Orlikowski W., Hofman D. (1997) “An Improvisational Model For Change Management: the case of groupware technologies”, *Sloan Management Review* 38:11–21.
19. Orlikowski, W.J. & Baroudi, J.J. (1991) “Studying Information Technology in Organizations: Research Approaches and Assumptions”, *Information Systems Research* (2).
20. Orlikowski & Iacono (2001): Research commentary: desperately seeking the “IT” in IT research – a call to theorizing about the IT artifact. *Information Systems Research*, 12(2):121.
21. Knorr Cetina K. (1999) Epistemic cultures: How the sciences make knowledge. Cambridge: Harvard University Press.

22. Pickering, A. (1995). The mangle of practice: Time, agency, and science. Chicago, IL: University of Chicago Press.
23. Latour, B. (2004). Why has critique run out of steam? From matters of fact to matters of concern. *Critical Inquiry* 30: 225–248.
24. Levina, N. and E. Vaast (2005) "The Emergence of Boundary Spanning Competence in Practice: Implications for Information Systems' Implementation and Use," *MIS Quarterly (29:2), Special Issue on Knowledge Management*, June, pp 1–29.
25. Ciborra, C. (2000). The Labyrinths of Information. Oxford University Press, Oxford.

Supporting Access to Online Legal Information: Semantic Strategies

M.A. Biasiotti[1] **and G. Peruginelli**[2]

Abstract To have access to legal information is a fundamental requirement for a variety of communities: ordinary citizens, scholars and legal professionals. Users of legal information belong to different categories and have various requirements and competencies. They use legal information for various purposes, and differences exist in the way such information is disseminated. To ensure access, commercial publishing is insufficient. In particular in the context of legal information the Internet promises to effect a radical transformation in the existing system of legal material. Legal producers and providers have made a great progress in placing legal materials on the web; these efforts have almost been too successful, as the legal researcher must now deal with an enormous amount of information spread across different servers. This huge amount of available legal information does not correspond to an enlargement of the right to access such sources as contents are not easily searchable. Therefore some ICT tools able to facilitate the retrieval of legal documents are to be adopted. This paper presents some semantic strategies, tools as well as methodologies developed within some EU and national Projects for specific types of legal information.

Introduction

A Glance to Legal Information

The dissemination of legal information contributes to the rule of law and to the overall ideals of democracy in a number of ways. Many are the benefits of accessing legal information, such as the awareness of the applicable rule of law, the creation of conditions necessary to the equality and fairness of a legal system, while

[1]Institute of Legal Information Theory and Techniques, CNR, Firenze, Italy, biasiotti@ittig.cnr.it
[2]Institute of Legal Information Theory and Techniques, CNR, Firenze, Italy, pe-ruginelli@ittig.cnr.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_40, © Springer Physica-Verlag Berlin Heidelberg 2010

improving the functioning of democratic institutions, the development and improvement of social and economic conditions. Ignorance of the law excuses no one, and citizens have the right to know the laws governing their conduct. Everyone has the means to gain knowledge of the law, and governments have an obligation to put forth legal knowledge by enabling access to the law using all available and reasonable media [1].

The rapid explosion of electronic information on the Internet is an unquestionable reality, as well as its enormous impact on research, business and every social activity. However this electronic transformation has its drawbacks; in fact navigating through such an amount of information sources, often unstructured, may make people waste their time and miss their expectations [2].

- In particular in the context of legal information the Internet promises to effect a radical transformation in the existing system of legal material. Legal producers and providers have made a great progress in placing legal materials on the web; these efforts have almost been too successful, as the legal researcher must now deal with an enormous amount of information spread across different servers.
- Nowadays legal research is facing a serious problem: the abundance of electronic legal information makes it very difficult to organize such resources in a way that they can be consulted with confidence, checked and cited as valuable sources.
- It is worth noting [1] that modern legal research greatly relies, apart from legislation and case law, on secondary sources, and researchers need help from legal experts and law information professionals who know how to organize, analyze, index, information to make it accessible. Discontinuous and obsolescent networked information is of low utility and runs the risk of becoming extremely expensive in economic terms as well as making information providers and users' wasting precious time.

Three different types of information are traditionally comprised in the concept of legal information: legislation, case law and legal authority.

Legal information was traditionally delivered on print formats, but the increasing production of legal texts has brought about a crisis in information access and the traditional tools were no more sufficient to its distribution, as widely discussed in [3]. In this context, legal information retrieval systems provided the earliest example of substantive use of information technology in legal work. The early developments originated in government departments, military institutions and university environments where computer technology offered an efficient means to classify large amounts of data. In the seventies, databases having the capacity to store the whole of the United States statute and case law materials next to secondary material reproduced in full text form were created. In the same period similar information systems were developed in Europe. A more recent development has been in the growth of the World Wide Web-based legal information retrieval systems. Nowadays an enormous amount and variety of legal information is available on the web and accessibility, coverage, currency, reliability, searchability and useability are considered major key issues of relevance to legal information retrieval.

From our point of view, it is to be pointed out that while the first electronic legal information systems were created to guarantee the widest and most appropriate dissemination of legal information within national contexts, nowadays, an ever increasing attention is given to the issue of transnational dissemination of national legal information; the focus is on the implementation of information systems allowing the researcher, the lawmaker, the judge and the citizen of a given country to have access to the legal information of other countries by means of adequate supporting tools. This paper analyses three different projects centred on the development of tools able to facilitate access to some specific types of legal information. The three research initiatives have been carried out within the Institute of Legal Information Theory and Techniques (ITTIG-CNR) where both authors work.

- DALOS Project for legislation.
- Caselex Projecy for case law.
- Portal to Italian Legal Literature for legal authority.

DALOS and Caselex are projects directly funded by the European Commission and to which the authors of this paper participated carrying out some specific activities linked with the development of semantic layer and tools.

The DALOS Project: The Ontological Approach

The DALOS project, financed under e-Participation program, aims at providing legal drafters and decision-makers with linguistic and knowledge management tools to be used in the legislative processes, in particular within the phase of legislative drafting.

This will contribute to the harmonisation and coherence of legislative texts by means of:

- Providing the drafters with easy access to the pertinent ontological resources so that they can obtain immediate clarifications on legal terms used, navigate through the network of legal terms, consider the ways in which the same concept is expressed in different languages.
- Enriching linguistic-ontological resources both via interaction with legal experts directly involved and via the integration of ontology learning tools, able to cluster relevant terms from legislative texts and organizing them in taxonomical chains integrating ontological tools within the legislative process.
- Facilitating accessibility to legislative texts by European citizens, thus promoting their participation in the legislative process and their involvement in the law comprehension process.
- Improving the quality and the readability of legislative texts, thus contributing also to the “certainty of law”.

– Moreover, once the text is delivered, ontological knowledge will facilitate retrieval for European citizens and also interpretation and implementation of legal documents.

These results, besides a well structured multilingual domain-specific ontology require a set of computer tools, clustered around such ontology [4, 5]. In DALOS project such tools are expected to manage multilingual issues: they are addressed to harmonize legal concepts and related terminologies used in European legislation as well as in the legislation of different European countries. To obtain this result the project is exploiting linguistic ontological resources developed within previous European project experiences. In particular to guarantee the feasibility of the project, the ontological-terminological resources developed within LOIS project (EDC 22161 – see http://www.loisproject.org), are made available for their integration within the drafting tools, used by legislative offices, through a defined standard interface, thus without interfering in the chain of legislative production, but nevertheless guaranteeing the improvement of the law making activity and the final products of the legislative processes. Using such resources legislative drafters will be able to query linguistic and ontological resources, searching for appropriate and standardized terms or locutions, corresponding to specific legal concepts. The above resources will be integrated with T2K ("Text-to-Knowledge"), an ontology learning tool jointly developed at CNR-ILC and Pisa University (Department of Linguistics) which combines linguistic and statistical techniques to carry out the ontology learning task. DALOS prototype is focused on the specific area of protection of consumers' economic and legal interests.

The final result of DALOS project will be a linguistic tool assisting the process of drafting legislation by providing ontology-based and statistically selected suggestions for terminological re-use and knowledge management.

The Caselex Project: The Knowledge Organization System Approach

One recent and very advanced example of an information system allowing transEuropean access to national case law is Caselex, a service developed with the support of the EC Commission under the eContent and eTEN programmes.

Caselex (http://www.caselex.com) is an Internet based "one-stop-shop" service for national case law linked to the common denominator of EU law. It collects decisions of Supreme and High Courts of Member States, within selected areas of law connected with the implementation and application of EU law. Therefore, it has built a platform that brings the public case law content from a disconnected set of national information sources to an integrated and distributed European knowledge service, enabled by semantic web tools. The relevance of the distribution of decisions of national courts is still greater in the European Union, especially for decisions concerning the application of EU law (direct applicable EU law or the domestic law implementing EU law). The experience of the courts of other Member States could help the court of another country to better comprehend and interpret the same EU measure. The distribution of decisions made by national courts and the building of a sort of dialogue enhances their role as "*juges communautaires de droit commun*" and contributes to guaranteeing the uniform application of EU law in Member States [6].

This is the result of a strong alliance between public institutions (content holders and public sector organisations) and private actors (publishers).

Its knowledge infrastructure is designed for facilitating its access through a semantic layer supporting the user to understand what the content is like and to link it with the knowledge already existing in his experience and skills. In this way it is possible to meet the needs and capabilities of different categories of stakeholders.

Cases are collected in Caselex only when: (1) a national court interprets a term mentioned in an EU rule; (2) a national court says something about the 'value' of a certain EU rule; (3) a national court *de facto* applies an EU rule in a new way.

Caselex focuses predominantly on commercial law, presently consisting of 12 areas of law. Cases are offered in their native language full text, integrated with a headnote, a summary and additional metadata in English.

Cases selection and value added information editing are performed by a network of contributors composed of Country correspondents, Reviewers, Legal translators.

Browsing can be applied through:

– *EU provision*. All cases within the Caselex repository are connected to one or more core EU provisions which can be described as the main EU provision discussed in the case. Furthermore, other referred EU provisions are also added. Selecting one or more EU provisions will list the cases which have this/these provisions added as metadata.
– S*ubject*. All cases have one or more subjects from the Caselex Thesaurus added as metadata. Caselex has built up a specific thesaurus organized in 12 microthesauri, one for each relevant area of law; the thesaurus descriptors cover all issues considered by the EU measures of relevance to the areas of law covered by Caselex. The end user can browse through these descriptors and select one or more of them and the result list will display the cases with these subjects added to them.
– *Jurisdiction.* The end user can select case law connected to one or more jurisdictions from which the decisions originate.

The various browsing options can be combined internally or with a free text search.

Caselex is meant to bring a set of important benefits to its users. With respect to *all professionals*, Caselex in a unique and easy way allows users to retrieve and capture the knowledge of qualified and relevant case law from abroad without legal expertise of foreign countries. Language skills requirements are reduced to a minimum, enhancing the accessibility. Fragmented, thus time consuming and expensive access to case law from multiple countries is overcome by a one-stop-shop for important case law from 31 European countries. Furthermore, European case law monitoring is easily available in a customised manner allowing better job fulfilment.

The trans-European access to national case law is to be considered an obvious and relevant issue due to the widespread increasing development of globalization affecting all aspects of social and economic activities all over the world. Since this process implies that people living in a country entertain permanent relationships with people, enterprises and institutions of other countries, the knowledge of national case law is essential for understanding the legal order of the different countries.

Many legal information systems in Europe provide this type of access. They prove themselves more useful when they are equipped with semantic tools supporting the stakeholders in their searching needs especially when they are lacking of those capabilities to manage multicultural and multilingual data.

The Portal to Italian Legal Literature

The Institute of Theory and Techniques of Legal Information puts efforts in developing a system to ensure a unified point of access to legal authority [8].

The project which is at the moment a feasibility study was born in 2003 and intends to offer a gateway to multiple legal authority resources, provided by European countries, to be achieved by exploiting rich metadata and by providing tools to discover, select and use relevant material.

The project intends to give access to different level of information of legal authority (bibliographic references, abstract, full text) and to retrieve the amount of available legal authority in electronic format (single articles, summaries of cases and statutes, conference papers, etc.) in order to guarantee searchability, usability and interoperability of digital content within the context of the existing legal framework.

The Portal is indented to cover both data coming from structured data repositories (specialised legal databases, library and publisher's catalogues) and web documents (namely HTML semi-structured documents). The aim is to integrate these two different data sources in a unique view using a uniform metadata scheme such as Dublin Core metadata set. In order to harvest data from structured repositories, the OAI (Open Archive Initiative) approach is recommended [9]. This approach enables access to web-accessible material through interoperable repositories for metadata sharing, publishing and archiving to foster the proliferation of open European knowledge pools of digital objects, on behalf of education and research communities, as well as citizens.

At the moment work is underway on the enhancement of the existing solutions oriented to semantic searching, as well as to the implementation of specific facilities to support legal users in semantic querying the Portal, trying to guarantee both precision of retrieval and recall efficacy. In particular, to ensure retrieval precision, the

Portal aims at enriching documents with high quality metadata, so that retrieval is more focused and able to better match the semantics of the query Moreover, to guarantee recall in retrieval, the Portal aims at matching the related information needs. To obtain this, the query has to be formulated in a way that expresses at its best the semantics of such needs. For this purpose users are to be offered facilities to construct a query, browsing a hierarchy of legal categories, as well as to expand it with broader or narrower terms. Through such expansion of an original query, users can retrieve relevant documents which did not match the query as originally formulated.

This service improves the expressiveness and completeness of the query, so to match at its best user information needs, as well as to achieve recall.

In conclusion the designed project aims at providing a single point of access into disparate repositories where categories of law, as content of the field dc:subject, automatically generated for web resources, are the essential metadata to point to relevant legal authority documents improving precision in retrieval. As shown above, facilities in query formulation are offered to users through the exploitation of a legal controlled vocabulary, improving recall.

Conclusions

The access to national and EU legal information is to be considered an obvious and relevant issue due to the widespread increasing development of globalization affecting all aspects of social and economic activities all over the world. Since this process implies that people living in a country entertain permanent relationships with people, enterprises and institutions of other countries, the knowledge of national case law is essential for understanding the legal order of the different countries.

Many legal information systems in Europe provide this type of access. They prove themselves more useful when they are equipped with semantic tools supporting the stakeholders in their searching needs especially when they are lacking of those capabilities to manage multicultural and multilingual data.

The push towards digitalisation is favoured by the integration between the computer supported drafting of documents and their electronic distribution, and also by the availability of reliable technologies for ensuring authenticity and integrity of electronic documents (like electronic signatures). Electronic legal documents rather than being a copy of pre-existing original paper documents tend to become the official legal texts.

The production of private contracts and administrative acts in electronic formats, to be preserved in computerised databases, is today common in most jurisdictions of developed countries. Digitalised legal information, being freed from its traditional paper hardware, can be processed by computer, and transmitted over computer networks: it can inhabit the expanding virtual word of the so-called cyberspace. The Internet already contains many legal sources, and already is, in many domains, the main source of legal information for lawyers and citizens.

The Internet (in combination with computer nets which are internal to public administrations), is the place where legally relevant information is exchanged, and where, as a result of such exchanges, legally binding texts are produced. As legally relevant procedures are taking place through communication exchanges over Internet (or Intranets) – procedures for the production of administrative acts, in the framework of e-government; procedures for the judicial decision of litigation, in the framework of the on-line process, and so on – the legal relevance of the cyberspace changes: not only the Internet is the place where one can find information about what legal events are happening in the real word, but it has become a significant component of the legal world, in which many legal event are primarily taking place.

References

1. Poulin, Daniel. Open access to law in developing countries. First Monday, vol. 9, no. 12, December 2004. http://www.firstmonday.org/issues/issue9_12/poulin/index.html
2. Harris, Cheryl. An Internet education : a guide to doing research on the Internet. Belmont : Integrated Media Group, 1996
3. Paliwala, A. et al. User Needs in Electronic Law Reporting: A Research Study of The Law Reports, *The Journal of Information, Law and Technology (JILT)*, 1997 vol. 2 http://www2.warwick.ac.uk/fac/soc/law/elj/jilt/1997_2/paliwala/
4. Gruber, T. R.. Toward principles for the design of ontologies used for knowledge sharing. In Guarino, N. and Poli, R., (ed.), Formal Ontology in Conceptual Analysis and Knowledge Representation, Deventer, The Netherlands. Kluwer, 1993
5. Rinke Hoekstra, Joost Breuker, Marcello Di Bello, and Alexander Boer. The LKIF Core ontology of basic legal concepts. In Casanovas P., Biasiotti M. A., Francesconi E., Sagri M.A. (ed.), Proceedings of the Workshop on Legal Ontologies and Artificial Intelligence Techniques (LOAIT 2007), June 2007. http://www.estrellaproject.org/lkif-core
6. Biasiotti M.A., Faro S., Nannucci R. TransEuropean Access to National Caselaw: The Caselex Project. In Francesconi E. et al. (ed.) Jurix 2008 Conference Proceedings
7. McKechnie, D. The Use of the Internet by Courts and the Judiciary: Findings from a Study Trip and Supplementary Research, The Journal of Information, Law and Technology (JILT), vol. 11 2003, 109–148
8. Francesconi E., Peruginelli G. *Access to Italian Legal Literature: Integration betweeen Structured Repositories and Web Documents*. In: “DC 2003. Proceedings of the International DCMI Metadata Conference and Workshop”, Seattle, Washington, USA, pp. 99–107
9. OAI – The Open Archives Initative Protocol for Metadata Harvesting, http://www.openarchives.org/OAI/openarchivesprotocol.htm

Technology as a Tool of Transformation: e-Cities and the Rule of Law

J.M. Eger[1] and A. Maggipinto[2]

Abstract New model for successful urban organization in the global age is emerging. Municipalities can survive the increasingly intense global competition by the local political arrangement, but how? The electronic dialogue between Public Administrations, citizens and enterprises represents the key element for the development of the public sector. This interactive communication is able to carry out a sharing of information and knowledge that is both an instrument and the main task for Municipalities in the Digital Era. The e-government is a complex and multidimensional issue. Cities of the Future will be built along "information highways". These smart communities – in which each individual is part of the whole – promote the context for our lives and the fabric of our existence. If technology is a tool of transformation, e-government is a way to fulfill the conditions of good governance. The electronic government is not just ICT: it also includes rules and procedures, because the public administration cannot innovate without a normative drive. So it must operate under the Rule of Law, protecting general principles such as equality, administrative transparency, rights protection for all citizens. Democratic legal systems have to foster and promote civil and political rights also in the scenario of "electronic cities". Technology has opened up domains of information which only some years ago were unthinkable, and everyone – including people who are disadvantaged due to limited re-sources or education, age, disabilities – should be able to enjoy the related benefits.

Cities: Global Paradox and Local Interdependence

The geopolitical landscape of the world is being redefined. Information and markets are becoming increasingly globalized.

Products and services can't be contained within national borders anymore, as economic and political intelligence. An instantaneous flow to all corners of the

[1] San Diego State University, San Diego, CA, USA, jeger@mail.sdsu.edu·
[2] Università di Bologna, Bologna, Italy, andrea.maggipinto@unibo.it (www.maggipinto@org)

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_4, © Springer Physica-Verlag Berlin Heidelberg 2010

globe makes almost impossible for national governments to influence political or economic conditions. We are living a geopolitical paradox, in which the nation-state, too large and distant to solve the problems of localities, has become too small to solve the borderless problems of the world [1].

This paradox is related to (or maybe the effect of) what is called “globalization,” an age-old concept which has come rushing to the fore presenting new and uncertain challenges in the last decades. It’s just unfolding as a new wave of economic and political change. Such globalizing process is determined essentially from three factors: one economic, that is the development of international commerce and relationships trades between States; one political, developed in the course of the twentieth century and determined from the discouragement of the “iron curtain” and the contrast between communism and capitalism; one, at last, technological, carried about fifteen years ago: the birth of Internet and the World Wide Web. After nearly a century from the publication of “The Great Illusion” – the book of the prize Nobel Norman Angell – seems to emerge in Internet a “new interdependence” between Countries, and of course between communities.

No longer dependent upon national governments for policy ideas and information, local communities are taking social and economic matters into their own hands. Public policies must be pursued to promote job creation, economic growth and an improved quality of life in a local perspective, regardless of the policies enacted at the national level with an increasing accountability of local governments for their residents’ well-being.

In the 1960s the post-industrial economy and society was foreshadowed by Fritz Malcop, Marc Porat and Daniel Bell [2]. Today, cities across the world have been struggling to reinvent themselves for the Global Village, facing the twenty-first, an age in which information is the most valuable commodity.

Our communities are competing with every other community around the world for basic manufacturing requirements and provision of high tech and biotech services. With this flattening, the change-taking place within our communities must be accelerated, our centres of knowledge – at every level – must be reinvented [3].

Cities of the past were built along waterways, railroads and highways, cities of the future will be built along “information highways,” wired and wireless information pathways connecting people, home, office, school, hospital and Institutions.

Infrastructures are important, but the effort to create a city of the future is not so much about technology as it is about quality of life, organizing one’s community to reinvent itself for the knowledge society and preparing its citizens to take ownership of their community.

We are already seeing the development on a global scale of mechanisms for ensuring that the global corporation has some checks and balances on its far-flung activities and influences worldwide. By retooling many of these existing organizations and creating new ones, the rights of privacy, intellectual property, piracy, terrorism, the free flow of communication, and democracy itself must be addressed.

New model for successful urban organization in the global village is emerging. Municipalities can survive the increasingly intense global competition only by the local political arrangement.

Electronic Words: Dialogue and Level of Communications

The process of modernization in the public sector is often considered to be the result of the implementation of computer science applications and digital technologies in the Public Administration (PA) for achieving institutional functions. In reality, computer science and technologies based on the automatic elaboration of information have started an ongoing change of individual sensibility and of social culture. This evolution has also impacted the public sector and the relationships between citizens and Institutions.

This technology impact is only relevant if it accomplishes the primary objective of the modernization process: to put principles and values that characterize a modern democracy – such as simplification, transparency and inclusion – into effect.

Information technology has represented the first field of development for e-government plan, all over the world. It is the communication technology that represents the real challenge for the public sector and for the communities today. Local administrations often find difficulties on the way of innovation, because they cannot cooperate with each other. They are traditionally not accustomed to compare themselves with other subjects, out of their area of competences.

The communication technology is the turning point for the development of all communities. Three are these levels in which new interactive communications can be articulated and developed: (1) inter-administrative level (dialogue between Public Administrations); (2) inter-subjective level (dialogue between Citizen-PA); (3) political-institutional level (dialogue between Citizen-Government) [4].

In this scenario of change, the electronic dialogue between agents – i.e. Public Administrations (PPAA), citizens and enterprises – represents the key element for the development of the public sector. This interactive communication – not a mere unidirectional flow of information from Institutions to the citizen through often over-informative websites – is able to carry out a sharing of information and knowledge that is both an instrument and the main task for the public administrations in the relationship with the citizens.

Governing Telecommunications

As we moved from a manufacturing-based toward a service-based economy, the telecommunications have a growing importance for the social development, increasing administrative efficiency; ensuring delivery of municipal services, improving democratic governance.

In the new world order of global interdependent economies, the local government must nurture a new and exciting vision for its city as an intelligent information city, able to plug into the information economy, based upon the belief that the political will exists, with government and industry joining forces in the community, to transform every city providing a productive and fertile economic environment for their citizens, a truly international information city.

Three are the broad areas of concern related to the role of communications in the social and economic development building the information highways [5].

Partnerships Between Private and Public Sectors

Building the new "rivers of commerce" in the post-industrial economy will depend heavily on the sophisticated use of information superhighways and the development of information products and services.

Telecommunications regulation has traditionally rested in the hands of the central government, but the changing technological environment is encouraging relentless innovation in the ways advanced telecommunications is provided and used in the state. In the emerging information landscape, the cities must take this to heart and carve a new niche for themselves, in the best interest of citizens.

Every city should establish a smart private/public partnership to build a community-wide communications infrastructure to serve the citizens. Such a partnership linking of all of institutions and facilities, including health care providers, schools and universities, museums, art and cultural attractions, the tourist and entertainment industries, local utilities, and local government will provide the public and private sectors greater, more timely access to important services which will make the region more economically attractive, internationally competitive, and enhance the quality of daily life.

Interconnection and Interoperability

The challenge for cities of the future is not building the infrastructure, but ensuring the benefits are widely understood and the systems are used by all sectors of the economy and society.

Ways to energize, excite and involve whole communities are necessary: librarians, school teachers, health care providers and other workers, young and old. Unless we can bring the full benefits of these advances in telecommunications home to businesses, government, the non-profit sector and individual consumers, we will fail to capitalize on the genius the technology affords us.

The challenge is not whether the city gets wired, but whether those various networks are interconnected and interoperable, whether the combined broadcast capacity all those systems represented is accessible and affordable for the broadest possible array of services, to the broadest number of citizens.

The Information Society has the potential to distribute more equally knowledge resources, to offer new job opportunities, also by overcoming the traditional barriers to mobility and geographic distance and to make the Institutions closer to the citizens. But the governance of this innovation has a complex task: maintaining a general vision and embracing the fundamental issues of the entire system, to make a shared information and knowledge society real.

Telecommunications and Cooperation Policies

Cities must develop their own bold telecommunications policy, and do so in cooperation with their neighbours.

Telecommunications regulation is traditionally at the state level, but it is leadership at the city and local municipality level that is most important. It is here where the accountability for delivering services to the citizens ultimately rests, and it is here where the cities must develop their own telecommunications policy.

A new relationship city-state government requires a new dialogue, a "new federalism", and a local telecommunications policy and information strategy must be developed, but not being done independently of the state laws or regulations.

Communications alter regional boundaries, affecting basic structures of the economy and communities. Perceptive governments and industry leaders have seen and understood the promise of advanced communications for their economic and social development.

Building the information superhighways will be crucial to political and economic survival in the global economy. The strength of our Nations depends upon the growth and prosperity of our cities, and cities – to the extent they understand this imperative – must lead, not follow, by seizing the information initiative.

Knowing Governance

In the literature, the term governance – from a state-centric approach (in which government is the most important actor and steers society through authority) to a network approach (stressing social systems autopoietic and self-organizing structure) – seems to remain largely descriptive rather than explanatory.

In between these two extremes (governance with government and governance without government), we find moderate approaches considering governance as a socio-political and linguistic process, a cooperative concept "with policy outcomes resulting from overcoming the decisional and coordination problems inherent in large complex policy arena" [6].

The place where civilization was born and where the city-state form of democracy first began – Athens – can be take into account today as a symbol of the dynamic potential of cities to create and provide the linkages among culture, commerce and civic pride so important to the wealth and well-being of a community. A symbol of what we now can call governance: a "method/mechanism for dealing with a broad range of problems/conflicts in which actors regularly arrive at mutually satisfactory and binding decisions by negotiating with each other and cooperating in the implementation of these decisions" [7].

Will the cities, as engines of civilization, succeed and survive in the transition to a global knowledge-based society? What role will cities play in the global age?

"All men naturally desire Knowledge" (Aristotle), and we are going towards knowledge-based economies in which science and technology-based societies use knowledge. The procedures and infrastructures enabling the production of knowledge are a driving force for innovation, the most important precondition for economic growth and competitiveness. But it's not just economics, it also has very important political and societal aspects.

In this transition we have to take into account the man's need: human society "is established for a single end: namely, a life of happiness. And just as for his well-being an individual requires the companionship provided by family, so for its well-being a household requires a community, for otherwise it would suffer many defects that would hinder happiness. And since a community could not provide for its own well-being completely by itself, it is necessary for this well-being that there be a city. Moreover, a city requires for the sake of its culture and its defence mutual relations and brotherhood with the surrounding cities" (Dante, Convivio, IV, iv, 1-2).

Digital Citizenship and the Rule of Law

As the use of ICT grows, so does its impact on society, also in the relationships between Institutions and citizens.

Computer science and technologies based on the automatic elaboration of information have started an ongoing change of individual sensibility and of social culture. This evolution has also impacted the public sector and the relationships between citizens and Institutions. For example, citizens have certain expectations: service-oriented website, faster procedures and modern technology of communication.

Institutions know they must increase the legitimacy, accountability and transparency of the decision-making by reconnecting with citizens and involving them more directly in the policy process. They believe the technology has an important role to foster democracy and development.

New instruments and objects, emerged from this technological scenario, have arisen in a historical moment when, for example, in Italy with laws 142 and 241 in 1990, the Public Administration had just begun a process of organizational and procedural modernization. This technology impact is only relevant if it accomplishes the primary objective of the modernization process. This object consists of putting principles and values that characterize a modern State – such as simplification, transparency and inclusion – into effect.

The electronic government is not just technology: it also includes rules and procedures, because the public administration cannot innovate without a normative drive. So it must operate under the Rule of Law and protect this rule through the applications of general principles: principle of good government, principle of administrative transparency, protection of basic rights of citizens.

Internet represents a great instrument for sharing and meeting ideas, also political. That's the reason why is undeniable that "the Net" has a social function. So it has a direct effect also on the relationships between Citizens and Institutions.

The pluralistic theory underlines nowadays the crisis of the representative democracy, so maybe it would be logical that the associations and the interest groups should get more involved into political life. The governance of technological innovation represents a way to fuel the continuous renewal towards more efficient democratic models. The collaboration between citizens and Institutions is only a positive aspect if it's well-planned and constructed.

The theoretical model of the Rule of Law seems to define new challenges to face through the communication and information technology. First of all, the Rule of Law is based on these unavoidable elements, among others: equality and freedom of citizens. How can the legal system put this element into effect in a highly technological society?

The use of technology by the Administrations has begun since the 1970s and it was considered a way for improving the internal system efficiency: it has the ability to promote integrated working of various departments updating of information, quick processing of data, rapid and secure communication, efficient dissemination of information and allow effective monitoring of processes.

The real modern concept of e-government was born with the spreading of the World Wide Web and the use of the Internet. That is why it is so focussed on the dialogue between Institutions and Citizens and it depends on a "digital citizenship" that is motivated and able to use technology.

But this "digital citizenship" presupposes a citizen that (1) has access to digital information and infrastructure, (2) has the skills to use these and (3) is motivated to use these possibilities to communicate.

It's clear that the primacy of the Law is still a fundamental value in the Information Society. Democratic legal systems have to foster and promote civil and political rights also with reference to the use of ICT, against digital divide [8].

Technology has opened up domains of information which only some years ago were unthinkable, and everyone – including people who are disadvantaged due to limited resources or education, age, gender, ethnicity, disabilities – should be able to enjoy the related benefits.

References

1. Eger, J.M. (1997) Cyberspace and Cyberplace: Building the Smart Communities of Tomorrow, *Union-Tribune*, October 26, 1997.
2. Porat, M. (1977) *The Information Economy: Definition and Measurement*. Special Publication 77–12, U.S. Department of Commerce. Bell, D. (1977) *The Coming Post-Industrial Society*, New York: Basic Books.
3. Friedman, T. (2005) *The World Is Flat: A Brief History of the Twenty-first Century*, New York: Farrar, Straus and Giroux.
4. Maggipinto, A. (2008) Internet e Pubbliche Amministrazioni: quale democrazia elettronica? *Il Diritto dell'informazione e dell'informatica*, 1, 45–57. Rome: Giuffrè.
5. Eger, J.M. (1994) San Diego: The City of the Future - The Role of Telecommunications, *Report of The Mayor's Advisory Committee on the City of the Future*.

6. Peters, B.G. (2002) *Governance: A Garbage Can Perspective*. Rehie Politikwissenschaft/ Political Science Studies, Wien.
7. Schmitter, P. (2002) Participation in governance arrangements: is there any reason to expect it will achieve "sustainable and innovative policies in a 48 multi-level context"?, in J. R. Grote and B. Gbikpi (Eds) *Participatory Governance. Political and Societal Implications*, 51–69. Opladen: Leske and Budrich.
8. Maggipinto, A. and Visconti E. (2008) A normative approach to democracy in the electronic government framework. In A. Mazzeo, R. Bellini, G. Motta (Eds.) *E-Government Ict Professionalism and Competences Service Science*. Boston: Springer

The Challenges of e-government Evaluation

M. Sorrentino[1]

Abstract This paper perceives e-government evaluation as a field of social research where interdisciplinary inputs can enlighten not only the results, but also the process of implementing the e-services. Drawing on contributions from organization theory, we propose an interpretive key that assigns a dual role to e-government evaluation: valuable cognitive resource and tool of accountability for the policymakers. The preliminary reflections offered here, based on an exploratory case study, aim to provide further insights for the academic e-government community as a whole and help better inform public management praxis.

Introduction

Are the arguments in favor of e-government supported by an adequate evaluation framework? On which basis can we evaluate the success of an e-government program? At present, there are no tried and trusted common criteria capable of responding to this fundamental question.

Researchers who study e-government implementation generally come from the sphere of information systems. Therefore, the result is for the most part a techno-centric view of e-government [1, 2] or, at best, draws on partial contributions by one or other of the many disciplines that have approached the theme (e.g. economics, policy studies, law, administration, sociology, etc.). Another major research current in e-government implementation evaluation is management science, for obvious reasons, given the role played by the consultancy firms that operate in the public sector and the oversight agencies.

This paper maintains that, by nature, evaluation is an applied research area oriented to forming an opinion on the processes and results of public programs, in other words, it seeks to broaden the cognitive scope of the policymakers and the administrations [3, 4]. The evaluator relies on a toolbox (conceptual, theoretical,

[1]Università degli studi di Milano, Milano, Italy maddalena.sorrentino@unimi.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_7,

methodological, technical) to ascertain – data in hand – whether the intervention has or hasn't changed "the world" compared with the initial plan.

In evaluation language, the work of influencing the policymakers and administrations is expressed using the term enlightenment [5]. However, in our opinion, e-government would be more appropriately addressed by conducting an evaluation and not merely by applying a measurement logic, given that this latter assumes two conditions difficult to observe in the PA: limited complexity and absence of uncertainty [6, p. 16]. We will use the broadest meaning of the term "results" to encompass not only the services and performances delivered, but also the effects it has on the larger social system.

We have identified three different types of evaluation, depending on whether the object of analysis is: (a) the immediate products (outputs) or the effects triggered by the public policy (i.e. outcomes and impacts); (b) the implementation, i.e. the practical launch of the services; or, (c) the phase in which the agenda is defined (known as the issue-making and decision-making phase). This is how the ex-post evaluation of all the activities that retrospectively analyze the outputs, the outcomes, and the impacts of a public policy is defined. The ongoing (or in itinere) evaluation is defined as all those techniques used to analyze performance during the implementation process. Ultimately, the ex-ante evaluation is defined as the retrospective analysis of the decisions taken before the launch of the implementation phase.

The three types of evaluation meet diverse cognitive needs. The ex-ante and expost evaluation confirm or revoke the decisions already taken. Vice versa, the ongoing evaluation – which generally responds to a more advanced cognitive question – accompanies the decision-makers during the actual implementation of the services, accounting and reporting on the situation as it unfolds. Because the ex-ante evaluation has no bearing on the aims of this paper from hereon we will discuss prevalently the two other categories.

The discussion that follows takes the cognitive stance of an external analyst seeking to offer a scientifically founded opinion on a recent e-government initiative promoted by the City of Milan. We plan to use this case to verify the practicability of an evaluation approach that factors in the viewpoint of both the demand-side (that is, the needs to which a provision plans to respond) and the supply-side (i.e. the administration enacting the regulation). We will use the analytical tools of Policy enquiry and the Organization theory as our interpretive keys.

The case is presented in the form of an exploratory study, the goal of which is to develop pertinent hypotheses and propositions for further enquiry [7]. Spurring that methodological choice is the fact that the analysis focuses on a pilot scheme not yet concluded at the time of writing this paper. According to the City of Milan, the trial period will last for 12 months. The analysis draws on documents such as announcements, presentations, news releases, and articles that have appeared both in the press and on the official websites.

The paper is set out as follows: Sect. 2 illustrates the key points of the Ecopass Project, while Sect. 3 describes the different levels of evaluation. Section 4 comments on the case and proposes an interdisciplinary touchpoint for analyzing the case in question. Section 5 discusses some of the possible implications stemming from the use of this framework for the research and practice of e-government evaluation and presents our conclusions.

Sample Case: The Ecopass Project

With the idea of fighting pollution, the City of Milan decided to introduce a vehicle entry charge (called the Ecopass) in July 2007, aimed at restricting (Mon–Fri from 7.30 am to 7.30 pm) access to polluting vehicles. The provision in question (the first of its kind in Italy) came into force in trial form on January 2, 2008.

The regulation involved a broad spectrum of interventions to the viability, the technological platforms, administrative procedures, personnel training practices, and citizen communication. In terms of information systems, the implementation of the Ecopass initiative made it necessary to enact several changes to the City of Milan's legacy systems. For example, these had to be linked to some of the archives kept by the Ministry for Transport. The area affected by the regulation (8.2 sq km) required hefty investments in, among other things, the installation of 43 access points monitored by CCTV and other remote control devices. When a vehicle drives through these access points, the number plate is checked against the data contained in the national vehicle archive managed by the Ministry for Transport. The category of the vehicle is used to determine its pollution level and the corresponding cost of the entry permit. The new system also harnesses a complex computer network – consisting of a control room, information desks, websites, a call center, a toll-free number, and automated teller machines – to enable applicant citizens to pay and receive the Ecopass permit.

The project triggered an intense debate not only across various institutional and political levels (e.g. the administrations of the City and Province of Milan and of the Regione Lombardia), but also among a host of technicians from several disciplinary spheres. The controversy heated up also due to a slew of malfunctions and delays in the electronic payment systems. The shifting of the blame between the implementers (which received much coverage in the press) and the critics of the procedures adopted for purchasing the technologies exacerbated the disputes between the regulation's supporters and opponents, but did not lead to its modification. In the past months, most of the glitches encountered on the technological front were removed; further – thanks to work adapting the information systems – the tickets written for infringing the highway code were made accessible on the web.

The Ecopass project calls for launching "forms of citizen consultation" combined with the "monitoring of the regulation's impact from the environmental, socio-economic, and vehicle traffic viewpoints." However, as yet, the City of Milan - through its "Mobility Agency" – has limited itself to the systematic diffusion on its website of periodical technical reports ensuing from the monitoring of traffic flows and air quality in the town center. At the time of writing this paper, it is highly likely that the administration will confirm the initiative also for 2009.

Evaluation Levels

A controversial regulation, such as the one just described, puts the evaluator in a tough position. We recall that the role of the evaluation is to furnish (to interested parties: policymakers, citizens, institutions, clients) a founded and constructive opinion from a different cognitive position. In essence, evaluating means connecting the "context and content of what is implemented" [3].

Taking different cognitive positions leads to different opinions [4, p. 21]. The most diffused cognitive position is that of common sense. A common sense opinion, as expressed by the man on the street, translates into the approval or disapproval of the conduct of the administrators in respect of a certain service or on the principles guiding the action. That type of opinion, therefore, neither provides an evaluation of its merit nor serves to understand the reasons for its success or lack of success. An example of zero level evaluation is the intense debate – reported also in Italy's leading newspapers – that has involved the various layers of public opinion on the Ecopass project.

Apart from the common sense-derived opinion, we have the cognitive opinion of the expert, i.e. opinions founded on direct experience or competence. The opinion of the stakeholders is, by definition, partisan [8]. Therefore, if a stakeholder is a political body, the evaluation will be guided, above all, by its ideological orientation and interests. This latter – in the policymaking arena – is positioned at evaluation level one. The past few months have seen a great many representatives of local and governmental institutions intervene in the Ecopass debate. Citizen committees and delegates of the various categories (e.g. craftsmen, retailers, professionals, companies based in the suburbs) have all "pleaded" their case.

The opinion above that of "level one" comes from outside the policymaking arena, i.e. it is not influenced by vested party interests. This type of view stems from an extraneous cognitive position, which we can class as evaluation level two. This is an ideal position as it not only enables the policymakers to enrich their knowledge, but also raises the degree of accountability to the citizen-voters. In that sense, the evaluation helps to shed a new and different light on the problems in question. The extent to which the goals of the Ecopass project have been achieved will be verified at the end of the trial period. At the date of this report, no external evaluation had been conducted on this initiative, at least to our knowledge.

Case Commentary

The Ecopass is a case in the public domain that, as such, presents conceptual challenges that are well known to scholars, policymakers, and public administrators alike. Among other things, these concern the object to be assessed (e.g. a project, program or policy, or particular aspects of the activity), the evaluation method (how can we gauge the effectiveness of the regulation and under what conditions does that measurement acquire significance?), and the goals to pursue. In turn, this latter aspect is further complicated by a numerous cast of actors (e.g. recipients of the services, but also systems of interest), who express different expectations, perceptions, and opinions, also in respect of what, at first glance, seems to be an individual and specific result, in our case the reduction of air pollution in the historic town centre. The slogan chosen by the City of Milan is “Less Traffic, Cleaner Air.”

How has the evaluation puzzle been addressed in the sphere of the Ecopass project? To date, the opinions offered by the diverse parties in question have stopped at level zero and level one, while the assessment activities undertaken by the City have been conducted in a fairly de-contextualized way compared with the internal dynamics and decision-making processes. For example, July 2008 saw Councilors publish a document that purports to show a correlation between the coming into force of the Ecopass and the data related to the level of hospital admittances of the residents who live in the town center.

Interpreting the case in line with Policy enquiry [9] suggests that the logic of delivery benchmarking has prevailed in Milan, that is, the public administrators have concentrated solely on reporting systems based on data and information that mostly exist within the institution already. Without going into either the merit of the criteria chosen by the City to show that it has achieved the results expected from the Ecopass project or the cause-effect relation on which these are built, we believe we are looking at an evaluation attempt that has been kept wholly within the perimeter of the policymaking arena and that basically consists of a selective documentation (i.e. “without evidence of lack of success,” [10, p. 93]) of the results obtained in the timeframe in question. According to [6, p. 40], in these cases, it is more appropriate to talk about “pre-evaluation methods.”

To move forward in our reflection, we might be better drawing on the analytical tools offered by Organization science. That is not an antithetical choice over other disciplinary areas that have approached the evaluation theme, but, to the contrary, is complementary. Nevertheless, there can be no doubt that organizational theory presides over the process logic that structures the technical goals and technical actions in organizational settings.

A theoretical perspective founded on organizational action [11, 12] shifts the evaluation focus to processes of action and decision, to the intentional and bounded rationality that has led to the implementation of the Ecopass project. That approach traces the effects of the interventions launched in the technical area back to the organizational processes of: design (i.e. the decisions on the architecture and technical standards); adoption (i.e. the decisions of integrating the artifacts in the activities); and use (i.e. of appropriation in the daily practices of the users) of ICT platforms.

The Ecopass case highlights this complex interweave of decisional processes at diverse levels, distinguishable only from the analytical standpoint, in which time plays a key role. For example, it is precisely due to the very short-term deadlines, that the IS department of the City of Milan had to adopt a “big bang” approach (in which the transition to the new system was implemented in a reduced timeframe); the decision deemed the most risky by the relevant literature (see, for example, [13, 14]) because irreversible. During the first few weeks of implementing the Ecopass, a malfunction in the device that automatically reads the number plates caused c. 160,000 fines to be issued to motorists unaware that they had infringed the new regulations for driving into Milan town center. The ensuing requests for clarification by the motorists sent the municipal offices and the call center into turmoil, while the justices of the peace and the prefectures were swamped with appeals.

Time constraints also influenced the decisions on personnel training/instruction and on internal communication. The new system was a carrier of constraints and opportunities: it enabled the decision-makers to produce new forms of regulation that, in turn, had an impact on the informative assumptions of the various subjects. For example, the January-September experience revealed the existence of a substantial cognitive gap between the actors involved, some of whom had no idea of the work done by the others, even though the implementers (traffic police, municipal transport company, information systems department, councilors) report to the same single institutional subject, i.e. the City of Milan.

Most of the glitches encountered on the technological front were eventually removed and solved, therefore, ultimately, we could say that the infrastructure set up for the Ecopass project "held." Retrospective reconstruction of the practice highlights a sometimes tortuous unraveling of decisions and objectives, which partly changed along the way in conjunction with the players' growing awareness of the opportunities for change. One example is that, thanks to the interventions on the software applications, some new front-end services were made accessible via the City of Milan's website.

The case of the Ecopass is a particularly fast-paced example of a process of high-profile organizational change with a major impact on the citizens, whereby the adoption of a new ICT-based solution, despite being an important objective, is not an element, on its own, capable of determining the results.

In a perspective such as that proposed here, also the evaluation takes on a different role. Above all, the evaluation is an integral part of the organizational action and is itself a process. A significant consequence is that the evaluation cannot be decontextualized, given that it necessarily appears within a specific organizational setting and involves a number of plans (technical, structural, institutional).

Implications and Conclusions

At this point in our reflection, we believe the foundations have been laid for addressing e-government evaluation research from a more advanced and interdisciplinary cognitive level. Policy studies help us to wipe the plate clean of the assumption that e-government is neutral. In addition, these admit from the start that shifts and swings exist compared with the initial plan, so we must perforce consider the results on the recipients (demand side) of the provisions, not the provisions as such. On the other hand, organizational analysis can help throw light on another front (the supply side), i.e. on the processes of action and decision that have led to specific effects.

Therefore, bounded rationality guides the organizational action and enables its evaluation. Further, the evaluation itself is understood to be a bounded rational process intrinsic to the organizational action. That means we can exclude a priori the possibility of successfully maximizing the results (and thus evaluating these in terms of efficiency), because it would be like saying that the relationship between the means – i.e. the technical knowledge, the software programs, the operating practices, and the ICT platforms developed and deployed – and the ends – or the problem that lies at the root of the e-government program – is optimal. Unlike other kinds of assessment, the organizational evaluation can always be carried out. It is an evaluation of the organization's "fitness for the future" [10, p. 84] and consists of evaluating the goals of the action, the process relationships, and the reciprocal congruency of all these dimensions.

But what are the advantages of adding the organizational dimension to the conceptual "toolbox" with which the evaluator is equipped? In this paper, we restrict ourselves to highlighting three aspects worthy of attention. First, placing the organizational processes of action and decision at the center of the analysis means considering time a key variable. That is compatible with the assumptions of the ongoing evaluation (defined as level two), i.e. that which offers the policymakers and managers the highest cognitive input for correcting or reorienting the public objectives.

Second, and as a consequence of the preceding point, shedding light on the processes helps increase the body of common knowledge available on the organization and its relationships with the environments and the diverse categories of subjects with which it relates. Enlightenment, in turn, is a step forward in improving organizational learning and creates the conditions that favor further assimilation of a culture oriented to external accountability.

Third, the processual vision of organizational phenomena enables us to analyze situations in which the change goes beyond the "boundaries" of a specific institution. This factor is especially significant, given that e-government is rarely implemented by one public administration alone: see, for example, the trend of sharing the delivery of e-services via intermunicipal agreements [15].

Our contribution to the reflection pauses here, for now. The paper presents only an initial (and therefore limited) exploration of the direction indicated. The Ecopass project is still a work in progress and can interpreted using several keys, although most certainly the organizational approach augments the significance of evaluation research.

References

1. Chan, C.M.L., Y. Lau, and L. Pan (2008) E-government implementation: A macro analysis of Singapore's e-government initiatives, *Government Information Quarterly*, 25: 239–255.
2. Heeks, R. and S. Bailur (2007) Analysing e-government research: Perspectives, philosophies, theories, methods and practice, *Government Information Quarterly*, 24: 243–265.

3. Pressman, J. and A. Wildavsky (1973) *Implementation*, University of California Press, Berkeley (3rd edn.).
4. Lippi, A. (2007) *La valutazione delle politiche pubbliche*, Bologna: il Mulino.
5. Weiss, C.H. (1998). *Evaluation: methods for studying programs and policies*, Englewood Cliffs: Prentice Hall.
6. Rebora, G. (1999) *La valutazione dei risultati nelle amministrazioni pubbliche*, Guerini e Associati, Milano (in Italian).
7. Yin, R.K. (2003) *Case study research*. Sage Publications, Thousand Oaks.
8. Lindblom, C. (1964) *The intelligence of democracy: decision making through mutual adjustment*. New York: The Free Press.
9. Regonini, G. (2001). *Capire le politiche pubbliche*, il Mulino, Bologna (in Italian).
10. Thompson, J.D. (1967) *Organizations in action*, McGraw Hill, New York.
11. Maggi, B. (1990) *Razionalità e benessere. Studio interdisciplinare dell'organizzazione,* Etaslibri, Milano, 3rd edn. (in Italian).
12. Maggi, B. (2003) De *l'agir organisationnel. Un point de vue sur le travail, le bien-être, l'apprentissage*, Octarès, Toulouse (in French).
13. Alter, S. (1996) *Information Systems. A management perspective*, Menlo Park: The Benjamin/Cummings.
14. Veryard, R. (1991) *The Economics of Information Systems and Software*, Butterworth-Heinemann, Oxford.
15. Sorrentino, M., and E. Ferro (2008) Does the Answer to eGovernment Lie in Intermunicipal Collaboration? An Exploratory Italian Case Study. In M. Wimmer J.H. Scholl, and E. Ferro (eds.) *Electronic Government, Communication Proceedings of the Fifth International EGOV 2008 Conference*, Turin (Italy), Berlin Heidelberg: Springer-Verlag: 1–12.

The Epistemology and Ethics of Internet Information

E.H. Spence[1]

Abstract Beginning with the initial premise that as the Internet has a global character, the paper will argue that the normative evaluation of digital information on the Internet necessitates an evaluative model that is itself universal and global in character [1]. The paper will show that information has a dual normative structure that commits all disseminators of information to both epistemological and ethical norms. Based on the dual normative characterization of information the paper will seek to demonstrate: (1) that information and internet information (interformation) specifically, has an inherent normative structure that commits its producers, disseminators, communicators and users, everyone in fact that deals with information, to certain mandatory epistemological and ethical commitments; and (2) that the negligent or purposeful abuse of information in violation of the epistemological and ethical commitments to which it gives rise is also a violation of universal rights to freedom and wellbeing to which all agents are entitled by virtue of being agents, and in particular informational agents.

Introduction

The overall primary objective of this paper is to describe and propose a meta-ethical as well as normative model for the theoretical and practical evaluation of the quality of digital information on the Internet. This model as I shall argue must of necessity be universal and objective in its mode of justification and motivation and global in its reach. It has to be able to transcend cultural borders so as to be able to objectively evaluate the quality of information that is in its essence borderless and global. Unless otherwise specified, I will use the term cultural borders to refer to all type of borders, including geographical, national, ethnic (ethnic borders within

[1]University of Twente, Enschede, Netherlands, e.h.spence@utwente.nl

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,

DOI 10.1007/978-3-7908-2148-2_35,

multi-ethnic nations such as the USA, Canada and Australia, for example), religious, gender, political, and lifestyle borders.

Given the global reach and scope of the World Wide Web that now reaches and impacts on every part of the planet, any theoretical model that seeks to not merely describe the cultural quality of interformation but evaluate it, at least in its epistemological and ethical manifestations, must itself be global in its application and scope. For it to be global in its application, however, it has to be universal and objective in its mode of justification and motivation. It must be able to evaluate interformation on the basis of universal principles that most if not all reasonable individuals irrespective of their cultural differences and affiliations can accept and more importantly must accept on the basis of their shared minimal rationality.

The main aim of the paper is to provide a solution to this problem by proposing a universal theoretical model which can provide at least in principle a method for evaluating objectively interformation in all its modes of dissemination across the globe. The proposed solution comprises two main parts that together seek to show that information is doubly normative:

(a) Information and internet information (interformation) specifically, has an inherent normative structure that commits its producers, communicators and users (disseminators), everyone in fact that deals with information, to certain mandatory epistemological and ethical commitments.
(b) The negligent or purposeful abuse of information in violation of the epistemological and ethical commitments to which its normative inherent structure gives rise is also a violation of universal rights – specifically, universal rights to freedom and wellbeing to which all agents are entitled by virtue of being agents, and in particular informational agents.

Hence, the abuse of information through, for example, misinformation practices, constitutes (a) a violation of the epistemological and ethical commitments to which the normative inherent structure of information gives rise and (b) a violation of universal rights to which all agents and specifically informational agents are entitled.

Finally and echoing comments by Umberto Eco in The Open Work (1989) [2] – namely, that with regard to human beings information theory becomes communication theory – the paper will also show that the demonstrated dual normative structure of information in terms of its own inherent normative structure, as well as the universal rights of informational agents to which it gives rise, confirms and supports Eco's insightful comments.

The Normative Structure of Information

In providing the dual normative model for the evaluation of information and interformation specifically, outlined above, the paper will employ an epistemological account of information based on a minimal nuclear definition of information.

Following Luciano Floridi it will define information as "well formed meaningful data that is truthful" [3] and following Dretske it will define information as "an objective commodity capable of yielding knowledge"; knowledge in turn will be defined as "information caused belief" (1999) [4].

What is necessary for both information and knowledge is truth. For information without truth is not strictly speaking information but either misinformation (the unintentional dissemination of well-formed and meaningful false data) or disinformation (the intentional dissemination of false "information").

Using the minimal account of information described above, the paper will now develop a normative account of information, which demonstrates and describes the generic ethical commitments that necessarily arise in the dissemination of information.

Briefly, the argument is as follows: Insofar as information is a type of knowledge (it must be capable of yielding knowledge, one must be able to learn from it) it must comply with the epistemological conditions of knowledge, specifically, that of truth. And insofar as the dissemination of information is based on the justified and rightful expectation among its disseminators and especially its users that such information should meet the minimal condition of truth, then the disseminators of information are committed to certain widely recognized and accepted epistemological criteria. Those epistemic criteria will in the main comprise objectivity as well as the independence, reliability, accuracy and trustworthiness of the sources that generate the information. The epistemology of information in turn commits its disseminators to certain ethical principles and values, such as honesty, sincerity, truthfulness, trustworthiness and reliability (also epistemological values), and fairness, including justice, which requires the equal distribution of the informational goods to all citizens. Thus in terms of its dissemination, information has an intrinsic normative structure that commits everyone involved in its creation, production, search, communication, consumption and multiple other uses to epistemological and ethical norms. These norms being intrinsic to the normative structure of information with regard to all its disseminating modes are rationally unavoidable and thus not merely optional.

Information and Universal Rights

The goal of the following argument is to show that apart from committing its disseminators to unavoidable epistemological and ethical standards by virtue of its own inherent normative structure, information commits its disseminators to respect for peoples' universal rights to freedom and wellbeing. That is, information, must not be disseminated in ways that violate peoples' fundamental rights to freedom and wellbeing (generic rights), individually or collectively, or undermine their capacity for self-fulfilment (Negative Rights). In addition, information must as far as possible be disseminated in ways that secure and promote peoples' generic rights and capacity for self-fulfilment (Positive Rights) when those rights cannot be secured or promoted by the individuals themselves and can be so secured and promoted at no comparable cost to its disseminators [5,6]. But from where does this authority come and what are the fundamental rights to which I refer? Alan Gewirth's Principle of Generic Consistency (PGC) offers a description and prescription for both the rational authority (based primarily on instrumental and deductive rationality) and the content of the fundamental rights (freedom=FR and wellbeing=WB) that persons have necessarily and only by virtue (sufficient reason) of being purposive agents.

Due to constraints of space, I cannot provide a justification for Alan Gewirth's argument for the Principle of Generic Consistency (PGC) on which his derivation of rights is based, as this is well beyond the scope and limits of this paper. I offer such a detailed defense in my Ethics Within Reason: A Neo-Gewirthian Approach (2006) [6]. I will, however, offer a brief summary of the rationale of the argument for the PGC by way of a schematic outline of the three major steps of that argument.

The Rights of Agents: The Rationale for Alan Gewirth's Argument for the Principle of Generic Consistency[2]

Gewirth's main thesis is that every rational agent, in virtue of engaging in action, is logically committed to accept a supreme moral principle, the Principle of Generic Consistency. The basis of his thesis is found in his doctrine that action has a normative structure, and because of this structure every rational agent, just in virtue of being an agent, is committed to certain necessary prudential and moral constraints.

Gewirth undertakes to prove his claim that every agent, qua agent, is committed to certain prudential and moral constraints in virtue of the normative structure of action in three main stages. First, he undertakes to show that by virtue of engaging in voluntary and purposive action, every agent makes certain implicitly evaluative judgments about the goodness of his purposes, and hence about the necessary goodness of his freedom and wellbeing, which are the necessary conditions for the fulfillment of his purposes. Secondly, he undertakes to show that by virtue of the necessary goodness which an agent attaches to his freedom and wellbeing, the agent implicitly claims that he has rights to these. At this stage of the argument, these rights being merely self-regarding are only prudential rights.

Thirdly, Gewirth undertakes to show that every agent must claim these rights in virtue of the sufficient reason that he is a prospective purposive agent (PPA) who has purposes he wants to fulfill. Furthermore, every agent must accept that, since he has rights to his freedom and wellbeing for the sufficient reason that he is a PPA, he is logically committed, on pain of self-contradiction, to also accept the rational generalization that all PPAs have rights to freedom and wellbeing, [8, pp. 48–128].

[2]A full and detailed defense of the argument for the PGC against all the major objections raised by various philosophers can be found in Spence 2006 (Chaps. 1–3) [6, 7, 8].

At this third stage of the argument these rights being not only self-regarding but also other-regarding, are moral rights. The conclusion of Gewirth's argument for the PGC is in fact a generalized statement for the PGC, namely, that all PPAs have universal rights to their freedom and wellbeing.

Applying the PGC to information, we can now make the further argument that information generally and interformation specifically, must not be disseminated in ways that violate informational agents' rights to F and WB, individually or collectively (Negative Rights). Moreover, information must as far as possible be disseminated in ways that secure and promote the informational agents' rights to F and WB (Positive Rights). Conceived as the Fourth Estate, this places a significant and important responsibility on the disseminators of information in the media, especially journalists, both offline and online.

For example, certain media practices such as media release journalism [9], misleadingly and deceptively disseminate media release information produced by Public Relations professionals by having it presented as objective and independent information though print or broadcast media sources (newspapers, television and radio) as "news". This is done without any disclosure that these so called "news stories" are sourced from media releases produced by PR professionals on behalf of their clients, often verbatim and sometimes with the journalists' bylines attached to them. Such practices are ethically objectionable. They are so, because they are designed to deceive and do deceive the public by stealth, sometimes in collusion with journalists and government representatives. Moreover, these practices constitute corruption for they are conducive to the corruption of the informational processes and products that are essential for informing citizens on matters of public interest in an objective, truthful and fair manner [10–13].

Such practices, which once appeared only in the old corporate media (newspapers, television and radio), have increasingly become more prevalent on the Internet, for example, in blogs. Media deception is demonstrably unethical on the basis of the PGC because it can actually or potentially at least violate the rights to freedom and wellbeing that people have generally as agents and specifically, as citizens that require accurate, reliable and trustworthy information on matters of public interest. More generally, media deception through collusion by PR professionals, journalists and government representatives, violate all citizens' rights to freedom and wellbeing collectively by undermining the democratic process itself that requires the truthful, fair and objective production and dissemination of information on matters of public interest. It is partly for that reason that media control is sought and exercised by totalitarian regimes, such as those in China and Iran for example, that do not want their citizens to be well informed.

Interim Conclusion

Information generally can be epistemologically and ethically evaluated internally by reference to its inherent normative structure. That structure commits its disseminators, to ethical and epistemological norms. This is especially true of professional communicators (Journalists and PR Consultants, for example, on-line and off-line). Insofar as the ethical values to which the inherent normative structure of information gives rise require that the informational agents' rights to F and WB should be respected, secured and promoted, those values are also mandated by the PGC and thus information can also be externally evaluated by reference to the PGC. Expressive Information can also be evaluated either internally or externally or both, in this way. For example, identity theft on the Internet is morally wrong both because it is untruthful (internal evaluation) and because it can cause harm (external evaluation).

Information as Communication

In The Open Work (1989) [2] Umberto Eco makes a very interesting and I think importantly pertinent comment to the present concerns of this paper. He claims that,

> "It would indeed be possible to show that the mathematical concept of information cannot be applied to the poetic message, or to any other message, because information… is a characteristic of the source of messages: the moment this initial equiprobability is filtered, there is selection and therefore order, and therefore meaning….The objection is perfectly correct if we consider information theory only as a complex of mathematical rules used to measure the transmission of bits from a source to a receiver. But the moment the transmission concerns information among human beings information theory becomes a theory of communication…" [2].

Given the space constrains of this paper I will not be able to offer but the briefest analysis of Eco's insightful and promising comment. Eco's comment is insightful and promising because it points in the same conceptual analytical direction of the present paper. That is to say, it clearly articulates what my paper only implicitly suggests that with regard to information among human beings information theory becomes a theory of communication.

As a point of departure from Eco's penetrating comment, the present paper further and with some novelty argues moreover that information theory as a theory of communication commits its disseminators to certain epistemological and ethical norms by virtue of its dual normative structure: firstly, because being a teleological orientated activity in its own right that aims at truth or truthfulness (has as its telos or goal truth or truthfulness), information as communication has an inherent normative structure that universally commits all its disseminators to both epistemological and ethical normative standards; and secondly, information as a form of communication among informational agents universally commits all informational agents to the respect of the rights of freedom and wellbeing of all informational agents. This as we saw above requires that information must not be abused and misrepresented in the form of different types of misinformation in ways that violate those rights. Such purposeful misinformation constitutes under certain conditions, a form of corruption: the corruption of information as a process and product of communication[3] [14].

Conclusion

Beginning with the initial premise that as the Internet has a global character, the paper argued that the normative evaluation of digital information on the Internet necessitates an evaluative model that is itself universal and global in character[4].

The paper then proceeded to show that information has a dual normative structure. Based on the dual normative structure of information the paper sought to demonstrate that (1) information and internet information (interformation) specifically, has an inherent normative structure that commits its disseminators to certain mandatory epistemological and ethical commitments; and (2) that informational agents have universal rights to freedom and wellbeing that renders the negligent or purposeful abuse of information in violation of the epistemological and ethical commitments to which it inherently gives rise, both epistemologically and ethically objectionable.

Finally, using Umberto Eco's insightful comments that with regard to information among human beings information theory becomes a theory of communication, the paper was further able to confirm Eco's claim that information theory among human beings becomes indeed a theory of communication. And when information becomes communication, as it must with regard to informational practices among human agents, it unavoidably and universally gives rise to both epistemological and ethical commitments.

References

1. Gorniak-Kocikowska, K. (1996). The Computer Revolution and the Problem of Global Ethics. *Science and Engineering Ethics* 2:177–190.
2. Eco, Umberto (1989) The Open Work, translated by Anna Cancogni. Cambridge, MA., Harvard University Press.
3. Floridi, Luciano (2005). Is Semantic Information Meaningful Data? *Philosophy and Phenomenological Research*, LXX(2):351–370.
4. Dretske, Fred (1999) Knowledge and the Flow of Information. Stanford, CSLI Publications.
5. Gewirth, A. (1998) The Community of Rights. Chicago, University of Chicago Press.
6. Spence, E. (2006) Ethics Within Reason: A Neo-Gewirthian Approach. Lanham, Lexington Books (a division of Rowman and Littlefield).
7. Beyleveld, Deryck (1991) The Dialectical Necessity of Morality: An Analysis and Defence of Alan Gewirth's Argument to the Principle of Generic Consistency. Chicago, University of Chicago Press.
8. Gewirth, A. (1978) Reason and Morality. Chicago, University of Chicago Press.
9. Simmons, P. and Spence, E. (2006) The Practice and Ethics of Media Release Journalism. *Australian Journalism Review*, volume 28(1), July 2006, pp. 67–181.

[3] For a detailed account of informational corruption see Edward H. Spence (Autumn 2008) Media Corruption, *International Journal of Applied Philosophy* [14].

[4] I agree, therefore, with Gorniak-Kocikowska's claim that because of its global nature "computer ethics has to be regarded as global ethics" (1996) [1].

10. Quinn, A. and Spence, E. (2007) Two Dimensions of Photo Manipulation: Correction and Corruption. Melbourne: Australian Journal of Professional and Applied Ethics.
11. Spence, E. (2005) Corruption in the Media. In Jeanette Kennett (Ed.), Contemporary Issues in Governance: Proceedings of the GovNet Annual Conference, Melbourne, Monash University, ISBN 0-7326-2287-5.
12. Miller, S., Roberts, P., & Spence, E. (2005) Corruption and Anti-corruption: An Applied Philosophical Approach. Upper Saddle River, NJ, Pearson.
13. Spence, E. & Van Heekeren, B. (2005) Advertising Ethics. Upper Saddle River, NJ, Pearson.
14. Spence, E. (2008) Media Corruption, International Journal of Applied Philosophy, Volume 22:2, Fall 2008.

The LUMIR Project: Developing the GP's Network Pilot Program in the Basilicata Region

M. Contenti[1], G. Mercurio[2], F.L. Ricci[3], and L.D. Serbanati[4,5]

Abstract The Lucania – Medici in Rete (LuMiR) project aims to support the changing environment in the Italian National Health Systems, embodying a shift from organisation-centric to patient-centric services in the Basilicata Region. The primary objective of the LuMiR project is to foster collaborative, cross-organizational and patient-centric healthcare processes, supporting them with a suite of e-services for patient related clinical information communication and sharing among active stakeholders. It also aims to provide ICT support for other business activities. In the paper the methodology adopted in the LuMiR system design and development is described. It is a three-phased development process adopted to comply with institutional constraints and to better support a gradual change in the daily working practice of healthcare professionals called to use ever more sophisticated healthcare applications. The LuMiR system realization is in progress and its current state is also presented.

Introduction

Recent trends in healthcare service management emphasize the patient-centric paradigm and the key role of effective primary and community care. The continuity of care – along the continuum of a disease and across multiple healthcare settings – is promoted, and individual medical encounters are encompassed within complex processes of care (e.g. in the disease management).

At the same time, current healthcare is characterized by highly interdisciplinary processes which depend on timely provision of citizen related information at the

[1] CNR Roma, Italy, mariangela.contenti@itb.cnr.it
[2] CNR, Roma, Italy, gregorio.mercurio@itb.cnr.it
[3] CNR, Roma, Italy, fabrizio.ricci@itb.cnr.it
[4] CNR, Roma, Italy, luca@serbanati.com
[5] "Politehnica" University, Bucharest, Romania,

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_30, © Springer Physica-Verlag Berlin Heidelberg 2010

points of care, in order to enable more informed decisions, to deliver appropriate care and to prevent medical errors.

The Lucania – Medici in Rete (LuMiR[6]) project intends to support this changing environment embodying a shift from organisation-centric to patient-centric services in the Basilicata healthcare system. Its primary objective is to foster collaborative, cross-organizational and patient-centric care processes [1], supporting them with a suite of e-services for patient related clinical information communication and sharing. It also aims to provide ICT support for other business activities (e.g. administration and governance of healthcare organization, epidemiology, public health, etc.).

Section "e-Health institutional initiatives in Italy" describes the Italian e-Health institutional initiatives framing the LuMiR project. The LuMiR system is presented in Section "The LuMiR System" and in Section "The LuMiR Project" the methodology adopted for the LuMiR project design and development is describes. Finally, in Section "Remarks and future works", further remarks and some hints on future works are provided.

e-Health Institutional Initiatives in Italy

The systematic adoption of ICT is broadly considered a promising strategy to improve the economic sustainability of healthcare, while ensuring and enhancing the quality of services. Several countries worldwide are now heavily involved in managing and monitoring national roadmaps to innovate the sector (e.g. [2]), and novel eHealth applications are spanning throughout the whole healthcare delivery system: commonly based on cross-organization Electronic Health Records System (EHR-S) they support, from time to time, an interdependent set of managerial, administrative, epidemiological, clinical or relational needs and business processes.

Also in Italy, numerous eHealth programs and projects are currently carried out. Whereas the precursors started by autonomous regional or local initiatives, several others are now following European and national roadmaps. Actually, since 2005, an Italian permanent eHealth Board, the so called Tavolo di Sanità Elettronica (hereby TSE), was established to carry out a national strategy for eHealth in order to: (1) harmonize the individual eHealth action plans of the federated regional governments; and (2) support a coordinated implementation of interoperable ICT infrastructures and applications. So far the TSE issued a general and comprehensive eHealth conceptual framework [3], as well as architectural guidelines for a software infrastructure supporting distributed healthcare processes, namely the eHealth Basic Infrastructure (Infratruttura di Base per la Sanità Elettronica, IBSE).

[6]The LuMiR project is carried out by the Institute of Biomedical Technologies of the Italian National Council of Research and the Basilicata Region (website: www.sanitaelettronica.cnr.it/lumir (in italian)).

A core component of IBSE is the Health Individual Broker (InfoBroker Individuale Sanitario, hereby IBIS). It implements an efficient storage and routing of digitally signed electronic clinical documents, by referencing, notifying, and making them available to the authorized healthcare providers. It relies on a federated Registry/Repository system in which: (1) a Registry stores document content metadata; and (2) a Repository is a storage where electronic documents (pointed at by Registry records) reside and are retrieved by conventional means. In this approach, the healthcare information systems at the points of care produce clinical documents compliant with the HL7 CDA r2 standard, register them in the IBIS repository and publish them in the IBIS Registry for future access by the interested and authorized healthcare professionals.

Among the several initiatives undertaken, the GP's Network Pilot Program (Rete di Medici di Medicina Generale – RMMG) targets the primary care settings in 9 Regions in the Centre and South of Italy. It was jointly funded by the Ministry of Technological Innovation and the Ministry of Economy and Finance in 2006. It aims at fostering the implementation and adoption of TSE compliant ICT solutions in order to stimulate and support the cooperation of GPs and paediatricians with other healthcare professionals in the delivery of collaborative and ICT-enhanced healthcare services. The LuMiR project is the enactment of the RMMG Program in the Basilicata Region.

The LuMiR System

Core activities of the LuMiR project are the design, development, deployment and adoption of a longitudinal EHR-S. The LuMiR system interconnects at application level all the Points of Service (PoSs), that are the healthcare information systems of the individual points of care (Fig. 1). It also integrates other regional healthcare IT systems in use in the Region (registries and/or repositories). All the public healthcare organizations operating in the territory will be involved, as well as the citizens who could be able to access the information on their own health status.

In the design of the LuMiR system [6] the main principles considered are the following: (a) patient-centric approach; (b) use of multiple views on EHR contents; (c) promotion of technical and semantic interoperability; (d) integration of legacy applications; (e) enforcement of international standards; (f) promotion of re-usability; (g) easy adaptability to changes in the environment; and (h) assurance of information security and privacy by policy-based configurable models.

From a technological point of view, LuMiR is a distributed and component-based software system implementing a Service Oriented Architecture (SOA) and based on a peer-to-peer communication infrastructure compliant with the IBIS specifications [7]. In order to facilitate the exchange of information and knowledge among healthcare providers using routing mechanisms, the LuMiR system integrates other PoSs, each of which is a producer and/or consumer of clinical information and freely evolves loosely coupled with the others.

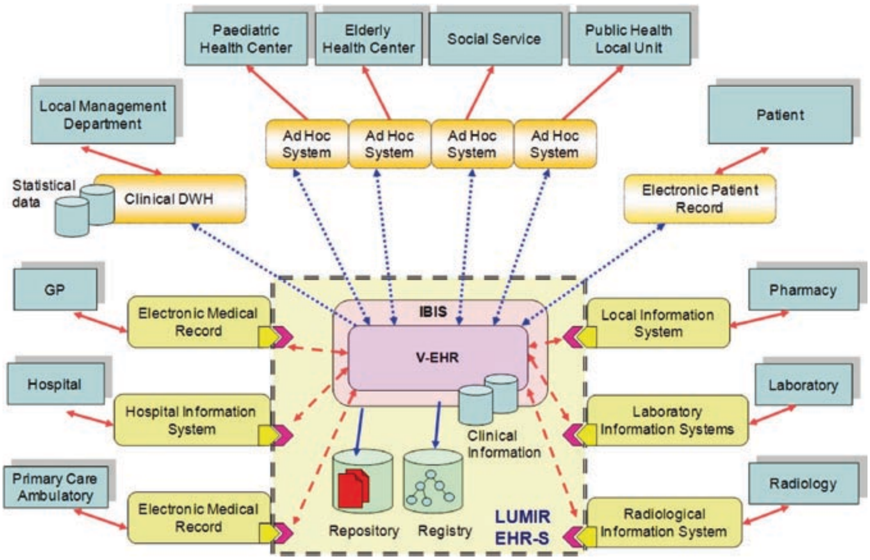


Fig. 1 The LuMiR system conceptual architecture

To guarantee the interoperability among the PoSs in the LuMiR project several standardization initiatives were taken into account, such as ebXML, SAML2, XACML, as well as HL7 and CEN TC/251, specific for the healthcare-domain, and SPCoop, specific for the Italian Public Administration. Also terminologies standards were considered (e.g. SNOMED, LOINC).

To capture and properly manage characteristic information and concepts a customized Domain Analysis Model (DAM) has been developed [6]. It is derived from the HL7 v3 RIM and integrated with other concepts, extracted from the CEN TC/251 standard on continuity of care (CONTSYS) or specific to the LuMiR context. Actually, in order to reach interoperability and following the HL7 v3 methodology, use cases and interaction diagrams were designed and used to generate and customize HL7 compliant messages. They will be the standard messages for communications in the LuMiR system (Fig. 2).

The LuMiR DAM is structured into four conceptual macro areas (Fig. 3):

1. *Contact and Episode of Care Area* where information on medical events and episodes are modelled.
2. *Clinical Guideline Area* where clinical guidelines and their composing healthcare activities are defined. The purpose of this area is to define treat-ment plans for the health issues identified as targets of care.
3. *Individual Treatment Plan Area* where a defined treatment plan with its health care services is customized and scheduled according to the patient's characteristics, health status and preferences.
4. *Service Realization Area* where healthcare services are carried out according to an explicit or implicit individual treatment plan and reported with results.

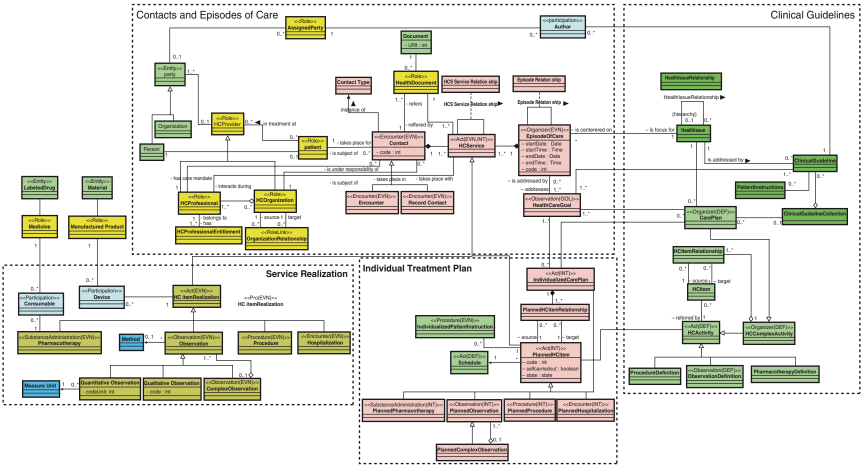


Fig. 2 The LuMiR system DAM

Fig. 3 Screenshot of the LuMiRp0 system

The information model is centered on the *Contact* and *Episode of Care* concepts. A Contact is a set of healthcare services (HCService), provided by a care professional during an encounter with the patient, and considered relevant for the patient's healthcare status. Each HCService belongs to one or more ongoing Episodes of Care, each of which regarding a Health Issue.

The LuMiR Project

In the LuMiR system development many institutional, organizational and technological issues claimed attention. For this reason an evolutionary, iterative and incremental approach has been adopted [4]. It was enriched with a socio-technical perspective based on the awareness that healthcare services are produced and delivered through interaction of people, technologies and business processes and, that changes in one of the three elements produce further changes in the others [5]. The approach appeared as the more adequate to cope with the size and the complexities of the project for many reasons.

Formerly the LuMiR project is constrained by institutional guidelines and recommendation issued by the TSE and by an RMMG harmonisation workgroup, part of which initially under development and still in continuous evolution.

In the Basilicata Region, some ICT systems for healthcare were already developed and adopted. Some of them are managed centrally by the Region itself. The more relevant for the LuMiR project are: (a) a registry of citizen anagraphical records specific for healthcare purposes; (b) a cross-organization booking system for ambulatory healthcare services, (c) a cross-organization system for first aid/hospital admission and discharge; (d) a distributed authoring tool and a centralized repository for medical reports; and (e) a specialised service for asynchronous teleconsultation in cardiology.

Moreover many software vendors operate in the market providing products and services to the different points of care. Their products span from few integrated Hospital Information Systems, to a certain number of specialized applications supporting the operational activities of specific departments and/or ambulatories, up to several Electronic Medical Records for GPs offices.

Concerning the daily working practice the business processes supporting the primary care service delivery vary sensibly from site to site, reflecting the geographical and demographical characteristics of each area, as well as the organization and distribution of the local healthcare facilities.

This is why we decided for an incremental life cycle of the LuMiR project, by planning the project activities in three macro-phases corresponding to three successive releases of the software infrastructure: LuMiRp0, LuMiR1, and LuMiR2.

LuMiRp0 is an early prototype, functioning as a sort of trial environment used to carry out a field experiment. With a relaxed implementation of the non-functional technological aspects (e.g. security, privacy and reliability), it serves small groups of selected healthcare professionals, providing them with all those patient related clinical information easily available – since already archived in digital format in some regional or local healthcare information systems. The LuMiRp0 system also integrates minimal services for sharing and storing patient related clinical data (Fig. 1), also relying on some key concepts of the LuMiR system (e.g. healthcare service from the FSE EHR-S specification,, episode of care, and contacts). Figure 3 presents a screenshot of the GUI physicians operate for browsing patients related clinical data. In this way, care providers are involved in the project since the first phase, and this makes it possible to: (1) better elicit when and how clinicians cooperate together and exchange documents and information in order to promote a paradigm shift in the physicians approach to patient care, more centered on communication and collaboration as the successive macro-phases require, (2) identify how and in which contexts the LuMiR system could simplify and empower daily working practices; and (3) identify some quantitative indicators to measure the improvement resulting from the new approach to patient care.

The LuMiR1 system is the actual implementation of the TSE specifications for the EHR-S. It is more focused on the interoperability, security, privacy and reliability issues at the clinical documents level. As the TSE requires it is a document-oriented Registry/Repository supporting the storage and sharing of digitally signed clinical documents. Nevertheless due to the course granularity of documents, the LuMiR1 system is not particularly suited for the management of complex, longitudinal user-requests involving the contents of the clinical documents.

The project last increment, the LuMiR2 system, integrates all the results achieved with the previous systems for promoting the patient-centric paradigm in healthcare. It merges the care providers needs, elicited during the field experimentation, with all the technological aspects, addressed in the development of the LuMiR1 system. Actually the LuMiR2 system intends to make a step forward the TSE specification within the Basilicata Region. The platform is centered on the Virtual Healthcare Record (VHR) conceptualization (Fig. 1) which: (1) gathers, integrates, and records clinical data related to significant medical events occurred throughout his/her life; (2) makes patient related clinical data available to the authorized stakeholders; (3) enables easier development of vertical applications oriented to better support healthcare processes (e.g. disease specific care pathways, performance measurement,etc.).

In the interaction among the VHR and any PoS (whatever a legacy system or an ad-hoc application):

1. Citizen related clinical information are extracted from digitally signed XML documents compliant with the HL7 CDA r2 standard. These documents are produced by local applications, registered in the VHR system and associated to the medical event that originated them. The documents are also registered in the IBIS Registry/Repository.
2. Each clinical event is notified by the VHR to all the local applications interested in that event.

3. Local healthcare applications can retrieve citizen related clinical information from the VHR in the form of specifically tailored aggregation of patient clinical data. Original clinical documents are also available using the VHR services.

In this way citizen related clinical data can be promptly available to the authorized healthcare professionals, as well as to the citizens themselves, with different levels of granularity according to the specific needs and requests.

Remarks and Future Works

In the paper the LuMiR system and the methodology adopted for the LuMiR project design and development are described.

At the moment the field experiment with LuMiRp0 is in progress in two different public healthcare organizations of the Basilicata Region. The development of the LuMiRp0 and its adoption in the field experiment were burdensome but fundamental activities. On one side, the simplification of the technological aspects facilitated the tasks in charge to the software vendors and allowed a rapid development of the integration adapters. Also the software vendors involvement since the early stages of the project has been profitable for the establishment of a collaborative environment and business partnerships, strategic for the subsequent more complex phases of the project. On the other side, the design and development of the LuMiRp0 system, supported with narrative scenarios and focus groups, put the focus on the socio-technical dimensions and the actual business processes, enabling to elicit important system requirements. Also the set up and execution of the field experiment have been providing important lessons learned on possible hindrances for the final adoption.

The development of the LuMiR1 system is in progress and will be concluded until the end of this year.

The LuMiR2 system design is in progress, and the following development will incorporate all the results previously achieved, as well as other extensions: (1) integration of data from the clinical documents into a VHR for each citizen; (2) e-Services dedicated to the citizens and devoted to support their empowerment, (3) healthcare process support with ICT capabilities to define, edit, enact, and monitor citizen care pathways.

References

1. Ricci, F.L. and Serbanati, L.D. (2005) *.MobiDis: Toward a Patient Centric Healthcare Information System*. In Proceedings of MIE2005 – The XIXth International Congress of the European Federation for Medical Informatics. p 557–562.
2. eHealth ERA project (2007), *eHealth Priorities and Strategies in European Countries Report*, available online (http://www.ehealth-era.org/documents/2007ehealth-era-countries.pdf)

3. TSE, Italian National Board for eHealth (2005). *A Shared Policy for e-Health*.
4. Larman, C., Basili, V.R. (2003) *Iterative and Incremental Development: A Brief History*. Computer 36(6):47–56
5. Coiera, E., Westbrook, J.I., Callen, J.L., and Aarts J.(Eds) (2007) *Information Technology in Health Care 2007. Proceedings of the 3rd International Conference on Information Technology in Health Care: Socio-technical Approaches*, Amsterdam, IOS Press
6. Contenti, M., Mercurio, G., Ricci, F.L., Serbanati L. D., *LuMiR: A Region-wide Virtual Healthcare Record*. To appear in Proceeding of the 9th International HL7 Interoperability Conference 2008, Crete, Greece
7. TSE (2006). *Architectural Strategy for eHealth*.

The Mediating Role of Technology-Based Training on Change Management Success. A Research in Progress[1]

M.C. Benfatto[2], C. Del Vecchio[3], and M.R. Di Renzo[4]

Abstract This paper examines the positive connection between change management, behaviors and training and the effectiveness of e-learning platform in order to facilitate organizational change. To this aim, we first point out the relevance of behavioral capacities in managing successful adaptation to change. In this context, the aim of training does not consist in giving key people ready-made solutions. It rather involves a multi-stage process where each individual gets a one-to-one support through which he/she learns how to cope with exceptional or novel circumstances, while capitalising on their own potential and accelerating their self-development. In particular we claim the effectiveness and benefits of training platforms tailored around the managerial population and the new trends of modular multimedia learning programs. Finally this work will present a research in progress regarding the real contribution and role that technology can offer to those who undertake a learning cycle aimed to the development of the value of accountability. The analysis is based on an on-line training platform developed in a big firm operating in the telecommunication industry.

Introduction

Rapid technological and social changes, greater competition, in the current market economy have made efficiency improvement a crucial managerial challenge for firms to conduct their business and to remain competitive in the marketplace. This

[1] M.C. Benfatto and C. Del Vecchio are the authors of paragraphs 1 to 2. M.R. Di Renzo is the author of paragraph 3

[2] Università LUISS Guido Carli, Roma, Italy, mcbenfatto@luiss.it
[3] Università LUISS Guido Carli, Roma, Italy, cdelvecchio@luiss.it
[4] Università LUISS Guido Carli, Roma, Italy, mrdirenzo@luiss.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_53, © Springer Physica-Verlag Berlin Heidelberg 2010

means internally (1) a radical change in enterprises social identity and business, (2) a deeper reflection on employees' behaviors and competences, (3) a review of enterprise values and organisational culture [1]. In this scenario, in order to gain higher organizational effectiveness and coherence, it is necessary to look at change not as an exceptional event, but as the key element for strategic and organisational development throughout broader organizational change programs. In other words, what we now think about is how to create in organizations the organic capacity for continuous and ever-faster change and adaptation.

In the literature we can identify several change management models, that, even if proposing different techniques and tools, suggest some fundamental values at the heart of successful change projects. Among them people are pointed out as the key components [2]. It is clear, then, that a process of change management implies on the one hand a full understanding of the dynamics and potential issues in people's organizational behaviors; on the other hand the willingness of the actors involved in the change process to adapt their skills and competences [3]. In this perspective training becomes the catalyst of change. It helps knowledge and competence updating; moreover it fosters the development of tools for motivating and making employees aware of change.

The connection between change management strategies, behaviors and training, the latter as the most effective method to facilitate the implementation of change management programs, are analysed in the first part of this paper. Secondly, the present work will focus on the use of innovative training methods, usually driven by benefits/ drawbacks analysis, in highly complex organizations. In particular the need to deliver training anytime, anywhere, throughout customised and flexible learning environments. Thirdly a case will be presented on a multinational firm and its change management plan, based on the use of innovative technological training systems, whose aim consists of educating a population of selected top managers to the culture of accountability.

Literature Review

Organisational change has been conceptualized, studied, and analyzed in a wide variety of ways. Some researchers look at how change occurs and focus on the development of process theory; others consider the nature of change and the development of content theory [4]. Flamholz and Randle distinguish between three types of transformational change. The first type represents the transition from an entrepreneurial to a formal organisation structure; the second one is the revitalization of an existing business; and the last one is the fundamental re-thinking of what industry or business the organisation is in [5]. Another popular distinction made with regard to organisational change pertains its incremental or radical extent, [6, 7]; other authors, instead, focus not on the change itself but on the change process and the role of the change agents involved [8, 9]. Schein and Kotter address the failure of organizational change programmes by arguing that the reason so many change efforts run into resistance or outright failure is traceable to the organization's inability to effectively unfreeze and create readiness for change before attempting a change induction. In this respect, organizations often move directly into change implementation before the individual or the group to be changed is psychologically ready [8, 10]. Prior literature emphasizes the need to understand change from the perspective of those engaged in its implementation [11–14]; while several researchers have begun to place substantial emphasis on various factors that can influence employee reactions to change that occur in different contexts [15, 16]. In broad terms, employee reaction to change has been tied to a wide range of factors, from prevailing change process conditions to specific employee perceptions. Given the importance of these research directions, it is not surprising that much of the change management literature is written from the perspective of those who seek to understand how organisations or organisational behavior (whether micro or macro) can be changed in some way for the better. Pendlebury et al. claim that the most effective levers of change management reside in processes, culture and people behaviors [17].

If the change process can be accurately planned, however the most critical role, in radical organizational changes, is played by behaviors and basic principles of organizational culture. In order to impact directly on those levers, many authors claim that any plan of strategic change primarily focuses on a punctual training program for high profile employees, because, once change has deepen its roots into the managerial class of an enterprise, it, consequently, cascades other parts of the organization determining strategic changes in each function, no matter what the gerarchical level is [18]. Given the importance of these factors, Pendlebury et al. suggest that one of the keys to successful change management is training [17]. The aim of training is to help the workforce rapidly acquire two types of skills. On the one hand, the nature of their activities and responsibilities may change drastically, making it necessary for them to acquire new expertise in the way they actually fulfil their role or do their job. On the other hand, these same employees will also be in the front line of the change process, so if they are to contribute to change as effectively as possible, they will need to know how to carry out change.

But change also requires alterations in the way people behave. The obstacles are such that it proves necessary to give some key people in the business (especially managers) one-to-one support to help them accept change and transform their methods and behaviors in line with the objectives defined in the vision. This type of support puts together training with techniques of coaching. The aim of training consists of (1) improvement of performances and (2) individual carrier definition (3) support to organizational change [19]. Once identified these aims, it is possible to start planning the actual training objectives that refer to the different dimensions of individual professionalism:

– Professional knowledge, which concerns the ability to de-structure well-established schemes and to enrich oneself available knowledge.
– Capabilities, which is related to the valorisation of oneself competences throughout the internalization of experience and the elaboration of new knowledge.

– Conceptualization capacity, which enables individuals to dominate complex operative issues by focusing on the ability to select and elaborate the right information.
– Behavioral capability, which allows individuals to adjust oneself leadership style, motivation, communication, cooperation and negotiation.

If the first three dimensions focus on the idea of knowing and know-how, behavioral improvement, instead, tends to focus on individual perception of oneself, owned resources and the capability to manage connections and communication processes. This is why we claim that behavioral capabilities have to be considered as the most effective support to the dynamics of organizational change. A training project centred on behaviors is often planned when radical changes in the strategies and organization of an enterprise occur and is aimed to facilitate the diffusion of a new culture. The target population in this kind of interventions are middle and top managers; coherently the training session does not consist of institutionalized knowledge, due to the heterogeneous roles in the class and the extent of their professionalism. This population's need for training is instead driven by radical change processes, which ultimately require a restructuring of competences, rather than learning of new knowledge. As a premise to our case, we take into account change management as the third aim of training, as identified in Taylor and Lippit's scheme (see Fig. 1) [20], and split up the training scheme as follows:

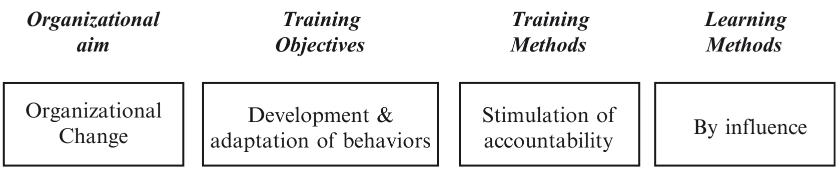


Fig. 1 Scheme of a training aimed to change management

Secondly it is necessary to identify an instrument that enables the organization

– To customize learning environments to managers' changing needs.
– To pare down the cost generated by geographically distributed attendees.
– To replicate and update centrally and at minimal costs the contents of the training.

The opportunity of mixing different educational methodologies, through the use of traditional and innovative learning tool, enables to fit the requirements of students and organizations more effectively. Researchers affirm that a virtual training environment services those who desire the flexibility of on-demand training, while applying the interactive capabilities of the Internet/Intranet. Moreover the advantages of technology-based training are the control of content, ensuring that all students receive the same quality of learning, and the enhancements brought to the learning environment by multimedia [21, 22]. In this perspective, technology-based learning seems to respond to most of these requirements. A recent trend in this field consists in breaking up the actual contents into small portions. Described as "Knowledge objects," "modules," and "learning objects" or "learning pills," these discrete portions of information can be catalogued, re-used, and combined in customized programmes that provide learners with all the items they need, no more and no less [23]. Individuals in the present, fast-paced business world demand more choice in managing their training and development. Almost every major university offers some type of distance learning program. Distance learning, delivered through the Internet or a corporate Intranet, allows a student to progress through a program in a self-paced learning environment [24]. With the arrival of technology-supported training, however, the ability to measure results has increased exponentially. In fact ICT-based training includes built-in programming for tracking everything from learner responses, to quizzes, to how many times someone goes back to the same module. While most training programs still do not measure well how learners apply new skills to their work or how that application effect the organization's business results or the individual performance, the ability to at least report on the data of how the program is administered can be a great support to training managers.

Case study

Context of Analysis: Sample and Training Course Structure

This analysis focuses on an e-learning program implemented in a multinational telecommunication firm. The learning program was addressed to a population of about 140 managers, with an age on average of 44 years old, coming from different organizational areas: 37% from the commercial department, 26% from the Asset Corporate Governance area, 8% both from the financial department and the Ceo & Top Management, 5% both from Human Resources department and regulatory affairs and institutional relations, 3% from Legal Affairs area, 2% both from International and National Wholesale and Portal and new services R&D, finally 1% from ICT, Reporting and Quality. The learning program aimed to promote the value of accountability. Accountability is defined in this firm as the capability (1) to exceed one's role responsibility by improving efficiency and effectiveness (innovation) (2) to assume firm's objectives and to actively contribute to outcomes (entrepreneurship) (3) to take into account constraints and to act carefully (organizational awareness). A first stage, consisting in face to face meetings, preceded the multimedia process, during which each participant completed a test to self-evaluate his/her own organizational behavior. The second step consisted of on-line sessions, through the help of an e-learning platform, that gives access to learning pills, which are very short and structured courses of 5/7 minutes on average. Each pill is composed by four components:

- *Situational*, creates a bridge with the student experience.
- *Theoretical*, gives the basic knowledge and encourages the topic development.

– Of *edutainment*, gives ideas to think, to use creativeness, and to encourage new perspectives on the topics.
– Of *learning reinforcement*, provides tools to consolidate what is taught.

Each session, in turn, is made up of learning objects (or info learn), the least training units that are independent from the others

– The situational session consists of a *cartoon* or a *movie* with actors.
– The theoretical session is divided into *multimedia lesson* and *printing file.*
– The edutainment session is divided into educational game, image and *advanced readings.*
– The learning reinforcement session consists of an *interactive test*.

The e-learning process lasted for 4 months, with weekly sessions of three learning pills, which meant 60 pills in total in about 20 weeks. Each participant received a weekly e-mail invitation to login into the platform. *Training pills* (see Table 1) have been grouped in three clusters, each with its own training aims.

Table 1 The three clusters

Cluster	Self	Team	Company
Objectives	Encouraging participant to think about the importance of accountability in order to boost coherent behaviors.	Developing awareness on the importance of accountability in facilitating team performance in terms of improving individual motivation, communication, team operational effectiveness, and climate.	Promoting the value of accountability within the firm.

Analysis Modeling

The aim of the analysis is to evaluate the effects of technology use on managers' learning process. The model is based on the relation among three variables:

– *Independent Variables*: demographic variables (age, organizational department) and self-assessment of the organizational behavior.
– *Mediating Variables*: degree of e-learning platform use, measured by number of login, time of connection, nr. of looked up pills, and individual perception of technology effectiveness.
– *Dependent Variables*: participants' upgrading of accountability competence.

Hence, this model allows to analyze the impact of independent variables on the dependent variable both directly and mediated by technology means. In this preliminary step, the analysis is focused on the independent and mediating variables. Data on dependent variable will be collected in the next performance evaluation. Data on platform access show a nuance flow. In effect, at the beginning of the training period more than half of the overall population had access to the platform. 61% of managers visited the platform during the first three weeks. However, after this period, the number of logins shows a decreasing rate. Only 11% of the overall population continued to login into the portal until the end of the e-learning course. More interesting evidence could be drawn by thoroughly analyzing the behavior of the population in the mentioned 61%, that had access to the platform at least once.

– 35% of managers logged out without seeing any pills.
– 60% of managers used 1–20 pills.
– 5% of managers involved used 21–pills.

When considering the training pills sorted by clusters, we draw the following evidence

– 62% of used pills belonged to Self cluster.
– 23% of used pills belonged to Team cluster.
– 17% of used pills belonged to Company cluster.

When analyzing the access to the pills by content typology, we note that

– 21% concerned Situational class.
– 15% concerned Didactic games.
– 14% concerned Multimedia lessons.

Further Research

This analysis contributes to further research in two directions. First, the contribution that technology offers during learning processes in developing behavioral competences will be estimated, in particular with regard to the improvement of participants' accountability. This analysis will be conducted after the evaluation of individual performances. Second, future research will inquire the benefits and the limits of on-line training. This will be made through a test, with open/ended questions, on two samples and through two different techniques. The analysis will be performed two months after the end of the e-learning course. A first test will be done through a focus-group composed by those students who have used the pills most. A second test will be conducted via e-mail and will be addressed to people who abandoned the distance learning course after about three weeks. The sample involved in the focus group, after having completed the test, will participate to a group interview to estimate the perceived utility of the course in terms of behavioral changes. In fact only these participants can test the distance learning course effectiveness.

References

1. Gabrielli, G. (2006) Conoscenza, apprendimento, cambiamento. *La gestione dei programmi di knowledge e change management*. Milano, Franco Angeli.
2. Fletcher, S. (1997) Competence and Organizational Change. London, Kogan Page.
3. Wright, P.M., Dunford, B.B. and Snell, S.A. (2001) Human Resources and the Resource-Based View of the Firm, *Journal of Management* 27(6): 701–721.
4. Rebora, G., et al. (2007) Change Management: teorie organizzative e modello applicativo. Casi Aziendali. Assago, Kluwer.
5. Flamholtz, E.G. and Randle, Y. (1998) Changing the Game: Organizational Transformation of the First, Second, and Third Kinds. New York, Oxford University Press.
6. Nadler, D.A. and Tushman, M.L. (1989) Organizational Frame Bending: Principles for Managing Reorientation, *Academy of Management Executive* 3: 194–204.
7. Tushman, M.L. and O'Reilly, C.A. III (1996) Ambidextrous Organizations: Managing Evolutionary and Revolutionary Change, *California Management Review* 38(4): 8–30.
8. Schein, E.H. (1999) The Corporate Culture Survival Guide.San Francisco, CA, Jossey-Bass.
9. French, W.L. and Bell, C.H. (1998) Organization Development: Behavioral Science Interventions for Organization Improvement. 6th edn Englewood Cliffs, NJ, Prentice-Hall.
10. Kotter, J. (1995) Leading Change: Why Transformation Efforts Fail, Harvard Business Review 73(2): 59–67.
11. Duck, J.D. (1993) Managing Change: The Art of Balancing, Harvard Business Review 71(6): 110–118.
12. Lau, C.M. and Woodman, R.W. (1995) Understanding Organizational Change: A Schematic Perspective, *Academy of Management Journal* 38(2): 537–554.
13. Weber, P.S. and Manning, M.R. (2001) Cause Maps, Sensemaking, and Planned Organizational Change, *Journal of Applied Behavioral Science* 37: 227–251.
14. Smollan, R.K. (2006) Minds, Hearts and Deeds: Cognitive, Affective and Behavioral Responses to Change, *Journal of Change Management* 6(2): 143–158.
15. Dent, E.B. and Goldberg, S.G. (1999) Challenging 'Resistance to Change', *The Journal of Applied Behavioral Science* 35(1): 25–41.
16. Mabin, J.V., et al. (2001) Harnessing Resistance: Using the Theory of Constraints to Assist Change Management, *Journal of European Industrial Training* 25(2): 168–191.
17. Pendlebury, J., Grouard, B. and Meston, F. (1998) The Ten Keys to Successful Change Management. Chichester, Wiley
18. Korsgaard, M.A., Sapienza, H.J. and Schweiger, D.M. (2002) Beaten Before Begun: The Role of Procedural Justice in Planning Change, *Journal of Management* 28(4): 497–516.
19. Fontana, F. (1994) Lo Sviluppo del Personale. Torino, G. Giappichelli Editore.
20. Taylor, B. and Lippit, G. (1985) Management development and training handbook. London, MaGraw-Hill.
21. Trentin, G. (2001) Dalla Formazione a Distanza All'apprendimento in Rete. Milano, Franco Angeli.
22. Rosenberg, M.J. (2001) E-Learning: Strategies for Delivering Knowledge in the Digital Age. London, McGraw-Hill.
23. Amicucci, F. (2004) La formazione fa spettacolo. Percorsi per una nuova formazione manageriale. Milano, Il Sole 24 Ore Libri.
24. Ehlers, U. (2003) Quality in E-Learning from a Learner's Perspective, *European Journal of Vocational Training* 29: 39–52.

The MISE Project: A First Experience in Mediation Information System Engineering

F. Bénaben[1] and H. Pingaud[2]

Abstract A research project in the domain of enterprise interoperability is presented. The first goal of this project was to make a proof of concept and to show the benefits in terms of interoperability that could be obtained from a model driven engineering approach applied to a collaborative information system design. The system architecture is built around a new concept: a mediation information system having in charge to manage heterogeneity between partners. The flexible model driven engineering of this mediation information system is made by adapting the configuration of an enterprise service bus technology. It is proposed to be the key factor to put interoperability into practice.

Introduction

Enterprise interoperability is widely considered nowadays as a main challenge for catching new business opportunities into different kind of economic networks by the means of information technologies. The benefits of interoperability are only effective when the cooperation is running. By the way, if the capacity is developed individually in a design time, the performances are collectively estimated in a running time. Enterprise interoperability can be analyzed using system engineering point of view. Regarding the proximity between integration and interoperability concepts, we could say for both of them that the same target is intended to be reached, i.e. to carefully assemble existing components in order to satisfy requirements on a predefined set of functionalities. But in the specific case of interoperability, the assembly of components is theoretically facilitated by the intrinsic nature of the selected components, the interface of which have been designed to this end. It leads to an overall system that is a weakly coupled set of components, while this

[1] Université de Toulouse, France, bernaben@enstimac.fr
[2] Université de Toulouse, France, pingaud@enstimac.fr

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_46, © Springer Physica-Verlag Berlin Heidelberg 2010

is not necessarily true in the case of integration (where coupling could be a tedious and time consuming task).

The challenge with enterprise interoperability is that the components appear to be organizations wanting to cooperate by using the best of their information systems. Therefore, many views of those organizations should be considered during system design and operation (for example: people, functions, information, IT resource). So, this challenge is not a trivial one as:

- It addresses a complex problem for a network of relatively independent organizations with all the related limits due to knowledge sharing and systems heterogeneities.
- It requires IT innovation philosophy binding the best of management activities and new Web technologies (with the associated competencies in various domains) in order to design, to implement and to operate efficient solutions with an objective of low costs in mind.

Our research contribution follows a pragmatic line, by giving prime importance to an information system architecture that could support such an ambition, including a business requirement phase. More than four years ago, we have launched an internal research project in the laboratory, called MISE, with the aim at making a first experimentation in the domain. Our motivation was to deliver a prototype of IT solution for a collaborative network organisation (CNO), trying to select the best of both management and engineering practices, and selecting promising information technologies.

We began to develop a first prototype of a collaborative information system which could enable connections between enterprises needing partnership. MISE means: "Mediation System Information Engineering". Two PhD thesis and one year post doctorate student [1, 2] have contributed to complete a first step of MISE during the period 2004–2008, in a complementary way, under supervision of the authors. This project was financially supported by the French National Foundation for Research (ANR- Project JoNes) and by EBM WebSourcing.

In the next chapters, we give an overview of the project delimitation, of main assumptions, and of the work breakdown structure of the MISE project during this first iteration, as well as a description of some results (software prototypes).

Main MISE Project Assumptions

Working on the project, we soon found ourselves having to think out the adapted architectures for such application. This definition of a Mediation Information System (MIS) dedicated to dealing with data exchange, as well as service and process executions, was imagined and drawn [3]. It is a key design element because the MIS impacts the architecture model's layers, from business to physical one, passing through functional and logical artefacts. It specifies that enterprise interoperability cannot be obtained by directly assembling independent components,

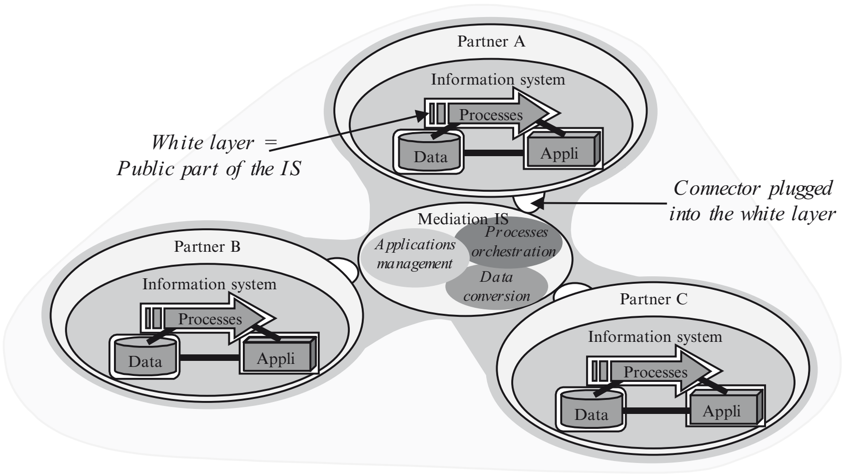


Fig. 1 A mediation information system

because this type of communication needs an intermediate component. This component is a media managing communication between individual partners.

MIS shouldn't be mistaken being often used to talk about Management Information System. With respect to the interoperability framework introduced by Chen et al. [4], the choice of an intermediate subsystem does not imply that we have developed a unified approach for enterprise interoperability. Our approach must be able to dynamically solve heterogeneity problems, especially because the MIS should be -by nature- dedicated to semantic supporting facilities. By the way, the federated approach could be developed on the basis of our architecture (Fig. 1).

This concept of mediation rapidly refined at the conceptual level and at the same time, progressively appears to be a reachable target at the practical level. If mediation is not a new word in communication sciences, we have proposed an adaptation for the problem under study.

In the same way, it was necessary to fix assumptions on the organizations wanting to interoperate. The profile of each partner assumes that public functionalities are exposed by means of services, on the one hand, and that public information structures of input and output individual message flows – from and to the public services – are available on line, on the other hand. Those hypothesis directly refer to a partner's profile with a good level of interoperability maturity.

Finally, the core of our problem concentrates on interoperability service utilities for mediation purposes. The added value of those utilities is a capacity to deal with versatile expectations from the way. MIS shall be configured and reconfigured in a very flexible manner in order to track changes in collaboration requirements. Such practice cannot be provided without the rationale of model based facilities. That is the reason why we decided to structure the work breakdown structure of the MISE project following a model driven engineering (MDE) approach (see Fig. 2.).

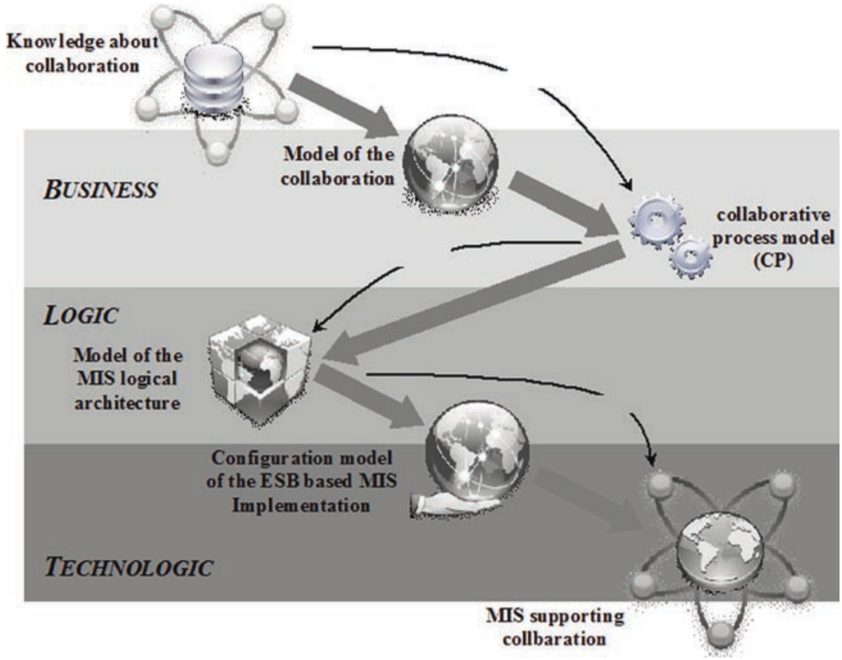


Fig. 2 Main steps of the MDE approach

Beyond these first sets of assumptions on mediation concepts and partner profile, a third difficulty was to define the target platform, i.e. designing the logical and physical architectures capable to manage the relevant information system. The service oriented architecture, mentioned above, limits the range of possible candidates. Our partner EBM WebSourcing (www.ebmwebsourcing.com) helps us to test a solution. This company is a leading open source company in the area of specific **technology of enterprise service bus** (ESB). Our idea was to prove that this technology could be appropriate for inter enterprise software architectures in the frame of the MISE project. Their open source ESB (PEtALS product) was defined as a target for implementation.

Overview of Model Driven Engineering Approach of the MIS

The MISE project's main issue was to develop a "broad" model driven engineering of the system. The MIS design process was structured in many steps relatively to the three basic architectural layers (see Fig. 3, with the business, logic and technological layers). At each engineering process step, a relevant system model is defined in an adequate language as a result. It is the input material of the next step. Therefore, for each step, a model transformation on an input model delivers the

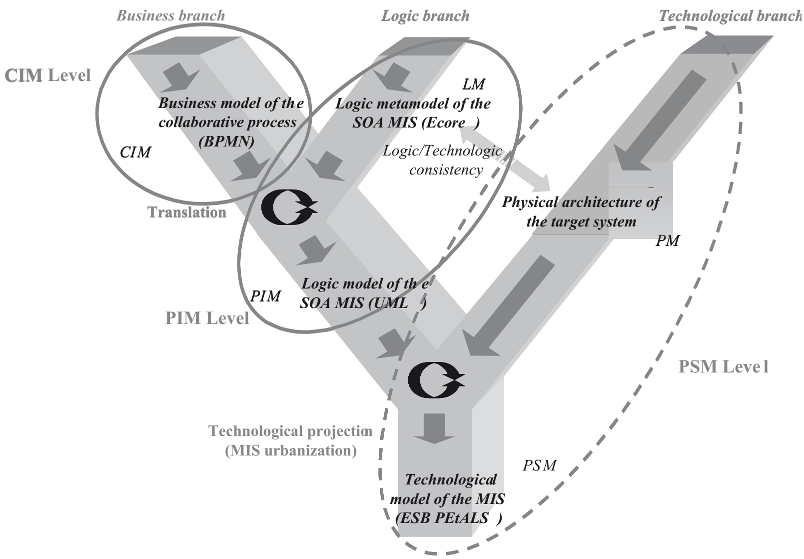


Fig. 3 A three layered system architecture

output model, using model morphism and model mapping theories [5]. Synthetically, we could say that the MIS MDE approach is structured around a "flow of models" through the architectural layers.

The process is initiated using a knowledge about the collaboration space, that could be understood as a business requirements formulation. It is developed using a Collaborative Network Ontology (CNO) [2]. This ontology includes two sub-ontologies connected by deduction rules: (1) Collaboration Ontology (CO) and (2) Collaborative Process Ontology (CPO). At this level, the model expresses the main communication functionalities of the collaboration. The ontology captures knowledge concerning business case and actigramme-based representations. They put the emphasize on partner contributions and information flows. As a central point of this MDE approach, a collaborative business process (CP) model is then produced from this knowledge by an inference engine and is then used as IS requirement formulation.

This CP is well structured in the BPMN language, following a specific meta model. The mediation functionalities are concentrated in a pool of the BPMN language and playing many roles [5], like the following ones:

– Public data exchange (flow).
– Public service execution (transformation).
– Public business process orchestration (coordination).

BPMN has been recently recommended by OMG. It is a semi formal process language used to represent behavioural aspects of information process. It has been mainly popularised for workflow applications. Parallelism, synchronisation and information resource sharing are easily represented using BPMN primitives.

Working on this CP model, an UML SOA profile is derived to capture the IS logical definition. Engineering work uses a computer aided design tool which encapsulates a transformation language engine. Three UML packagesare proposed corresponding to three views of the final result on the business track: *Services view*, *Information view and Process view*. Finally, our MDE process ends with the generation of the ESB configuration files preparing either the first deployment of the system or an updated version of it. This last step is done with an UML ESB profile.

A Prototyped Computer Aided MIS Engineering Tool

The MDE approach has been supported by many complementary tools adapted to MISE project's context. We described two main components of our prototype in the following: The CNO to CIM component and the CIM to PIM component.

The first component is in charge of the CP model design, starting from collaboration knowledge. This component has been totally developed under the Eclipse© framework:

- As shown in Fig. 4, a specific collaborative network editor has been designed using Graphical Modelling Framework (GMF). It helps to provide information relative to network characteristics and functionalities.
- Collaboration pattern deduction provides new knowledge about business services, resource dependencies and collaborative services using knowledge base (KB). This KB is specified with an ontology formalised with OWL-DL. Protégé© was chosen to edit CNO ontology. We have selected a SWRL Editor, a plug-in of the Protégé tool, to edit the deduction rules. Then the rules have been applied using the Jess engine.

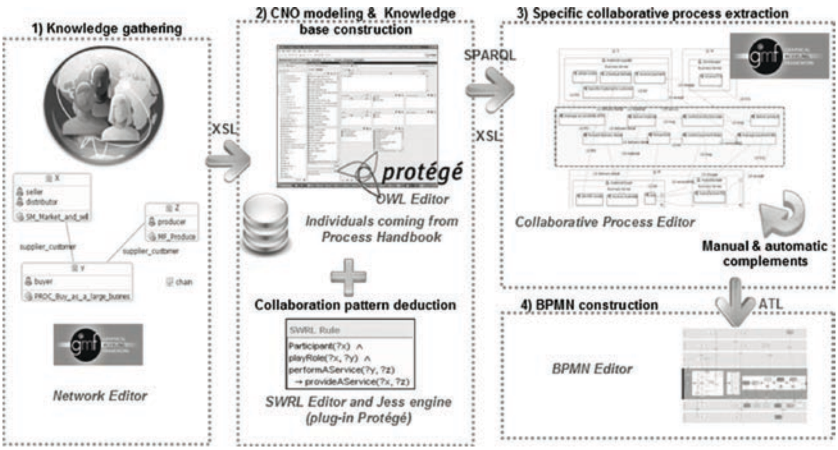


Fig. 4 First component of the prototype: from CNO to CIM

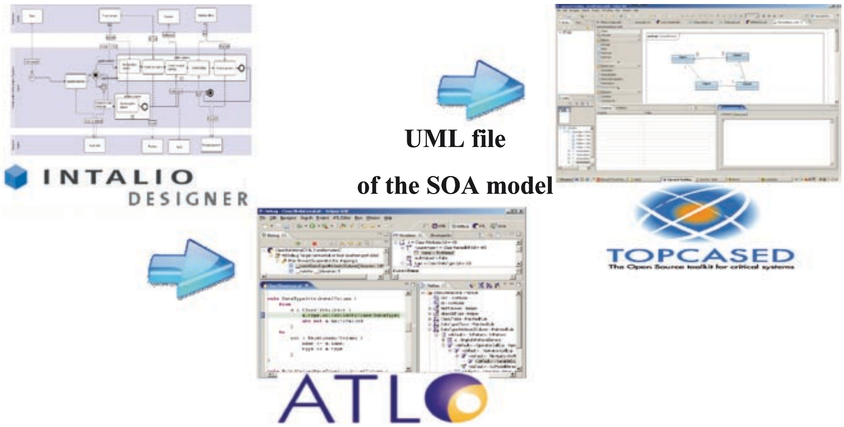


Fig. 5 Second component of the prototype: from CIM to PIM

– Specific collaborative process extraction and visualization not only refers to the relevant collaborative processes characteristics. Visualization functionality offers an opportunity to verify and validate the generated collaborative process *a posteriori*. Visualization has been implemented using also the GMF Eclipse plug-in, while a SPARQL query aims at extracting knowledge from the KB using Jena and Pellet engines.
– BPMN construction and visualization is focused on representing collaborative process model in a form of BPMN model. It has been done using the ATL transformation engine. The BPMN editor is Intalio designer.

In the same way, many tools have been used to manage the CIM to PIM component. The software production chain for this second MDE component is shown on Fig. 5. Again, the ATL transformation engine is used to design the UML model in a SOA profile. The UML model is then visualized with the TopCased tool. Transport of information is done in ad-hoc XML format files. A third component was recently imagined to complete MDE demonstration. And It was a success!

Conclusions

Our presentation summarised many aspects of MISE project: objectives, goals, WBS, deliverables and results (prototype capacities). We have tried to show that the combination of many types of existing IT technologies could be combined in order to implement a whole MDE approach of a specific MIS. The support of this engineering process needs a computer aided solution. This is the only way to reach a high interoperability level as well as the flexibility expected by so managers that competitiveness will require in a near future. Starting from the results of the first iteration of MISE, we defined new research lines in the area of enterprise interoperability and mediation information system. We are now working on a project to determinate interoperability solutions for crisis management [7].

References

1. Touzi J. (2007) A model transformation for mediation information system design, Université de Toulouse –INPT PhD thesis, Ecole des Mines d'Albi-Carmaux
2. Rajsiri V, Lorré JP, Bénaben F., Pingaud H. (2007). Cartography based methodology for collaborative process definition, in *PRO-VE'07-8th IFIP Working Conference on Virtual Enterprises*, Portugal
3. Bénaben F., Touzi J., Rajsiri V., Truptil S., Lorré J.P, Pingaud H. (2008) Mediation Information System Design in a Collaborative SOA Context through a MDD Approach, *MDISIS Workshop, CAISE 08 conference, Montpellier*, France
4. Chen, D., Dassisti, M., Elvaester, B (2006), Interoperability Knowledge Corpus, Intermediate Report. Deliverable DI.1b, Network of Excellence InterOp, Contract No.IST-508011, available at http://www.interop-noe.org
5. Touzi, J., Bénaben, F., Lorré, J.-P., Pingaud, H (2006), Interoperability through model based generation: the case of the Collaborative IS. in INTEROP-ESA'06, pp. 407–416. Springer.
6. D'Antonio F. et al., (2005) InterOp Noe Report, Task Group 2.2 (MoMo), IST 508011, available at http://www.interop-noe.org
7. Truptil, S., Bénaben, F., Couget, P., Lauras, M., Chapurlat, V., Pingaud, H.(2008) Interoperability of Information Systems in Crisis Management: Crisis Modeling and Metamodeling. Published in INTEROP-ESA'08, Springer, Berlin

The On-TIME User Interface

T. Catarci[1], R. Giuliano[2], M. Piva[3], A. Poggi[4], F. Terella[5], and E. Tracanna[6]

Abstract This work presents the visual user interface of the On-TIME system, a task-centered information management system, whose aim is to actively participate to and support the user tasks. One of the key challenges that needs to be addressed for the success of On-TIME, is the design of a user friendly interface. Being On-TIME based on the use of a so-called Personal Ontology to provide a semantic account to user's personal data, the interface has to allow the user to easily browse the ontology. On the other hand, it has to address the management of tasks. This requires to both suggest tasks that the user might be willing to perform, and to support her while executing tasks. We present a typical user scenario in order to illustrate a possible interaction with the On-TIME interface, and discuss some preliminary user evaluation.

Introduction

Personal Interaction Management System (PIMS) [6] is a new paradigm of system, that allows users to focus on the tasks they have to perform rather than just managing their personal information. Hence, user tasks need to be explicitly represented both in their static aspects, i.e. the kind of information that they manipulate, the kind of programs involved in these manipulations, security and authentication issues that may arise, and in their dynamic ones, i.e. the sequences of actions that they require, the alternative choices that are given to the user, pre-conditions, post-conditions, and invariants for the various actions that are involved in the task. On-TIME is an example of PIMS, in which user tasks, as well as user data, are described in terms of explicit semantics that the user can share, i.e. by means of a

[1] Università La Sapienza, Roma, Italy, catarci@dis.uniroma1.it
[2] Università La Sapienza, Roma, Italy, giuliano.raffaele@gmail.com
[3] Università La Sapienza, Roma, Italy, hyunkel82@gmail.com
[4] Università La Sapienza, Roma, Italy, poggi@dis.uniroma1.it
[5] Università La Sapienza, Roma, Italy, baylisstic83@gmail.com
[6] Università La Sapienza, Roma, Italy, ematrac@gmail.com

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI: 10.1007/978-3-7908-2148-2_61,

so-called Personal Ontology, reflecting the user's view of the world and her personal interests.

In this paper we address one of the key challenges for the success of On-TIME, namely the design of a user friendly visual interface. In particular, the On-TIME user interface has two main components. The first component allows the user to navigate and edit the Personal Ontology, both at the conceptual and the instance level, with the capability of focusing on the instances with highest *level of activation*. These are the instances that are currently of most interest for the user, because of their nature and/or as a consequence of particular events, e.g. the user inspecting the instance, the reception of an email considered of interest. This component is based on coordinated multiple views, which allow the user to navigate the Personal Ontology by possibly switching from one view to the other, maintaining the same focus of attention. In particular, it provides both a tree view, which might be preferred by an expert user, and a graph view, which might be preferred by a less expert user, since it graphically provides an immediate idea of the relationships among the elements of the ontology.

The second component of the On-TIME user interface supports the user in the execution of her tasks. Since tasks are more of an abstract notion than a computer manageable entity, designing an interface to make them accessible, i.e. executable, is a challenge. Our solution is based on the idea of allowing the user to deal with her tasks like she does with files and traditional applications. For instance, she can execute a task by selecting it from a task list occurring in a dedicated application bar. In this case On-TIME would automatically infer the appropriate input for the task on the basis of the task definition and the instances level of activation. Alternatively, the user can execute a task by accessing an element of the Personal Ontology, and choosing among a list of tasks, that would take as input (or produce as output) the element itself. Note that in both cases, tasks suggested are those that are more likely to be willed to be performed. Specifically, these are the tasks that are more closely related to data having highest level of activation.

The paper is organized as follows. In Section "The On-Time System," we provide an overview of the On-TIME system, by briefly sketching its architecture. In Section "The Visual Interface: A User Scenario and Implementation Details," we present a typical user scenario in order to illustrate the main functionalities of the system. In Section "User Evaluation," we present user evaluation results. Then, after discussing related work in Section "Related Work," we conclude the paper by discussing future work and evaluation experiments in Section "Conclusions and Future Work."

The On-TIME System

In this section we briefly introduce the On-TIME system. To give an insight of the On-TIME features, we next present and discuss its main modules, namely the *Personal Ontology Management System* (POMS), the *Spreading Activation Module*

(SAM), the *Monitoring System* (MS), the *Recogniser Module* (RM), the *Task Manager* (TM), the *Task Inferencer* (TI), and the *Task Learner* (TL).

The POMS provides a semantic account to user's personal data. It crucially relies on the use of the ontology reasoner QuOnto[1], providing efficient services of query answering and update over the Personal Ontology. The SAM computes the level of activation of the Personal Ontology instances, taking into account both the nature of the instance, e.g. the instance representing the user has a high activation level, as well as the instances having a direct relationship with it. The MS detects the saving of new files in the file system, and notifies the interface about updates that the user may want to perform over the ontology, on the basis of information about the newly saved files, e.g. metadata, or information that is extracted from them. The latter process of extraction is actually performed by the RM, that checks for the occurrence of particular kind of data (e.g. dates, person names, etc.) in the files. The TM maintains tasks descriptions and is able to execute them. To this aim, it possibly (1) obtains input data by querying the POMS, (2) updates the POMS with output data, and/or (3) calls external web services. The TI takes into account both the tasks description and the instances level of activation to deduct what is the next task that the user might be willing to perform. Finally, the TL monitors the user behavior to actually "learn" the description of typical user's tasks.

The high-level architecture of On-TIME is graphically shown in Fig. 1. Note in particular, that Fig. 1 stresses the interaction between the main back-end system modules and three distinct components of the user interface, *namely the Application Bar* (AppBar), the *Personal Ontology Interface* (POI), and the *Task Manager Interface* (TMI). In the next section, we present these components, and further illustrate their interaction with the system, by describing a typical On-TIME user scenario.

The Visual Interface: A User Scenario and Implementation Details

In this section we present a typical user interaction with the On-TIME system interface.

Suppose that Antonella works in a research lab that has recently installed a new fantastic fax. Since system people at her lab are quite lazy, instead of uninstalling the old fax, they preferred to associate to the new fax a new fax number. Now, in order to use the new shiny fax, Antonella needs to update all the documents where she used to indicate the fax number. This can be easily achieved with On-TIME, by simply updating the Personal Ontology. Hence, the starting point of her interaction with On-TIME is the AppBar (Fig. 2) installed on her desktop.

The *AppBar* component is the core of the system interface and the first component that appears to the user. It is a side bar (like the widget bar in Windows Vista) that can easily be accessed by the user with the mouse. This bar is divided into three sections. The first section contains a link, represented as a button, for each possible

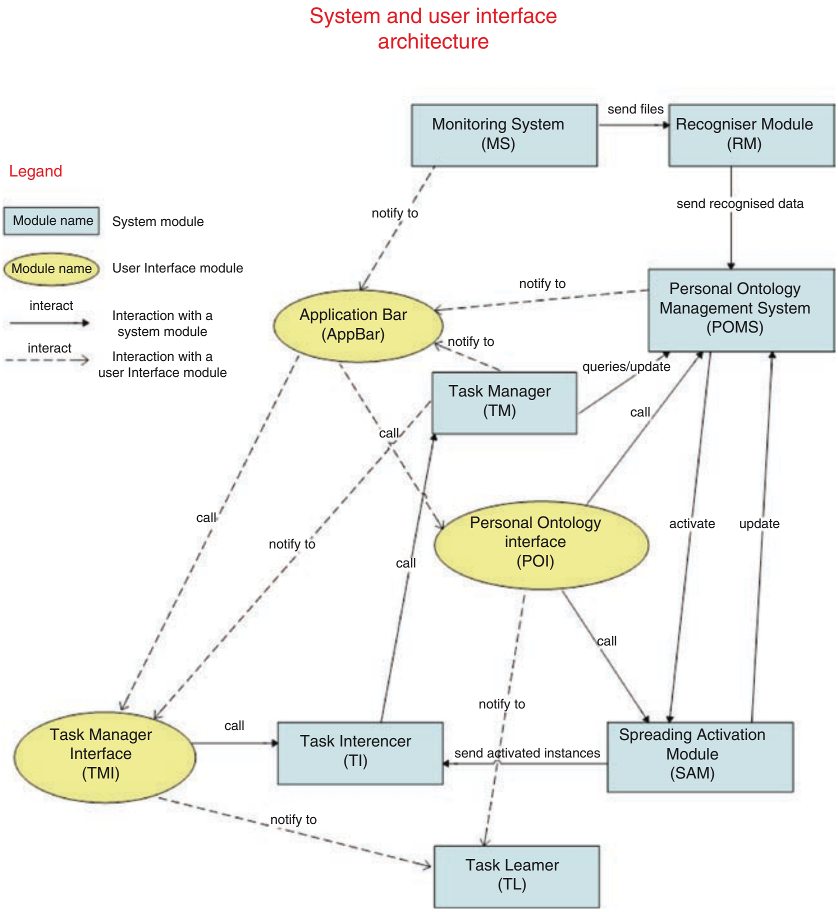


Fig. 1 On-TIME architecture

view of the *Personal Ontology Interface* (see below). The second section contains a list of tasks that according to the TM, are more likely to be willed to be performed. The third section contains the list of updates suggested by the MS. More precisely, if candidates instances, or instance attributes, that are not currently in the ontology, were found by the MS within the newly saved documents, the user would be able to update the Personal Ontology associating to those instances the right semantics, e.g. a date could be her best friend's date of birth or an important event date.

The *Personal Ontology Interface* is a component providing three coordinated views [9] over the Personal Ontology, having a common section that is an indented list showing the concepts hierarchy tree. While the common section allows the user to select a specific concept quickly, for example to view its instances in details, the three views have each a different purpose, and are coordinated so that when the user switches from one view to the other, she keeps focusing on the same particular

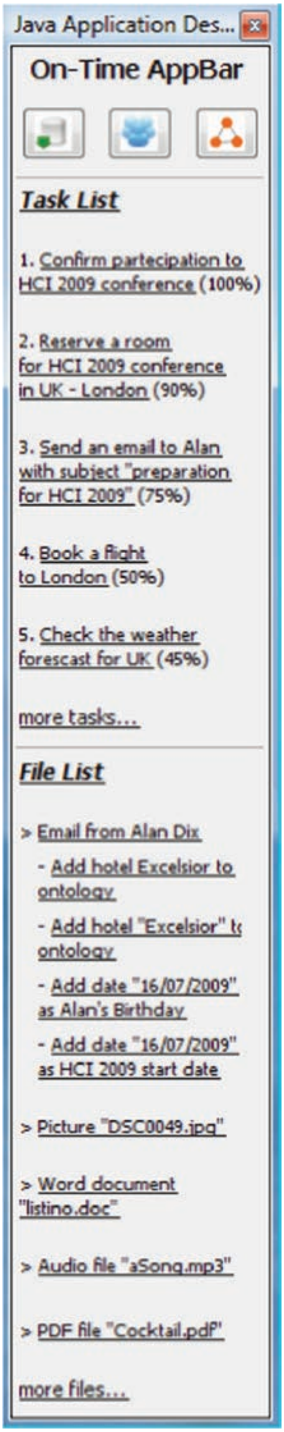


Fig. 2 AppBar component

instance/concept. Specifically, the *Structure View* allows the user to investigate the details of the ontology structure, the *Instance View* to select an instance of a specific ontology concept and to visualize and edit its details, and finally the *Navigation View* to browse the ontology through both its instances and concepts. Let us describe the latter in more details. It shows always two graphs, representing respectively connections among instances and concepts. One of the two graphs is always foreground and the other is visible in a frame positioned in the upper right corner of the screen, with the facility of switching between them. In order to optimize instance browsing, we use the focus plus context technique [3] which allows the user to focus her/his attention on a specific instance or concept, by moving it on the centre of the screen, highlighting neighboring nodes (at a certain distance from the focus) and displaying the names of relations connecting them. This approach allows for maintaining the graph visualization as thinner as possible, succeeding in managing huge graphs. Moreover, the user can navigate the graph arbitrarily, and then return to the focused instance, by clicking on an anchor that is always visible.

Coming back to our scenario, by clicking on the *AppBar* appropriate button, Antonella accesses the Navigation View (Fig. 3) to browse the Personal Ontology. Doing so, the ontology graph appears foreground, centered on the instance *pers(antonella)* denoting herself, (i.e. the system owner). Then, she verifies all relations connecting her with other ontology instances. In particular, she now switches to the Instance View, that according to the coordinated multiple views paradigm, is focused on *pers(antonella)*. Thus, Antonella immediately accesses the attribute *personFax* denoting the fax number that she is using, and she updates it. Note that,

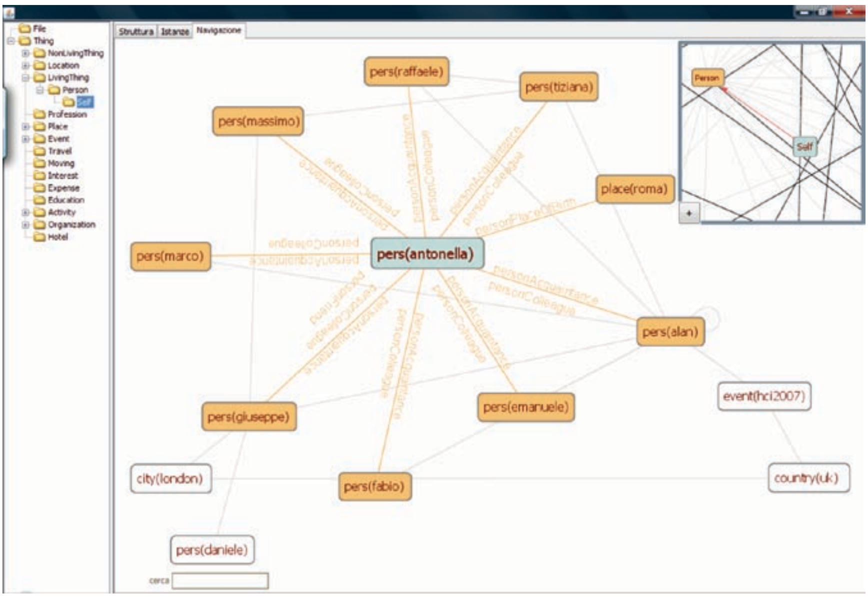


Fig. 3 Navigation view

while saving the changes, the POMS ensures that the information currently contained in the Personal Ontology is not contradictory [4].

Suppose now that Antonella moves her attention back to the *AppBar*. She would then notice that On-TIME suggests the task "Confirm participation to HCI2009 conference." Actually, the TI proposes such a task, because Antonella just received an email request of confirmation by the HCI2009 organizers, which was detected by the MS, and made increase the activation level of the instance denoting the event HCI2009. Moreover, it already happened several times that Antonella checked the correctness of her personal details before confirming her participation to a conference, in order to provide up-to-date contact details.

Antonella takes then advantage of this smart suggestion by the system, and executes the task by clicking on the relative link in the *AppBar* which opens a new window (Fig. 4). This window is part of the *Task Manager Interface*, the component that allows the user to interact with the TM. In our scenario, the selected task is then performed in two steps, which will be executed by a wizard. The first step is the reservation confirmation: clicking on the proposed link, a web page is opened where Antonella checks her data (automatically returned by the POMS) and makes the reservation. Then Antonella returns to the task execution window and clicks on the button "Yes I've confirmed," specifying in this way that the external action was completed succesfully. Then, the TM completes the task execution by updating the ontology with information about the HCI2009 conference. Specifically, the instance *event(hci2009)* denoting the event will be added to the relation *personConference* existing between the concepts *Person* and *Event*.

On-TIME implementation The system has been implemented in java technology, with the exception of the MS, written in .NET. The graphic components have been implemented by means of graphic widgets offered by java swing package: they are connected to an application layer that manages the access to the POMS. In order to implement the coordinated multiple views we started from the *Mediator pattern* [7], that we have modified to suit our needs. For graphs implementation, with all

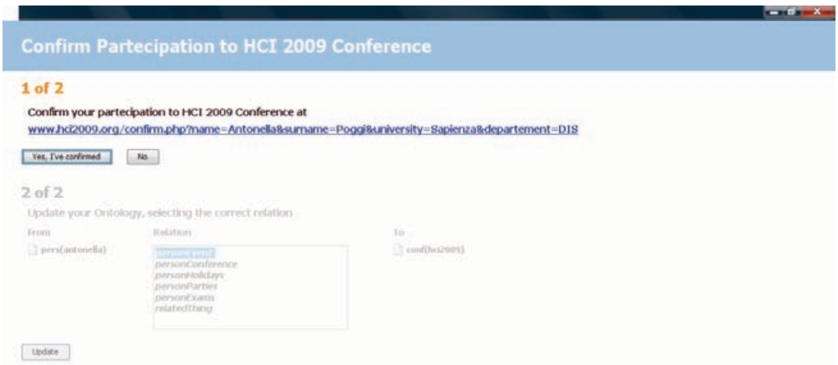


Fig. 4 Task execution window

relative methodologies, in particular the focus plus context technique, we used the java library *Prefuse*.

User Evaluation

The On-TIME development is based on a human-centered design, with an iterative-incremental development cycle requiring the involvement of all project stakeholders, including the final users of the application. In particular, the interface development, was made with the implementation of richer and richer prototypes up to the final version presented here. During the interface realization (both at prototype and implementation level) we have considered many technologies and visualization metodologies for ontology and tasks, discussing them in dedicated groups among system developers. Ideas like the use of coordinated multiple views technique, for coordinating the various ontology views, or the focus plus context technique for graph visualization, are the results of these internal meetings, where we have examinated many prototypes and assessed all possible improvements up to the actual state. After having traced the system development route, in order to verify the correctness of our choices, we involved also users in many tests. These tests were performed on specific user actions, all involving the system interface. We then asked to our users to give their sensations during the interface use.

To be more precise, we adopted Observational Techniques like Cooperative Evaluation [5], which allows for having a direct interaction between tester and developers. The cooperative evaluation tests were pretty positive, and confirmed that our choices were right and exhaustive for the user needs. We also got suggestions for improvements. In particular, the cooperative multiple view was appreciated by all users, since it was judged useful and necessary in order to avoid disorientation and incoherent screens. The Navigation View was appreciated too: it was defined the most usable and immediate one, so that also users with no expertise, not familiar with ontologies, were able to correctly interact with the system. Furthermore, we tested the *AppBar* component, to check whether the users would like to have it always visible. We also tested the projectual choices, taken during our project meetings, like the partition in three different areas. Test results were positive and confirmed the effectiveness of our choices. We finally executed several tests on the *Task Manager Interface*, a crucial feature of On-TIME. The wizard adoption has been approved with favour and encouraged us to continue with this choice.

Related Work

To the best of our knowledge, there exists no system in literature that is fully comparable with On-TIME: there are only ontology visualization tools or tasks-oriented systems. An interesting survey on ontology visualization techniques was made by

Akrivi Katifori et al. in [8], where many different metodologies (and related systems) were considered, namely, *Indented list, Node-link and tree, Zoomable, Space-Filling, Focus + context or distortion, 3D information landscapes*. These were a starting point for our work, which combines many of their positive aspects, such as the use of different colors, the facility of controlling the amount of loaded nodes, the facility of moving within the graph, the nodes search, etc. However, the On-TIME Personal Interface fundamentally differs from all these systems, in that it is directly connected to an inferential engine (i.e. QuOnto), and is not a simple ontology viewer.

Concerning task-oriented systems, the closest to our work is Activity-Centered Task Assistant (ACTA) [2], recently implemented as a Microsoft Outlook add-in. In this system, a user's task, named *ACTA activity*, is represented as a pre-structured container, that can be created inside the email folder hierarchy. Focusing on the interface, the only similarity between ACTA and On-TIME is the task list, named TV in ACTA, from which activities can be launched. However, the list of activities in ACTA is managed by the user, who can insert new to-dos or drag email messages into the list. On the contrary, the On-TIME task list is automatically inferred, taking into account the user current interests.

Conclusions and Future Work

In this paper we presented the user interface of the On-TIME system. The effort spent so far for realizing the interface was relevant, but many issues are still opened. One of the next challenges will be the organization of controlled experiments in order to study how to best place the interface items, and to evaluate different chromatic combinations for the various system windows.

References

1. A. Acciarri, D. Calvanese, G. De Giacomo, D. Lembo, M. Lenzerini, M. Palmieri, and R. Rosati. QuOnto: Querying ontologies. *In Proc. of the 20th Nat. Conf. on Artificial Intelligence (AAAI 2005)*, pages 1670-1671, 2005.
2. V. Bellotti, J. Thornton, A. Chin, D. Schiano and N. Good. TV-ACTA: Embedding an Activity-Centered Interface for Task Management in Email, *Fourth Conference on Email and Anti-Spam CEAS 2007* Aug 2–3, 2007, Mountain View, California.
3. S.K. Card, J.D. Mackinlay, and B. Shneiderman (Eds.). Readings in Information Visualization: Using Vision to Think, pp. 1–34, Morgan Kaufmann Publishers, San Francisco, Califomia, 1999.
4. G. De Giacomo, M. Lenzerini, A. Poggi, and R. Rosati. On instance-level update and erasure in description logic ontologies. *Special issue of the Journal of Logic and Computation (JLC)*. To Appear.
5. A. Dix, J. Finlay, G.D. Abowd, and R. Beale. Human-Computer Interaction, Pearson Prentice Hall, third edition, 2004.

6. A. Dix, A. Katifori, A. Poggi, T. Catarci, Y. Ioannidis, G. Lepouras, and M.,Mora.From Information to Interaction: in Pursuit of Task-centred Information Management. *In DELOS Conference* 2007, 2007.
7. E. Gamma, R. Helm, R. Johnson, and J. Vlissides. Design Patterns: elements of reusable object-oriented software, Addison-Wesley 1995.
8. A. Katifori, C. Halatsis, G. Lepouras, C. Vassilakis, C., and E. Giannopoulou. Ontology visualization methods - *A survey. ACM Comput. Surv*. *39*, 4, October, 2007.
9. C. North and B. Shneiderman. “A taxonomy of multiple window coordinations”, University of Maryland, College Park, Dept of Computer Science Technical Report #CS-TR-3854, 1997.

The Protection of Minors in ICT Networks: The Liability of the Internet Providers

G. Finocchiaro[1], E. Pelino[2], A. Ricci[3], and A. Spangaro[4]

Abstract Italian (and EU) legislation in force does not appear to address the protection of minors in ICT networks in a completely satisfactory manner. Such conclusion especially arises when one considers that no liability is attributed on providers which only transmit information generated by a recipient of their service, or which merely give access to a communication network, with only a few specific exceptions.

Introduction

On the other hand, it cannot be said that a wider protection is afforded by the Italian self-regulation Code on the Internet and minors, signed in 2003. This Code is hardly a binding legal instrument, being rather an agreement among the parties who signed it.

Above all, it is the lack of a diffused culture of prevention and sensitivity among providers to be more evident. As a matter of fact such gap of protection of minors has clearly surfaced many times over the recent years.

Having in mind the above framework, the present work is aimed to analyse some aspects of the protection of minors in ICT communications and the liability of providers under private law in the Italian legal system.

The Question

Is the ICT provider liable in case of minors' personal data abuse by third parties? Should it be? This is the twofold question we mean to address in this paper, given the present legislation, in Italy and more generally in the European context.

[1] Università di Bologna, Bologna, Italy, giusella.finocchiaro@unibo.it
[2] Università di Bologna, Bologna, Italy, enrico.pelino@unibo.it
[3] Università di Bologna, Bologna, Italy, annarita.ricci@unibo.it
[4] Università di Bologna, Bologna, Italy, alessandra.spangaro@unibo.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_39, © Springer Physica-Verlag Berlin Heidelberg 2010

Many other questions are related to this one. Should a duty to monitor communications be imposed on the provider? Who is going to bear the costs at the end? May the courts supply the legislative role?

The Scenario

In contemporary information society the need to protect minors who access the Internet is more and more pushing, especially when they use it as an instrument of self-expression. One of the most critical areas is that of Web 2.0-based services, and social networks in particular.

Unfortunately, many times young users are not clearly informed on the importance of privacy and on the dangers of sharing personal data. And even when they are informed, they are not aware of them.

The "Privacy Age Gap"

As it is generally acknowledged in the psychological literature [1] that the reason why adolescents particularly expose their personal data in social networks is a combination of age-related needs and social stimuli. As it has recently been pointed out in a joint statement by, among others, the American Academy of Paediatrics, the American Psychological Association, the Center for Digital Democracy: "Although adolescents are more sophisticated consumers than young children are, they face their own age-related vulnerabilities regarding privacy. Adolescents face enormous pressures to socially interact online – providing personal information in the process – and are less able to understand the potential long-term consequences from having their information available to advertisers, other individuals, and third-parties [2]. The document, quoting a survey by the Pew Internet & American Life Project [3], stresses that "[o]ne of the major reasons why adolescents are such enthusiastic users of social network sites is that the sites give them opportunities to present themselves to a group of peers and then get feedback and affirmation."

Worse than that, most privacy notices of social network sites drive much concern as to the ability of young people to really understand them. Minors can be hardly expected to master a legal language or a language which requires a superior level of education, let alone the fact that privacy notices are discouragingly lengthy to read.

Under a legal perspective it is therefore necessary to examine whether or not such an information gap has legal consequences. At least one starting point that could be likely agreed upon is the fact that adolescents need a special legal attention due to their peculiar age-needs and to what has been called their "privacy age gap" [4], that is a clear tendency to be less concerned that older users about revealing their personal data.

An Exemplary Case

A recent case can well exemplify the question. Just to mention a blatant case of poor performance of the overall system of protection of minors, we could briefly mention a major scandal that broke in Italy in 2006, involving a well-known mobile telephone company [5]. Such company established an online community, allowing its users to upload their own made videos. The service was conceived as that such videos could be viewed and downloaded by all community members. No age limit was set, and downloading was straightforward: users were simply asked to enter a code they had previously inserted at their first visit. Upon any download, authors received a small benefit in form of free telephone time. For downloaders it was even possible to directly contact authors via a message sent to the provider. The overall working of this system resulted in a number of minors uploading self-recorded videos with sexual content, as these latter proved to be highly demanded.

The Applicable Legislation

The main legal source at a European level is the Directive 2000/31/EC which concerns certain legal aspects of information society services, in particular electronic commerce, in the internal market. The cornerstone of this regulation is expressed at art. 12, according to which service providers are not considered liable for the illicit contents stored in their servers when the service they offer is indeed a mere transmission of data or a mere access to a communication network (...). In addition, under art. 13, the service provider is not liable for the automatic, intermediate and temporary storage of information, performed for the sole purpose of making the onward transmission of information more efficient to recipients of the service upon their request (...) [6]. According to art. 14, the service provider is not liable for the information stored at the request of a recipient of the service (...). Finally according to art. 15, service providers do not have a general obligation to monitor the information which they transmit nor a general obligation to actively seek facts or circumstances indicating an illegal activity [7].

Some considerations must be addressed to the provider's liability as set forth by Directive 2000/31/EC. Usually legislation specifies the cases in which a legal entity is considered liable, while the Directive is conceived exactly the other way around: it indicates in which cases providers are not liable. Such uncommon wording has actually resulted from a wide discussion on the economic impact of the obligations posed on the provider. The goal was not to limit this latter's business. In particular, the doctrine according to which the provider, as business entity, should exert a surveillance activity as a form of accountability has been set aside in favour of a more liberal policy contrary to all obstacles which, by limiting the activity of providers, might hinder the overall growth of the information society services.

Providers in Courts' Decisions

It must be made clear from the offset that no specific court decision appears to have yet been issued on the specific issue of providers' liability for personal information directly submitted by minors and then misused by third parties. However, when we broaden the scope and examine, more generally, the issue of liability of providers for illicit online contents uploaded or posted through their services, such topic appears to be quite a long standing one in courts' decisions. We can therefore move from such decisions and possibly apply their reasoning to our specific topic.

In Italy, at the end of the Nineties some Tribunals [8] started overthrowing the doctrine, widespread at the time [9], according to which providers should always be considered liable for illicit content uploaded through their services, no matter whether or not they had knowledge of it or should reasonably had knowledge it. The new line moved in the opposite direction, excluding any liability for providers who limited their activity in offering a transmission service to their users.

At the European level such reasoning had already been adopted in a decision of the District Court of the Hague on 12 March 1996, which ruled that a provider is not liable for copyright infringement within a newsgroup when it cannot reasonably have information of the illicit activity performed online [10].

Self-Regulation in Italy

The need to have recourse to additional instruments that could possibly get providers stick to a stronger notion of liability has driven most European countries, Italy included, to issue self-regulating codes. The Italian "Codice di autoregolamentazione 'Internet e minori'" (self-regulation Code on "Internet and minors") was subscribed on 19 November 2003 by the Italian Internet providers' associations.

This Code aims at ensuring minors a safe access to the Internet. More specifically, it seeks to protect minors both in terms of privacy safeguards from third parties' interventions and in terms of facilitation in the appropriate use of the Internet. The ultimate objective is to make the Net to work as a real educational and appropriate social tool.

It must be understood that this code, like any other self-regulation sources, only applies on a voluntary basis. Any legal person having their registered offices in Italy can subscribe the Code. Accepting the Code bears the obligation to meet with all its norms and, consequently, the willingness to undergo all checks and be subject to all related sanctions (art. 2.2). Subscribers are allowed to show on their websites a specific seal of compliance with the Code (art. 2.1).

As for the misuse of minors' personal data by third parties, the Code does not pose any specific liability on the hosting provider. However, as to the traceability of online contents, a general obligation of user identification is established. This means that all operators should identify the user. Such obligation has arisen some criticism as to its compliance with the legislation on the protection of personal data and in particular with the "principle of necessity" (art. 3 of Legislative Decree No. 196/2003).

Surveillance on the compliance with the Code is accomplished by a Guarantee Committee, with the power to issue sanctions for breaches of rules, which are: the official invitation to comply with the Code within 15 days, and the revocation of the seal of compliance. These are hardly effective measures.

Summarising

Drawing a line at this point of our analysis, and coming to a first conclusion, we can fairly assume that legislation in force on providers' liability and courts decisions on the same topic are not really targeted at the core subject we are investigating: the interests of the minors and the protection of their rights in connection with data protection. Scholars' works and legal literature on this subject is also scarce, if any.

For such a reason other possible solutions need to be explored, as for example either considering entire different sets of norms or even suggesting corrections to the existing ones or taking actions in an extra-legal domain. In the following we will discuss such solutions.

Solutions Within the Existing Legislation

– *Minor as a consumer?* Some suggestions come from the European legislation on consumers. This legislation is based on the assumption that what can be called a major "informative asymmetry" affects relations between providers and consumers. As a means to correct such an asymmetry, we may consider to pose on providers the obligation to give the consumers a detailed and precise set of information, and in case of breach of such obligation the contract should be void. In our opinion the doctrine of strong informative commitments on providers would prove to be a suitable one, provided that such information are extremely readable and proportioned to the level of education that can be expected from a minor.
– *Legal value of minors' consent* Another approach to analysis is to have recourse to the Italian Civil Code (hereinafter ICC) concerning consent expressed by minors. In our legal system, the minor cannot conclude legally effective contracts (art. 2 ICC), with the exception of acts of everyday life. This means that anyone whishing to enter a contract with a minor shall prior assess which kind of legal deed is concerned, and accordingly refuse the conclusion of a contract whose subject falls outside what normally pertains to the "everyday life". Otherwise the contract may be ruled as legally void (art. 1425 ICC). On such basis, it seems that providers offering online spaces which are at everyone's

disposal should carefully consider the risks that they may possibly undergo when contracting with minors.

– *Providers' benefit and the linked liability* We are considering the case of the provider which offers a virtual space to the users without setting forth specific rules for these latter. Even though providers do not directly interfere with their users' activity, it is true however that they do design these virtual environments in their best business interest, implementing the technologies that suit them best.
– In general terms there is no such an obligation on hosting providers to monitor information voluntarily published by users, still would it be still improper to expect from providers' a different course of action in case their users are underage, given the fact that they seem to take advantage of personal information collected? As per art. 48 of the Directive: "(...) this Directive does not affect the possibility for Member States of requiring service providers (...) to apply duties of care, which can reasonably be expected from them and which are specified by national law, in order to detect and prevent certain types of illegal activities". Here the key terms are "duty of care" and "reasonably". Indeed, it is *reasonable* that minors, given their "privacy age gap" and their socials needs, ask for a *duty of care* different from that pertaining to adults.
– *Liability arising from data protection legislation* In Italy (and EU) the storage of users' data (unless such data are anonymized) makes up to a data processing, therefore the processor shall implement all security measures appropriate to prevent such data to be damaged or illegally accessed or misused. In Italy, such rule places on the processor (here the provider) the same liability as per art. 2050 ICC, which means that in case the processor fails to prove to have established all appropriate preventive measures, it will be liable for patrimonial and, if the case, non patrimonial damages.

Other Solutions: A Stronger Self-Regulation

In recent years the trend toward self-regulation has significantly broadened, reinforced by the tendency of European Directives to encourage the adoption of self-regulation Codes [11]. Such codes are considered "soft law", which means that they tend to set forth slightly flexible rules.

We believe that a co-ordinated joint action on such Codes regarding minors could be effectively fostered at European level. At least, one practical result could be the issuing of less mild punishments in case of breaches to the rules.

Another obstacle results from a narrow understanding of the importance of such self-regulation sources on part of the society in general and ICT business in particular. Indeed, in Italy the Code on Internet and minors is not considered an added value for providers. It probably lacks a significant benefit for a company image.

Website certification could be an successful instrument in this respect, like certifications in other domain are, if it were not that such experimentation that took place in Italy but ended in very poor results. The reason to than is probably to be found in a feebly conceived campaign rather than in the idea itself.

Other Solutions: Information Awareness Campaigns

Another key element to be taken into account is a targeted information campaign for the younger users. While these latter are generally skilled in online services and applications, they show many times naïve when it comes to data protection and safety. The aim of a tutoring campaign on the correct use of the Internet could definitely help in accomplishing the expected results. Education campaigns should be run choosing a straightforward and friendly language. Lengthy texts written in small print should absolutely avoided. Use of icons should be encouraged. Furthermore, images of cartoons and videogame heroes could support such communications and possibly kindle the attentions of the youngest. A significant stress on the importance of simplified communication schemes [12] has recently been put by the Italian President of the national data protection authority [13].

Conclusions

We opened this article by asking ourselves whether providers can be held liable in cases of abuse of minors' personal data performed by third parties. At the conclusion of our analysis, we can confidently maintain that such a question shall be given a negative answer, at least when strictly considering legislation and courts decisions on providers' liability. However, the specific legislation in force on this topic is not above complaint, as it broadly refers to general providers' activity without even mentioning the possibility that users might be underage. This is clearly a legislative gap, which we believe should be filled without much delay. In this perspective, it is our opinion that the recourse the some or all the solutions suggested should be coupled to a legislative amendment in order to be effective. Such amendment should be specifically targeted to providers' obligations concerning minors and consider the question in due detail, with a clear understanding of how social networks work.

References

1. See Georgetown University Law Center, Institute for public representation, *Comment on Online Behavioral Advertising Principles*, 11 April 2008, available at url www.ftc.gov/os/comments/behavioraladprinciples/080411childadvocacy.pdf.
2. Perils might be the following: identity theft; sold of personal data and consumer profiles; invasive advertisement; damage to future job careers.

3. See Georgetown University Law Center, Comment (quoted), p. 6.
4. See Ponemon Institute and Vontu comments on research "2007 Consumer Survey on Data Security" at URL www.ponemon.org/press/06-25-07-Ponemon_Consumer_Survey_FINAL.pdf.
5. See Corriere della Sera, 3 May 2006, Rizzo, S., "Videohard e il telefonino si ricarica".
6. See Walden, I., sub art. 13 of the Directive 2000/31/CE, in AA.VV., Concise European IT Law, Bullesbach-Poullet-Prins (edited by), *Kluwer Law International*, 2006, p. 250.
7. See Walden, I., sub art. 14 and sub art. 15 of the Directive 2000/31/CE, in AA.VV., Concise European IT Law, Bullesbach-Poullet-Prins (edited by), *Kluwer Law International*, 2006, p. 252.
8. See e.g. Tribunale di Cuneo, 23 June 1997; Tribunale di Roma, 22 March 1999; *Tribunale di Roma*, 4 July 1998.
9. See e.g. Tribunale di Napoli, 8 August 1997; Tribunale di Macerata, 2 December 1998.
10. Contrarily, Cour d'Appel de Paris, 10 February 1999 recognized the provider's liability for copyright infringement on images.
11. See, among others, Whereas 32 and 49 and art. 16 of Directive 2000/31/EC, which has been implemented in Italy with Legislative Decree No. 70/2003.
12. See the solution implemented by the UK ICO: http://www.ico.gov.uk/youth.aspx.
13. Garante per la Protezione dei Dati Personali - Relazione 2007 - Discorso del Presidente Francesco Pizzetti, Roma, p. 9.

The Role of Customer Involvement in Library E-services

A. Scupola[1] and H.W. Nicolajsen[2]

Abstract In this article, we empirically investigate customer's involvement in the new development of e-services within research libraries. Our conclusion is that the main roles that customers have in library e-services innovation and new development are customers as resources and as users; the library found it challenging to motivate the customers to become co-creators of e-services as for example in online review services.

Introduction

The importance of involving customers or users in product innovation has been the subject of innovation theory over the last few years (e.g. [1, 2]). Collaboration between suppliers and users can lead to a mutual understanding of the users' needs and wishes, as well as an understanding of the technological opportunities [3, 4]. Bitner et al. [5] recommend the close involvement of customers in the design process of technology-based services. Von Hippel [6, 7] has showed how lead users have invented the majority of products in certain industries and has given numerous examples of user driven innovations leading to product and service innovations.

However, a number of studies (e.g. [8]) also show an opposing view regarding the benefits of involving users in product or service development as some authors argue that the input of users is of limited value and could even be damaging. For example, Leonard and Rayport [9] believed that users lack sufficient technical knowledge to produce innovations and are unable to articulate their needs and companies must look at other sources to enable the creation of breakthrough products and services. These findings are however again questioned by newer research arguing that the inclusion of customers may spark divergent thinking and creativity leading to new knowledge (e.g. [17, 18]).

[1]Roskilde University, CBIT, Roskilde, Denmark, ada@ruc.dk
[2]Aalborg University, Centre for Media, Communication and Information Technologies, Ballerup, Denmark, westh@cmi.aau.dk

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_3, © Springer Physica-Verlag Berlin Heidelberg 2010

In this article we explore the role of customers in the innovation of library e-services. The research question addressed here is the following: What is the role of customers in the innovation and development process of library e-services?

The research question is investigated through a case study of e-services development at a research library in Denmark. The paper is structured as follows. The introduction presents the background and research question. The second session presents the theoretical background of the paper. The following sessions introduce a definition of e-services and the research method. The last two sessions present the analysis and results as well as conclusions, limitations and recommendations for further research.

Users' Involvement in Innovation, New Service and New Product Development

The concept of user involvement is not a well defined concept despite the fact that much has been written about it [10]. Part of the reason for this is the fact that user involvement is a quite complex area covering many different facets. Alam and Perry [11] have developed a stage model of new service development. This framework takes into account the core element in user involvement in new service development highlighting the objective/purpose of involvement, the stages of involvement in the organizational innovation process, the intensity of involvement and the modes of involvement. Nambisan has likewise looked at the roles of customers in new product innovation which he categorizes as customers as resource, customers as co-creators and customers as users [12]. Lately these roles have been extended and further insights have been developed into the reasons for users to involve [13]. Finally, many models of the innovation process have been developed in the literature (e.g. [14]). Rogers' model [15, p. 392] defines the innovation process in an organization as consisting of two broad activities: the initiation and the implementation process. Each activity is then subdivided in a number of stages. Table 1 summarizes and compares the stages in the innovation process as described by Rogers, the stages of the new service development model as developed by Alam and Perry [11] and the different roles that the customer can have in the different stages as described by Nambisan [12]. But what are the different potential roles of the customers? This is discussed in the following section.

Roles of Customer Involvement in the Innovation Process: Customer as a Resource, as Co-Creators and as Users

The role of the customer as a resource in the phases of generating new product ideas has been extensively investigated by the marketing literature and the innovation

Table 1 Summary of innovation process stages, new service development stages and customer roles in the different stages

Innovation process stages [15]	10 stages of new service development [11]	Customer's roles in new product development [12]
Initiation: Step 1- Agenda setting: the organizational problems that may create a perceived need for innovation.	(a) strategic planning	
Initiation: Step 2- Matching is fitting a problem from the organization's agenda with an innovation	(b) idea generation (c) idea screening	Customer as resource
Implementation: Step 1- Redefining/ restructuring is when the innovation is modified and re-invented to fit the organization, and when the organizational structures are altered.	(d) business analysis, (e) formation of cross functional team, (f) service and process design, (g) personnel training,	Customer as co-creator
Implementation: Step 2- Clarifying: the relationship between the organization and the innovation is defined clearly	(h) service testing and pilot run, (i) test marketing	Customer as user
Implementation: Step 3- Routinizing: the innovation becomes an ongoing element in the organization's activities	(j) commercialization	Customer as user

literature (e.g. [2, 6, 16]). According to Nambisan it is well established that the contribution of customers as a resource varies with the maturity of the technology and the alignment of the product line with the customer base [12]. In the case of continuous innovations, customers are generally passive and firms have to find out about the customers opinion through market surveys or focus groups. Matthing et al. and Magnusson [17, 18] researching the development of new mobile services disagree on the passiveness of users. They found that it is definitely possible to get innovative and original ideas from potential customers.

However previous literature (e.g. [17, 18]) also argue that there are a number of challenges related to using customers as a resource in idea generation including selection of customers, creation of incentives to foster customer participation and capture of customer knowledge.

Customers may also play a key role as co-creators of new products or services. This is more often seen in the case of industrial products than consumer products. For example in the software industry, Microsoft and SAP often have representatives from customer organizations as members of their product development team [12, 19]. As co-creators, customers can participate in a number of activities varying from product design activities to product development activities. A number of several potential incentives that motivate customers to involve themselves as co-creators or co-producers have been identified. These include enhanced self esteem, greater opportunities to make choices or greater product customization

[20]. Some companies use e-forums to involve customers to contribute to the innovation process as for example Lego, where customers have been recruited to engage in software code development for LEGO mindstorm. According to Nambisan [12, p. 396] customer-firms interactions tend to be much more intense and frequent during co-creation, and mechanisms to support such interactions are costly and technology intensive. Alam likewise found that the stages requiring customers' involvement were seen valuable, but these were found much more expensive, time-consuming, more cumbersome and risky in terms of return on investment [21].

The last role that Nambisan has identified is the customer as a user [12]. In such a role customers can provide value in two ways: product testing and product support. For example in the software industry many firms have used their customers in beta product testing, thus enabling those firms to reduce their investments in internal product testing units [12]. For example the involvement of users in product testing can be used to identify problems early on in the development phase, thus minimizing the costs of redesign and re-development. Regarding product support, customers can acquire significant knowledge of or expertise on various aspects of product usage and they can use such expertise to help or provide support to other users. In addition "expert users may discover new ways of product usage, as well as shortcuts and other methods to enhance the overall value of the product" ([12], p. 396) (Table 2).

Table 2 Customer roles in new product development

Customer role	NPD Phase	Key issues/Managerial challenges
Customer as resource	Ideation	– Appropriateness of customer as a source of innovation – Selection of customer innovator – Need for varied customer incentives – Infrastructure for capturing incentives – Infrastructure for capturing customer knowledge – Differential role of existing (current) and potential (future) customers
Customer as co-creator	Design and development	– Involvement in a wide range of design and development tasks – Nature of the NPD context: industrial consumer products – Tighter coupling with internal NPD teams – Managing the attendant project uncertainty – Enhancing customers' product/technology knowledge
Customer as user	Product testing Product support	– Time-bound activity – Ensuring customer diversity – Ongoing Activity – Infrastructure to support customer-customer interactions

Adapted from [12]

E-Services Definition

According to Hoffman e-services are services whose production, consumption and/or provision takes place through the intermediation of an ICT-network such as Internet-based systems or mobile solutions [22]. In addition, there are three main characteristics of e-services:

- The service is accessible across the Internet or other electronic networks.
- The service is consumed by a person across the Internet or other electronic networks.
- There might be a fee that the consumer pays the provider for using the e-service, but that might not always be the case as for example in some e-services offered by the government.

According to Scupola [23], four types of e-services can be conceptualized based on the type of actors involved and their role as provider or consumer: business-to-business; business-to- consumer; government-to-business or to-consumer; consumer-to-consumer.

Research Method

A case study [24] was conducted to explore the research questions of this study. The case under consideration is a research library located in Denmark, Roskilde University Library. The data consists of primary data collected through qualitative explorative and semi-structured interviews and secondary data such as reports and other material on e-services development provided by the library personnel and other material retrieved on the web as well as research articles and books. Face-to-face qualitative interviews were conducted. The interviews lasted between 1 and 2 h, were tape recorded and fully transcribed. The sampling was purposeful. The respondents had to be involved in the e-services development process at top management level, managerial level or had to be librarians involved in using the e-services, thus being in direct contact with customers though e-services such as chat. By relying on [25], the data were analyzed by following the "general strategy of relying on theoretical orientation" of the case study. Following Miles and Huberman [26, p. 58], a provisional "start list" of codes was created prior to the field work to guide the analysis. The coding was manual [25, 26].

Analysis and Results

In the e-service innovation process in research libraries we found that customers have a more relevant role in the implementation stage as defined by Rogers [15] or the service testing and pilot run phases as defined by Alam and Perry [11].

There are two main roles which library customers have in e-services innovation and development: customer as a resource and customer as a user. We found very little evidence of customer as co-creator.

We found that in e-services innovation and development the role of customers is very limited in the initiation stage. The customer, especially as a user, has a more important role in the implementation stage, especially in the pilot run and testing phase. We found four major ways in which the customer as a user can be a source of input: (1) The customer can give feedback due to dissatisfaction or irritation; (2) The customers can be solicited by the library employees to give feedback.; (3) The customers can be observed by library employees to find out how they use e-services and which barriers and difficulties they find in using them; (4) Finally the customers provide the library employees' with important log data or content data, which can be used for example to run usage statistics.

In the development and improvement of an e-service called "Quick Search," library employees have used both observational techniques of users as well as users feed back in order to find good solutions.

Another example comes from the IT manager stating that making e-services in test-phase visible to the customers have contributed to get user feedback to improve the services. This input eventually informs the decision of whether and when to move the e-service from test phase to permanent launch phase.

Customers not only have a role as users where they can give personal feedback to the library. They can also provide libraries with log data that can be used for e-services development, just by using the library e-services. This can happen in two different ways. In the first way the library can use log data of the users to understand user behaviour, e.g. which e-services are used the most, which ones are not used, etc. These data can then be the base for further inquiries such as surveys, observations or focus groups. This information can eventually be used to stop some types of e-services or investigate why they are not used so much.

The other way in which customers indirectly can contribute is through the information they provide in online sessions such as for example chat sessions. The information provided in the chat sessions and especially the questions that customers ask can be used to improve the library e-services. For example if the customers often ask the same question, then this can be included in a set of Frequently Asked Questions (FQA) or it can be used to make a chat bot, where it is the computer system that answers the users instead of the librarian.

Finally, the library is planning an e-service where users can write recommendations or reviews about material they have read. In this e-service the library users might take the role of co-creator by contributing with the content of the service. Despite the technological challenges, the problem of making customers provide input is seen as a major challenge.

Discussion, Conclusions and Limitations

In our case of research library it appears that customers do not actively contribute with new break-through ideas to the development of e-services, but they do have an important role as users in refining initiatives coming from the library's top management and employees as well as a role as a resource in the more traditional approach of marketing research. This happens by responding to surveys or by providing log data through their actual use of systems or requests through for example chat box. This can be explained by the fact that e-services technology and e-services as a new type of ICT-based services are fairly new and customers have little awareness on how new technology might result in valuable e-services. However, it may also be explained by the way customers are approached by the library as there has been no attempts to actively involve them in more creative sessions regarding the future of the library and e-services wished for.

The conclusion of the research is that customers have a more important role in the implementation stage [15] than in the initiation or idea generation stage [15]. As stated by [12, 13, 27] new communication technologies are important means in involving customers in order to ensure dialogue between customers and employees and customer to customer. However we showed that the use of ICT in e-services further provides for involvement of users in indirect ways. Online surveys, feedback from dialogue boxes such as chat along with logged data may all contribute to e-services development based on indirect knowledge provided by users about their needs and requests. On the other hand new communication technologies also pose challenges with respect to user involvement as in the case of online reviews.

Finally the study presents a number of limitations. The study has only interviewed top managers and employees, and has not interviewed the customers. In addition the study has not taken into consideration other actors that influence the e-service innovation and new development process within library. These could be recommendable in future research.

References

1. Cheesborough, H.W. (2003) Open innovation: The new imperative for creating and profiting from technology. Boston, Harvard Business School Press.
2. Christensen, C.M. (1997) The innovator's dilemma: When new technologies cause great firms to fail. Cambridge: HBS Press.
3. Anderson, W.L. & Crocca, W.T. (1993) Engineering practice and codevelopment and codevelopment of prototypes, *Communications of the ACM* 36(6): 49–56.
4. Veryzer, R. (2003) Marketing and the development of innovative products. In L. Shavinina (Ed.). *International Handbook on Innovation* (pp. 43–54). Canada: Pergamon Press.
5. Bitner, M.J., Brown, S.W. & Meuter, M.L. (2000) Technology infusion in service encounter, *Journal of the Academy of Marketing Science* 28(1): 138–149.
6. von Hippel, E. (1986) Lead Users: a Source of Novel Product Concepts, *Management Science,* 32(7): 791–805.

7. von Hippel, E. (1988) Sources of innovation. New York, Oxford U. P.
8. Christensen and J. Bower. (1996) Customer Power, Strategic Investment and the Failure of Leading Firms, *Strategic Management Journal* 17: 197–218.
9. Leonard, D. and Rayport, J. F. (1997) Spark Innovation through Empathic Design, *Harvard Business Review* 75(6): 102–13.
10. Magnusson, P. Matthing, J. and Kristensson, P. (2003) Managing user involvement in service innovation, *Journal of Service Research* 6(2): 111–124
11. Alam, I. & Perry, C. (2002) A customer-oriented new service development process, *Journal of Services Marketing* 16(6): 515–534.
12. Nambisan, S. (2002) Designing virtual customer environments for new product development: Toward a theory, *The Academy of Management review* 33: 392–413.
13. Nambisan, S. and Nambisan, P (2008) How to Profit From a Better¿ Virtual Customer Environment, *MIT Sloan Management Review* 49(3): 53–61.
14. Zaltman, G., Duncan, R., and Holbeck, J. (1973) Innovations and Organizations. New York: Wiley and Sons.
15. Rogers, E.M. (1995) The Diffusion of Innovations. 4th edition. Free Press, New York.
16. von Hippel, E. (2001) User toolkits for innovation, *Journal of Product Innovation Management* 18(4): 247–257.
17. Matthing, J., Sandén, B.and Edvardsson, B. (2004) New service development: learning from and with customers. International, *Journal of Service Industry Management* 15(5): 479–498.
18. Magnusson, P. (2003). Benefits of involving users in service. *European Journal of Innovation Management* 6(4): 228–237.
19. Hoch, D., Roedning, C., Lindener, (1999), Secrets of mSoftware Success. Boston, Harvard Business Press.
20. Schneider, B. and Bowen, D.E. (1995) Winning the Service Game. Boston, Harvard Business School Press.
21. Alam, I. (2002) An exploratory investigation of user involvement in new service development. *Journal of the Academy of Marketing Science* 30(3): 250–261.
22. Hoffman, K.D. (2003) Marketing+MIS=E-Service. *Communications of the ACM* 46(6): 53–55.
23. Scupola, A. (ed.) (2008). Cases on Managing E-Service. IGI Publishing (Forthcoming).
24. Yin, R.K., (1994). *Case Study Research Design and Methods*, Second Edition, Vol. 5, Sage Publications.
25. Yin, R.K. (2003) Case Study Research: Design and Methods. SAGE.
26. Miles, M.B. and Huberman, A.M. (1994) Qualitative Data Analysis. Sage Publications, Second Edition.
27. Ozdemir, S., Trott, P. and Hoecht, A. (2007) New service development: Insights from an exploratory study into the Turkish retail banking service, *Innovation: management, policy and practice* 9(3-4): 276–291

The Strategic Role of IT: A Case Study of Two Swedish Retail Companies

L. Rusu[1] and M. El Mekawy[2]

Abstract The purpose of this paper is to study how IT can play a strategic role in retail business through a case study research approach of two Swedish companies. The main focus in this research approach is looking to examine: (1) how IT supports business and organizational strategies and (2) how business-IT strategies can be aligned. For this purpose we have applied two evaluation frameworks through which we have analyzed the business, organizational and IT strategies and compared business-IT alignment maturity. Finally, we have concluded with a discussion and suggestions for (a) successful relationship between three business, information and organizational strategies and for (b) improving business-IT strategic alignment that will help the IT decision makers in these retail companies to understand in which areas they should act in order to improve the strategic use of IT resources.

Introduction

Information technology (IT) has become today more important than it was before for the business strategy. Now IT is integrated in almost every part of the business processes [1]. According to Tang and Walters [2] as organizations evolve their strategies also so "IT and IT-enabled systems are now indispensable in supporting business strategies." As we see now the current business environment is a dynamic, fast-changing and highly competitive one. This can be at least partially explained by tremendous leaps that IT has taken in the last 30 years, especially the last 10–15 years of the Internet era. As a result, IT has become an important actor in all organizations an enabler of business and organizational change or a driver for transformation [3]. Therefore in such an environment, it is essential that business managers understand the potential use and critical role of IT. In the discussion about

[1]Royal Institute of Technology, Stockholm University, Stockholm, Sweden, lrusu@dsv.su.se
[2]Royal Institute of Technology, Stockholm University, Stockholm, Sweden, moel@dsv.su.se

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_64, © Springer Physica-Verlag Berlin Heidelberg 2010

Information Systems Strategy Triangle, [4] emphasis the importance of aligning and balancing the three corners of this triangle which are business, organizational and information systems strategies. Not only the connections and effects among the three corners are important, but the alignment's result in a strategic advantage is a very important goal for the organizations. For analysing the business-IT alignment there are many models that have presented in the research literature but the most well known are of [5] and [6]. From the models mentioned before we have used in our paper the last one of [6] which we found more suitable to be applied in our case study. On the other hand according to [7] strategic alignment is only one of the problems that are facing IT managers in developing of an IT strategy and in the authors opinion IT is more important today in the development and delivery of the business strategy. In this context the goal of our paper has looked to investigate, through a case study research approach, two successful Swedish retail companies and the strategic role of IT in their business. The selection of the retail companies has been done based upon the fact that both companies they are competing in the same marketplace and in this way we could compare and analyse the differences between them regarding the strategic role of IT.

Evaluation Frameworks for Strategic Use of IT

*Information Systems Strategy Triangle***.** The first evaluation framework we have used is IS strategy triangle that is a framework which relates the business strategy, information system strategy and organizational strategy, as it is shown in Fig. 1.

In every booming organization, business strategy is the driver for both IS strategy and organizational strategy too. Moreover business strategy is a well expressed vision that illustrates where business aims to reach and how to get there [8]. Different models (such as Porter generic strategies [9] and D'Aveni's hyper competition [10]) have been developed to discuss the different dimensions of business strategy in order to help general managers for understanding and analyzing the strategy of their businesses. Furthermore organizational strategy is a roadmap that reveals the way in which organization designs, plans, performs and controls its functions in order to implement its business strategies and achieve its goals [11]. Different models (such as Business diamond [12] and Managerial levers [13]) have been developed to identify the important components of organization's design, plan

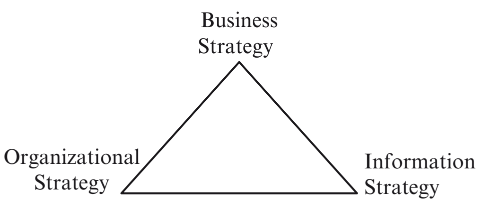


Fig. 1 Information system triangle [1]

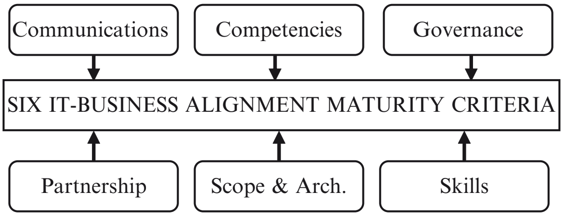


Fig. 2 Strategic alignment maturity model [8]

and control of their processes. These models helps in fact IT decision makers to review as-is the situation of organization for identifying troubles and available opportunities. Concerning the IS strategy this is define as the use of information technology to define the roadmap and information services to achieve business goals. Different models (such as IS strategy matrix [4] and IT components classification frameworks [3]) have been developed in order to provide the managers with a high level view of technology infrastructure, its resources and usage in the organization in order to contribute to determine technical capabilities, services and resources for achieving business goals.

Luftman's Strategic Alignment Maturity Model. The second evaluation framework used is Luftman's Strategic Alignment Maturity Model as it is shown in Fig. 2 that is providing a criteria to evaluate the maturity of strategic business-IT alignment over a scale of five levels (see [1,6] for details). The evaluation of the strategic alignment is done through six criteria which are: Communications Maturity, Competency/Value Measurement Maturity, Governance Maturity, Partnership Maturity, Scope & Architecture Maturity and Skills Maturity.

Research Methodology

Different models and frameworks (such as strategic alignment model [14,15] have been developed to provide a benchmark for evaluation of alignment. But as we have mentioned in the previous section in our research we have used the Information Systems Strategy Triangle and Luftman´s Strategic Alignment Maturity Model which we have considered very suitable for our research approach. In this context our paper has examined the strategic role of IT in two Swedish companies through a case study research approach [16]. Because of the confidentiality, claimed by the companies we will refer to these companies as Company A and Company B. The research was conducted from May, 2007 to April, 2008 through structured interviews with business and IT key decision makers from both organizations.

For this purpose we have applied the frameworks mentioned in the preceding section, on each company. Firstly, IS strategy triangle is applied to both companies for evaluating the relationship between the three sides of triangle in order to compare them and identify similarities and differences between these companies.

Secondly, Luftman's Strategic Alignment Maturity Model has been applied to both companies for the evaluation of the alignment maturity and an analysis was drawn in this case. For understanding the strategic role of IT in these organizations, it is important to start by examining different strategies and the correlation among them. Therefore the research questions we have addressed are the followings:

Q1. How does IT support the business and organizational strategies?

To answer this question, we started with a fundamental model that is Information Systems Strategic Triangle [4], because by using this triangle we can first better understand the two companies' concerning business, IT and organizational strategies and the way in which they perpetuate the needed balance for successful operations of their business, and secondly we could understand the impact of the triangle's three pillars as reciprocal relationship. Consequently, we need to precisely examine business choices and information systems modifications therefore this has been done by focusing on our second research question.

Q2. How IT and business strategies are aligned?

To answer this question, we choose to use Luftman's Strategic Alignment Maturity Model [6], because: (1) it mainly focuses on the relationship between business and IT/IS, (2) it helps not only to measure the strategic business-IT alignment of an organization, but also is looking to examine the actual implementation and mutual effect of both strategies in terms of business operation of an organization.

Data Analysis and Results

The Analysis Through the Information System Strategic Triangle

As we have mentioned before the companies named are confidential but for a better understanding of our analysis some information about companies business are provided as are following. The Company A is a retail one which provides a complete package purchasing product/services with expert knowledge, operational excellence and technical assistance whereas, Company B is a retail one which is selling home electronics, hardware and software for computers and DVD-films.

Furthermore Company A is concerned about its position in marketplace, therefore their IT budget is more than half of the organization's total budget. Since, the core business is IT related, most of the employees are aware of the technology potential. An important role in this direction is playing the Application and Operations Manager (AOM). Additional to that, AOM seats in the company's Business Advisory Board. One important finding in our analysis is that Company A considers separating their traditional IT. In this way the Company A has found an easier way to classify relations and effects of IT on business strategy and organisational structure. The company A is having highly skilled employees, and has considered to separate their traditional IT that is used internally from the IT that is used for customer services. Being a technology related company, it doesn't hesitate to adopt latest technologies to meet evolving customer needs and accordingly modify their IT strategies frequently.

Concerning Company B this organization has seen future prospects in e-business that could be supported by a strong IT infrastructure in Sweden therefore the company has invested heavily in IT. Since, the company is promoting e-sales, most of the employees have IT and business skills. Moreover Company B considers IT as a single unit for an easier deal with the business units and customers too. Furthermore IT department is headed by an IT manager, who is not a member of company's Business Advisory Board. On the other hand Company B don't prefer to go after technology in other words not to invest too much in IT. Instead, their priority is the business strategy for finding better ways of managing their stores, customers and goods.

The Comparative Analysis: Both companies invest in IT, but since for company A, AOM seats in the Business Advisory Board the company doesn't hesitate to adopt latest technologies on order to meet the evolving customer needs. For company B, they don't have any representative in the Business Advisory Board therefore they are reluctant to adopt new technologies. One important finding in our analysis is that Company A considers separating their traditional IT (that is used internally), from the IT customer service (that is used to interact with customers). This helps Company A in identifying easier ways to classify relations and effects of IT on business strategy and organisational structure. On the other hand, Company B sees IT as a separated unit that deals with business units. This separates IT strategies from business and organizational strategies. The separation decreases the probability of integration of the three types of strategies, and hence, the overall view on company's strategy is hindered. Although both companies understand the importance of Business-IT partnership, but they have different priorities in their business views. In Company A, there is a clear emphasis on IT strategies by making crucial decisions for changing technologies which suit their customers' needs. By developing their IT solutions and modifying IT strategies, business strategies are consequently changed and organizational structures are modified. In Company B they do not prefer to go after technology, instead they prioritize business goals as the leader for change. As a result IT strategy depends upon business strategy and IT is seen as a tool for achieving business goals.

The Analysis of Applying the Luftman's Strategic Maturity Model (LSMM)

From the structured interviews with the IT and business decisions persons from both companies as well as other related questions, we have measured the business-IT alignment using Luftman's Strategic Maturity Model [6]. In Company A, the understanding of business by IT is relatively higher than the understanding of IT by business. Business and IT metrics are used by the company to evaluate involvement of IT in the business. Moreover Company A follows a federated style of organiza-

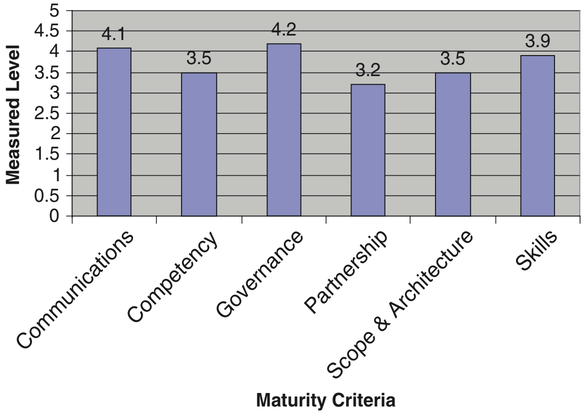


Fig. 3 Measured alignment for company A

tional structure, i.e. IT strategies are developed on headquarter and are localized in subsidiaries. In this way the company has achieved advantages of both centralized and decentralized governance. For company A, IT is the enabler for changing perception, plans and processes. Furthermore company's operations rely on IT skills of employees. The values of Lufthman's criteria, calculated for company A are given in Fig. 3. In company B, as business side is dominating, the knowledge sharing takes place in unstructured way, resulting in a low level of communication maturity. Business metrics are used to evaluate issues like purchasing statistics and customer satisfaction, etc. Moreover company B has adopted two types of organizational structure. In the headquarter structure this is hierarchal by having only three different departments with a centralized governance. Whereas in the subsidiaries the structure is more flat which facilitates a decentralized governance. Furthermore for company B, the business processes are the enablers for change. On the other hand the business skills are balanced with IT, however business relies on skills of market analysis and business operations. The values of Lufthman's criteria, calculated for company B are given in Fig. 4.

The Comparative Analysis: In company A the communication is done in a semi-structured way so the data can be obtained for analysis and evaluation from different parts of the company. In contrast, in company B the communication is done in an unstructured way which decreases communication maturity. Addition to that, information is not available for reuse and hence, therefore the overall analysis and evaluation of company are affected. In company A, as we knew IT unit is separated in internal and customer service based IT, but the IT metrics are providing a concrete analysis of both parts. Moreover some of the IT metrics are used for inbound performance evaluation, whereas other metrics are used to evaluate outbound (customer and supplier related issues) performance evaluation. In company B, through IT functionalities, the data about customers, suppliers and different processes, etc. is available and stored in the company. But since IT is seen as a single unit and it is not integrated with business, the data is not used for a performance analysis and

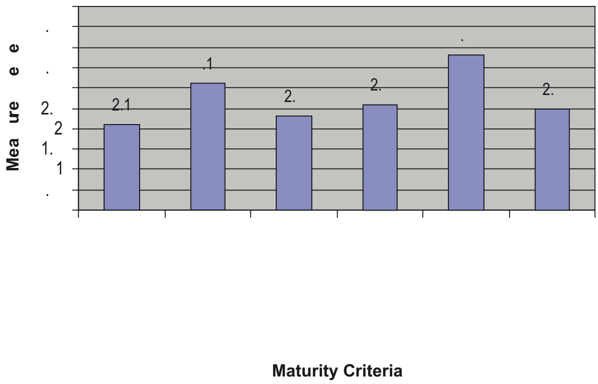


Fig. 4 Measured alignment for company B

the improvement of customer services. Furthermore in company A, the federated system allows the company to have flexible strategies. Therefore in the subsidiaries, it is possible to customize different strategies according to their local conditions which is improving the customer satisfaction. On the other hand Company B has adopted a centralized structure in it's headquarter which has as result a rigid business and IT strategies to subsidiaries. However through a well established network among subsidiaries, different resources can be shared for meeting local needs of subsidiaries.

From Figs. 3 and 4, we can highlight the high level of communication maturity in Company A compare with a lower one in Company B. In our opinion we can see this result to be a logical with our findings and investigation from our case study. For example in Company A, when we talked with senior business managers representing the business side and with the Application and Operations Manager (AOM) from the IT side, both sides gave as the same responses about their together regular meetings for bringing business and IT closer, and increase of their understanding and cooperation of their employees. On the other hand, in Company B we found a clear lack of understanding between business and IT. One example of that appeared easily to us in our interviews and analyses. In fact as we have seen the sales department is following only their business strategies, by collecting data about their customers and keeping their tracks and history. However, they do not agree about why they will have to share this data with the IT department. In this way, they do not only affect the overall alignment maturity in their organization, but they lose a chance of finding new ways of supporting their business strategy. By adding the customers' data to a data warehouse, more analysis, for instance, can be made and thus the company could find new ways for targeting and satisfying better their customers. Another important point in the business–IT alignment and which we have highlighted is the scope and architecture maturity. Although Company A shows a higher level of overall maturity, but Company B shows a better level of organization structure for supporting business-IT alignment. Moreover in Company B, they have a business strategy of supporting a flexible and transparent infrastructure to all business partners and customers and they also develop their own customized solutions for customers' needs. On the other hand, in Company A, they achieve their maturity level by evaluating and applying emerging technologies effectively to their business because the company believes in the technology potential. Furthermore the company mangers let their IT to drive their business processes.

Conclusions

Apart from the findings coming from our interviews with IT and business key decisions persons from the two Swedish retail companies, we can conclude that there are several similarities across both companies being studied in terms of IT, business and organizational strategies. However, clear differences can be found regarding their Business-IT alignment and the way their looking to achieve the competitive advantage. For a successful relationship between business strategy, information system strategy and organizational strategy, (1) IT should be integrated with business because there can not be a standalone business strategy for a company to compete in the information era. (2) IT manager/CIO should be more involved in business advisory board for keep a common strategic view over business, like in company A, (3) unlike company B, IT should not be separated or seen as an isolated unit because this leads to presenting IT as a static tool for business operations. For improving business-IT strategic alignment, (1) unlike company A and B, business and IT should use structured way for communicating and sharing information. This makes information available for reuse, improving customer services and performance analysis, etc. (2) like company A, by adopting federated systems, companies can have flexibility in strategies to localize resources and improve working environment for increasing customer satisfaction. In addition to that, like company B, sharing resources among subsidiaries can further increase governance maturity, (3) similar to company A, where IT should take the role of enabler or driver for changing business processes, even if the company doesn't adopt latest technologies, that will increase the IT involvement in business and hence increase of partnership maturity.

References

1. Luftman, J.N., Bullen C.V., Liao D., Nash E., Neumann C. (2004) Managing the Information Technology Resource: Leadership in the Information Age, Prentice Hall, New York.
2. Tang, Z. & Walters, B (2006) The Interplay of Strategic Management and Information Technology. In, IT-Enabled Strategic Management: Increasing Returns for the Organization, Idea Group Publshing.
3. Turban, E., Leidner, D., McLean, E. and Wetherbe, J. (2006) Information Technology for Management. Transforming Organizations in the Digital Economy, 5th Edition., Wiley.

4. Pearlson, K.E. & Saunders, C.S. (2006) Managing and Using Information Systems. A Strategic Approach, 3rd Edition, Wiley.
5. Henderson, J.C. and Venkatraman, N. (1993) Strategic Alignment: Leveraging Information Technology for Transforming Organization, *IBM Systems Journal*, 32(1): 4–16.
6. Luftman J. (2000) Assessing Business-IT Alignment Maturity, *Communications of AIS* 4(14): 1–50.
7. McKeen, J.D. and Smith, H.A. (2009) IT Strategy in Action, Pearson Education Inc.
8. Peppard, J. Ward, J. (2004) Beyond strategic information systems: towards an IS capability, *Journal of Strategic Information Systems* 13(2): 167–194.
9. Porter, M. (1980) Competitive Strategy, New York, Free Press.
10. D'Aveni, R. (1995). Coping with hypercompetition: Utilizing the new 7S's framework. *Academy of Management Executive*, 9(3): 45–57.
11. Silva, L. Figueroa, E. Reinhart, J.G. (2007) Interpreting IS alignment: A multiple case study in professional organizations, *Information and Organization* 17(4): 232–265.
12. Hammer, M. Champy, J. (1994) Reengineering the Corporation, Harper Business Press.
13. Cash, J.I. Eccles, R.G. Nohria, N. Nolan, R.L. (1994) Building the Information-Age Organization: Structure, Control, and Information Technologies, Richard D Irwin Publications.
14. Burn J.M., Szeto, C. (2000) A comparison of the views of business and IT management on success factors for strategic alignment, *Information and Management* 37(4): 197–216.
15. Avison, D. Jones, J. Powell, P. Wilson, D. Using and validating the strategic alignment model, *Journal of Strategic Information Systems* 13(3): 223–246.
16. Yin, R.K. (2002). Case Study Research. Design and Methods, 3rd Edition, Sage Publications Inc.

The Use of Web Services for Inclusive Decision Process: Towards the Enhancement of e-Democracy

F. Cabiddu[1]

Abstract This article focuses on the case study of the web sites of the Italian regional governments who have agreed to take part in the DE.CI.DI. project which aims put into practice e-democracy in provincial Public Administration. We have assessed the level of e-democracy developments based on four different dimensions: transparency and interactivity. We conclude that the spreading use of Internet has raised expectations that it may be used to encourage a more direct citizen engagement and modify the ways in which public decisions are taken, however those expectations have not been fully met yet.

Introduction

In recent years, there has been growing interest in research, in both theoretical and applied fields, in the influence of technology and in the way public organizations relate to the citizens. It is now widely accepted that the emerging and strategic use of information communication technology (ICT) regularly plays a role in internal as well as external communications and operations [1]. Moreover, the adoption of web-based technologies in order to deliver government services has become a global trend in public administrations [2–4] as well as an essential element in promoting new forms of government-citizen relationships. One aim of this adoption is to deploy information technology to improve the effectiveness and efficiency of democracy [5–7].

According to this view, this paper will contribute to previous research by focusing on the true experiences of citizens and of the services provided by web sites so as to make Internet a more effective democratic tool for the interaction between Public Administrations and citizens. We argue that adequate public decision will

[1]Università di Cagliari, Cagliari, Italy, fcabiddu@unica.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_6,

often require the active participation of the citizens in the decision making process. Making a decision is a complex process which must be based upon a method which is able to establish the optimum criteria in choosing an alternative, in evaluating the main effects of implementing the decision which was taken and in estimating the risks involved. Given the special nature of public choice and the special problems that arise in Public Administration, adequate decision requires that public organizations and citizens create a particular model of shared decision making – one that we refer to as inclusive decision making. Specifically, the paper considers Internet the most viable electronic channel through which a more direct citizen engagement is encouraged and also enables new ways in which public decisions are taken, the so called e-democracy [1, 8–11].

The paper is structured as follows. First, we will discuss the theoretical framework concerning the fields of inclusive decision making process, e-democracy and our research objectives. An exploratory research design has been adopted, and we will then present the findings of our single case study. The cross case analysis is followed by a discussion in which we relate our findings to theories of inclusive decision making process and e-democracy evolution.

Literature Review

The origin of theoretical standings which are at the basis of public participation in the decision making processes of Public Administrations can be traced back to the period falling between the Sixties and Seventies. In that decade, there was a tendency to improve the democratization and legitimacy of public policy [12] through participation, particularly for the decisions regarding the local policies involving all stakeholders. These stakeholders may be defined as "organizations and individuals whose interests are affected by the policy under discussion" [13]. The definition, in other terms, also includes common citizens, that is to say, those "not holding office or administrative positions in government" [14].

In the last decade, a growing number of contributions [15–17] have repurposed the theoretical debate concerning the participation of stakeholders in public decisions introducing the concept of deliberative democracy. The term refers to the decision-making process which is characterized by two peculiar aspects: the deliberative aspect and democratic aspect (or inclusive one)

The aspect of deliberation refers to the fact that the decision-making process is founded on impartial judgments based on common welfare. On the other hand, the democratic aspect of the process, is given by the fact that there is a form of participation, at a level of equality, of the representatives of all the parties involved in the consequences of that same decision [17].

The condition that makes the deliberation a democratic one, involves the participation of all the parties concerned in the outcome of the deliberation itself. The question is then how to include the opinion of ordinary citizens and support the local policy decision making process.

Technology brings a new element into this conceptual field. Developments in Information and Communication Technologies (ICTs), and particularly the increasing spreading of Internet, suggest that ICTs could be used to widen the spectrum of participants in policy making process[18]. Since the 1990s, information and communication technologies (ICTs) contribute to the emergence of a different type of democratic governance, i.e. democratic e-Governance [19–21]. The concept of democratic e-Governance can be used as an umbrella concept that combines three different perspectives about the utilization of ICTs in government's policies: the first point of view is named e-Government. It is about all political-administrative operations of governments in which ICTs are utilized; the second point of view is named e-Governance. It is about managing and routing multi-sectoral stakeholder relations with the help of ICTs. The purpose is that of taking care of policy, service and development functions of government; the last is named e-Democracy. The concept refers to democratic structures and processes in which ICTs are utilized [21].

By combining these three perspectives we can say that one important factor, which characterizes democratic e-Governance, is the participation of the citizens in *digital democracy initiatives*. This is accomplished by engaging in online discussion forums and participating in inclusive decision process in order to share a basis of understanding as common ground from which to mediate consensus [22].

Within e-democracy initiatives, it is common to distinguish between two areas: one addressing e-voting and the other addressing e-engagement or e-participation [23]. In the second part of this paper, we will be focusing our attention on e-participation, a term used to refer to the use of ICTs in supporting the information, consultation and participation of citizens.

Methodology

We decided that in keeping with the focus of our research, an exploratory approach would be the most appropriate method of collecting data within the Public Administration to provide insights to our research question. As the case study approach refers to an in-depth study or investigation of a contemporary phenomenon within a real-life context, we set up a single case study design using a theoretical replication logic [24]. In order to do this multiple sources of evidence was utilized. The research sample is made up of the web sites of the Italian regional governments who have agreed to take part in the DE.CI.DI. project which aims to try e-democracy in provincial Public Administration. The project aims to promote and increase the participation of citizens in public decisions.

We have assessed the level of e-democracy developments based on two different dimensions: transparency and interactivity. In order to evaluate the features related to transparency and interactivity, we have adopted the Web Site Attribute Evaluation System (WAES) methodology developed by the Cyberspace Policy Research Group [25].

Transparency on web sites refers to the extent to which an organization makes information about internal works, decision processes and procedures available.

Interactivity is a measure of the level of convenience, degree of immediate feedback and development of interactive e-services.

The indicators of transparency may be grouped into five categories. (1) ownership; (2) contacts and reachibility; (3) organizational information; (4) issue information and (5) citizen consequences and responses.

The indicators of interactivity may also be grouped into five categories: (1) security and privacy; (2) contact and reachibility; (3) organizational information; (4) issue information; (5) citizen consequences and responses.

The interaction between these two dimensions, transparency and interactivity, reflect the institution's degree of openness [25].

The scores shown in Table 1, show the value zero when the item analyzed doesn't appear on the web site and the value 1 when the items analyzed appear on the web site. The global scores in transparency and interactivity have been obtained by adding up the individual scores for every relevant item in each dimension.

Case Description: the DE.CI.DI. Project

The case being presented is the DE.CI.DI. Project (acronym for Democracy for Digital Citizenship), which aims at testing e-democracy at a Provincial administration level for those provinces which have agreed to take part in the project. The project, coordinated by the Province of Genoa, groups seven other provinces (Alessandria, Ascoli-Piceno, La Spezia, Lecce, Pesaro-Urbino, Piacenza e Savona). The project was initiated in 2006 as an answer to a national call promoted by CNIPA (The National Centre for Information Technology applied to Public Administration) in the context of the development of the second phase of e-government in Regions and Local Bodies, the intent being to promote the participation of citizens in the decision-making process of Public Administrations, through the use of Information and Communication Technologies (ICT).

In the development phase, DE.CI.DI. lay down a number of strategic objectives. Firstly, the implementation of a tool capable of promoting social integration, the analysis of the decision making process and the collecting of information regarding the use of services provided by the Province. Secondly, the development of a flexible system capable of questioning the public and its choices in order to stimulate active participation via internet to public life, with an emphasis on the expression of indications and suggestions concerning public expenditure.

The tool chosen for the investigation was the "informed investigation". At first, the participants expressed their view point on a specific matter without receiving any information about the topic under enquiry; at a latter phase, the same target group of citizens was again required to express their opinion on the same matter after having received detailed information.

Table 1 Web site scores by Genova

Items	Transparency	Score	Interactivity	Score
Ownership	T1a Agency involvement with site	1	I1a Does NOT require personal information (beyond return e-mail address) to communicate with agency	1
/Security and Privacy (Interactivity)	T1b Webmaster appears to be different from the one running the main government page, if one exists	1	I1b Security access method, such as password or secure server use, is associated with transaction with agency or access to personal information	1
	T1c Provides obvious tailoring indicating agency itself has ownership of site content			
	T1d Provides published date			
Contacts	T2a Provides central agency non-email addresses	0	I2a Provides e-mail link to webmaster	0
			I2b Provides e-mail link to senior agency official	1
	T2b Provides phone numbers or postal addresses for employees within agency beyond most senior officials	1	I2c Provides e-mail link to a number of agency employees	1
			I2d Provides an online issue-related forum for outsider participation such as chat lines, and list serves	1
	T2c Provides e-mail address to person responsible for both content of the site and technical support for the site	0		
	T2d Provides e-mail address to someone solely responsible for technical support for the site	0		
Organizational information	T3a Provides details on senior official's experiences or vision of future for institute	0	I3a Provides link to listed sub-elements within agency	0
			I3b Provides automatic update announcement or newsletter via subscription	0
	T3b Provides mission statement and various activities of agency	1		
	T3c Provides organizational structure in graphic form	0		

(*continued*)

Table 1 (continued)

Items	Transparency	Score	Interactivity	Score
Issue information	T4a Provides issue-related addresses for other government agencies	1	I4a provides link to outside issue-related government addresses	1
	T4b Provides non-issue-related addresses for other government agencies	1	I4b provides link to outside non-issue-related government addresses	1
	T4c Provides issue-related addresses for other NON-government information sources	1	I4c provides link to outside issue-related non-government information sources	1
	T4d Provides a searchable index for archived newsletters, laws, regulations, and requirements	0		
	T4e provides link to or text of public information law or regulation			
Responses/ Citizen consequences (Interactivity)	T5a Provides in depth explanations of requirements imposed on citizens resulting from agency activities	11	I5a Provides link to regulation information	1
			I5b Provides online form completion and submission	1
	T5b Provides instructions for appeal process for decisions or address of an ombudsman inside agency		I5c Provides link to appeal process for decisions and/or an ombudsman	0
			I5d Provides other language access to site for visitors unable to speak or read the language of the host country	1
			I5e Provides iconographic access to site for visitors	
Total scores	Transparency	9	Interactivity	11

Since October 2006, in order to take part in the decision making process, the citizens of the provinces which agreed to take part in the project could subscribe at the website dedicated to the project (www.decidi.it) by indicating their personal data and their personal ID number. The subscription allowed citizens to access the website environment pages, which were subdivided as follows: a detailed questionnaire which asked citizens about a specific matter; informative material and the position of participating associations holding different opinions and interests; a forum, where users interacted and made comments about the documentation which had been made available.

Case Analysis and Discussion

The case of De.Ci.Di. demonstrates how a Public Administration unleashes the capabilities of Internet to craft a robust e-democracy architecture that acts as a common denominator between the public administrator and the citizens.

An analysis of the websites, through the methodology of Website Evaluation System, of the eight provinces that agreed to participate in the De.Ci.Di. project allows to obtain key information about the transparency and interactivity of the provinces under enquiry and thus the true opportunities offered to the citizens participating in public decision making. From a first examination of sites the level maturity of websites is immediately noticeable. The website of province of Genoa is the only one reporting a quantity of information which allows for its evaluation in terms of transparency and interactivity. The websites of the provinces of Alessandria, Ascoli-Piceno, Lecce and Savona contain a list of topics that will be subject to voting by citizens, but are lacking, at least at this phase, of informative documentation about the topics dealt with. Furthermore, in the provinces of Lecce, Alessandria and Piacenza, no contact person is mentioned within the website to whom the citizen can refer to in order to obtain information about the project. The situation is slightly different in the websites of provinces of Pesaro-Urbino. In these websites, besides the listing of the topics subject to public opinion, detailed informative material relating to the themes is available and accessible. E-mail and telephone numbers are also on hand for those wanting any further information about the De.Ci.Di. project.

As highlighted by the synoptic table above (Table 1) the items which showed the best results in both dimensions (transparency and interactivity) are those referring to Ownership and Security as well as Privacy; Issue Information, Responses e Citizen consequences. The dimension that showed the worst results is that referring, once again, the two dimensions, of organization and information. As for transparency, the lowest score may be assigned to the eleventh item “contacts”. From the overall analysis of the table it is clear that the De.Ci.Di. project is to be considered a good example of e-democracy, even though wide areas of improvement still exist, particularly in reference to transparency.

This article has sought to clarify the means of e-democracy and to explain why it is important the use of an inclusive decision process for the adequate treatment of public problem.

E-democracy has enormous potential to encourage a more direct citizen engagement and to change in the area of public decision making but those expectations have not been fully met yet. In order to increase the contributions of web sites to the raise of inclusive decision processes, governments and policy-makers would do well to reinforce the transparency and the interactivity of their web sites.

The findings of our research suffer from the usual limitations of interpretive case studies, in terms of generalization. As with any empirical investigation, weakness in the methodology and data will be present, and this study is no different. Two limitations, in particular, should be mentioned.

Firstly, the data used in this study were collected exclusively from web site of Public Administration operating in Italy. Secondly, the sample of case study doesn't provide a complete and extensive survey on the Italian enhancement toward e-democracy but focuses on seven provinces in Italy.

References

1. Grönlund, A. (2002), (ed.), *Electronic Governement: Design, Applications and Management*, London, Idea Group Publishing.
2. Traunmüller, R. and Wimmer, M. (2003), *E-Government at a Decisive Moment: Sketching a Roadmap to Excellence*, in R. Traunmüller (ed) EGOV 2003, LNCS 2739, Berlin, Springer.
3. United Nations (2003) *World Public Sector Report: e-Government and the Crossroads*, New York, United Nation Publications, October 2003.
4. OECD (2004) *The E-Government Imperative*, Paris, OECD.
5. Rheingold, H. (1993) *The Virtual Community: Homesteading on the Electronic Frontier*. Addison-Wesley, Reading, MA.
6. Barber, B.R. (1998) Three scenarios for the future of technology and democracy, *Political Science Quarterly 113*: 573–589.
7. Gross, T. (2002) E-democracy and Community Networks: Political Visions, Technological Opportunities and Social Reality, *Electronic Government: Design, Applications and Management*, Grönlund, A. (ed.), pp. 226–248. Idea Group, London, UK
8. Macintosh, A. (2004) *Characterizing E-Participation in Policy-Making*, Proceedings of the 37th Hawaii International, Conference on System Sciences, Big Island, Hawaii.
9. Andersen, K.V. (2004) *E-government and Public Sector Process Rebuilding (PPR)*, Dilettantes, Wheelbarrows and Diamonds, Dordrecht: Kluwer.
10. Bellamy, C. and Taylor, J. (1996). New Information and Communications Technologies and Institutional Change, *International Journal of Public Sector Management* 9(4): 51–69.
11. Merz, Davenport, E. and Horton, K. (2004). *A Social Shaping Perspective on an e-Governmental System(ic) Failure*, in R. Traunmueller (ed.) EGOV 2004, LNCS 3183 Berlin, Springer-Verlag.
12. Arnstein, S.R. (1969), A Ladder of Citizen Participation, *Journal of the American Institute of Planners*, 8.
13. Bongers, F.J. (2000), *Participatory Policy Analysis and Group Support Systems*, Tilburg University.
14. Roberts, N. (2004) Public deliberation in an age of direct citizen participation, The American Review of Pubblic Administration, 34, 4.

15. Manin, B. (1987) On Legitimacy and Political Deliberation", *Political Theory*, 15, 3: 338–368.
16. Majone, G. (1989) *Evidence, Argument and Persuasion in the Policy Process*, New Haven&London, Yale University Press.
17. Elster, J., ed, (1998) *Deliberative Democracy*, Cambridge University Press, Cambridge.
18. Holden, S.H. (2003) *The Evolution of Information Technology Management at the Federal Level: Implications for Public Administration*, in Garson G.D. (ed.) Pubblic Information Technology Policy and Management Issues, Hershey, PA, Idea Group Publishing.
19. Hoff, J., Horrocks, I. and Tops, P. (Eds) (2000) Democratic Governance and New Technology. Technologically Mediated Innovations in Political Practise Western Europe, New York, Routledge.
20. Dutton, W.H. (1999), *Society on the Line. Information Politics in the Digital Age*, Oxford, Oxford University Press.
21. Anttiroiko, A.V. (2007), Democratic e-Governance – Basic Concepts, issues and Future Trends, *Digest of Electronic Government Policy and Regulation*, 30: 83–90.
22. McCullagh, K. (2003) E-democracy: Potential for Political Revolution, *International Journal of Law and Information Technology*, 11, 2: 149–161.
23. Lourenço, R.P. and Costa, J.P. (2006), Incorpotating citizens'views in local policy decision making processes, *Decision Support System*, 43: 1499–1511.
24. Yin, R. (1994) *Case study research*, 2nd edition, Thousand Oaks, Sage
25. Demchak, C.C., C. Friis and T.M. La Porte (2000), *Webbing Governance : National Differences in Costructing the Public Face*, in G.D. Garson (ed.), Handbook of Public Information Systems, New York, Marcel Dekker.

Toward an Effective and Efficient Query Processing in the NeP4B Project[1]

C. Gennaro[2], F. Mandreoli[3], R. Martoglia[4], M. Mordacchini[5], S. Orlando[6], W. Penzo[7], S. Sassatelli[8], and P. Tiberio[9]

Abstract In this paper we present our main current research activity in the Italian co-funded FIRB Project NeP4B (Networked Peers for Business). In particular, we provide an overview of our P2P query routing approach which combines semantics and multimedia aspects in order to make query processing effective and efficient.

Motivation

Information and communication technologies (ICTs) over the Web have become a strategic asset in the global economic context. The Web fosters the vision of an Internet-based global marketplace where automatic cooperation and competition are allowed and enhanced. This is the stimulating scenario of the ongoing Italian Council co-funded NeP4B (Networked Peers for Business) Project whose aim is to develop an advanced technological infrastructure for small and medium enterprises (SMEs) to allow them to search for partners, exchange data and negotiate without limitations and constraints.

According to the recent proposal of Peer Data Management Systems (PDMSs) [1, 2], the project infrastructure is based on independent and interoperable semantic peers who behave as nodes of a virtual peer-to-peer (P2P) network for data and service sharing. In this context, a semantic peer can be a single SME, as well as a mediator

[1] This work is partially supported by the Italian co-funded FIRB Project NeP4B (Networked Peers for Business). http://dbgroup.unimo.it/nep4b

[2] ISTI - CNR, Pisa, Italy, claudio.gennaro@isti.cnr.it
[3] Università di Modena e Reggio Emilia, Italy, federica.mandreoli@unimo.it
[4] Università di Modena e Reggio Emilia, Italy, riccardo.martoglia@unimo.it
[5] ISTI – CNR, Pisa, Italy, matteo.mordacchini@isti.cnr.it
[6] Università di Venezia, Venezia, Italy, orlando@dsi.unive.it
[7] Università di Bologna, Italy, wilma.penzo@unibo.it
[8] Università di Modena e Reggio Emilia, Italy, simona.sassatelli@unimo.it
[9] Università di Modena e Reggio Emilia, Italy, paolo.tiberio@unimo.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_26,

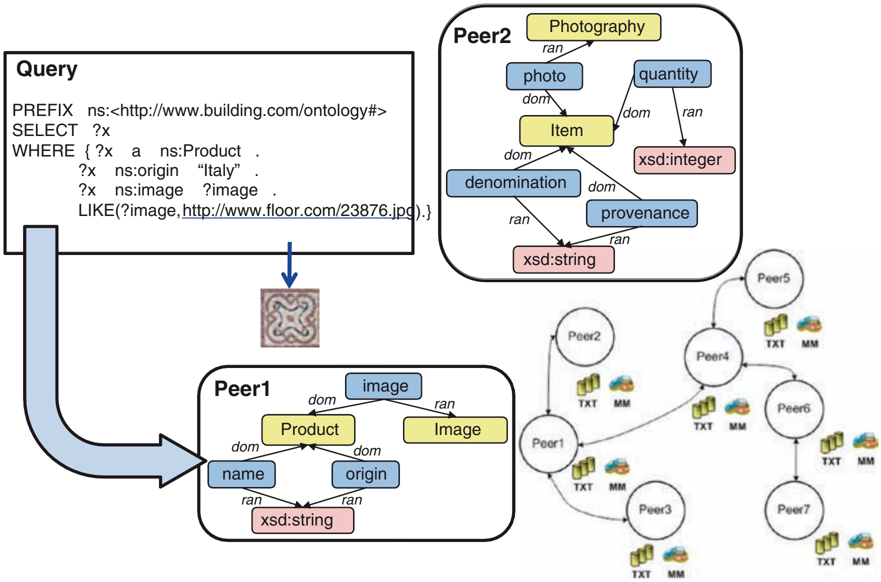


Fig. 1 Reference scenario

representing groups of companies, and consists of a set of data sources (e.g. data repositories, catalogues) placed at the P2P network disposal through an OWL ontology. These data sources include multimedia objects, such as the descriptions/presentations of the products/services extracted from the companies' Web sites. This information is represented by means of appropriate multimedia attributes in the peers' ontologies (e.g. `image` in Peer1's ontology of Fig. 1) that are exploited in the searching process by using a SPARQL-like language properly extended to support similarity predicates. As an example, let us consider the query in Fig. 1 which asks Peer1 for the Italian products similar to the represented one. As can be seen, the clause `WHERE` is extended with the operator `LIKE` indicating the referenced image.

Each peer is connected to its neighbors through semantic mappings, appropriately extended with scores expressing their strength, which are exploited for query processing purposes: In order to query a peer, its own ontology is used for query formulation and semantic mappings are used to reformulate the query over its immediate neighbors, then over their immediate neighbors, and so on. For instance, in Fig. 1 the concepts `product`, `origin` and `image` of the sample query must be reformulated in `item`, `provenance` and `photo` when the query is forwarded to Peer2. As to the computation of the semantic mappings and the associated scores, in the project an effective approach which exploits the semantics and the structure of the available schemas and which descends from the one proposed in [3] is employed.

In such a distributed scenario, where query answers can come from any peer in the network which is connected through a semantic path of mappings [2], a key challenge is *query routing*, i.e. the capability of selecting a small subset of relevant peers to forward a query to. Flooding-based techniques are indeed not adequate for both efficiency and effectiveness reasons: Not only they overload the network (forwarded messages and computational effort required to solve queries), but also overwhelm the querying peer with a large number of results, mostly irrelevant.

As part of the NeP4B project, we leverage our distinct experiences on semantic [4, 5] and multimedia [6] query routing and propose to combine the approaches we presented in past works in order to design an innovative mechanism which exploits the two main aspects characterizing the querying process in such a context: The semantics of the concepts in the peers' ontologies and the multimedia contents in the peers' repositories. More precisely, since the reformulation process may lead to some semantic approximation, we pursue *effectiveness* by selecting, for each query, the peers which are semantically best suited for answering it. Further, since the execution of multimedia similarity queries is inherently costly (they typically require the application of complex distance functions) we also pursue *efficiency* by limiting their forwarding to the network's zones where potentially matching objects could be found, while pruning the others.

On Query Routing

In the context of the NeP4B Project a query posed at a peer usually contains predicates involving the concepts of the peer's ontology and multimedia similarity constraints. Thus, both the semantics and the multimedia features of the retrieved data are fundamental: An image that, according to some given multimedia features, is very similar to the required one is not a relevant result if the two represented concepts are completely semantically unrelated (e.g. a church and a hotel with similar shapes). Thus, in order to provide an effective and efficient query processing both the aspects need to be considered.

In [4] an effective semantic query routing approach for PDMSs is presented. In the work, each peer maintains cumulative information summarizing the semantic approximation capabilities, w.r.t. its ontological schema, of the whole subnetworks rooted at each of its neighbors. Such information is kept in a local data structure called *Semantic Routing Index (SRI)*. In particular, a peer p having n neighbors and m concepts in its ontology stores an SRI structured as a matrix with m columns and $n+1$ rows, where the first row refers to the knowledge on the local schema of peer p. Each entry $SRI[i][j]$ of this matrix contains a score in [0,1] expressing how the j-th concept is semantically approximated by the subnetwork rooted at the i-th neighbor, i.e. by each semantic path of mappings originated at the i-th neighbor. A sample fragment of Peer1'SRI is represented in Fig. 2, where, for instance, the score 0.34 in the Peer4 row and the `Product` column is the outcome of the aggregation of the scores associated to the paths Peer4, Peer4-Peer5, Peer4-Peer6 and Peer4-Peer6-Peer7. Notice that, since SRIs summarize the semantic information offered by the network, they need to change whenever the network itself changes. SRIs construction and evolution is thus managed in an incremental fashion by exploiting the specifically devised process presented in [4].

SRI_{Peer1}	Product	name	origin	…
Peer1	1.0	1.0	1.0	…
Peer2	0.73	0.88	0.75	…
Peer3	0.69	0.48	0.30	…
Peer4	0.34	0.21	0.22	…

Fig. 2 Peer1's SRI

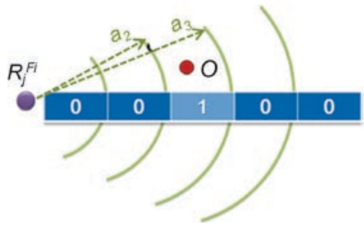


Fig. 3 Feature index of object *O* for the feature F_i

When a peer needs to forward a query, it accesses its own SRI for determining the neighboring peers which are most semantically related to the query's concepts. For instance, considering the concept Product of the query in Fig. 1, the most promising subnetwork would be the one rooted at Peer 2 (score 0.73 in Fig. 2). More precisely, if the query involves more concepts, the choice of the best neighbors is given by applying scoring rules which, for each neighboring peer, combine the corresponding SRI grades of all the query's concepts [5]. As a result, each neighbor is associated a score in [0,1] reflecting the semantic relevance of its subnetwork w.r.t. the query. These scores allow the forwarding peer to compute a ranking that can be exploited in order to implement different semantic routing policies [5].

As to the multimedia contents, *MRoute* [6] is a P2P routing index mechanism for efficient similarity search in metric spaces. To this end, each peer builds, for each of its objects *O* and for each considered multimedia feature F_i, different *feature indices*, in order to allow both multi- and single-feature queries. Each index exploits a *reference object* R_j^{Fi}, i.e. an object that is used to determine the position of other objects in a metric space. More precisely, it is a *k* binary vector $(b_0,\ldots,b_{k-1})$ which originates from a uniform partition of the distance between the object and the reference point $d(O.F_i, R_j^{Fi})$ into *k* intervals $[a_0,a_1),\ldots,[a_{k-1},a_k]$. The vector contains one bit $b_s = 1$ in correspondence with the interval $[a_s,a_{s+1})$ in which $d(O.F_i, R_j^{Fi})$ falls, 0s in all the other entries (e.g. see Fig. 3).

Then, considering the reference object R_j^{Fi}, each peer maintains a *global index* as the sum of the local indices associated with it (shown with dark background in the example of Fig. 4). Such an index shows how the peer's objects are distributed in the given intervals. Thus, it can be regarded as a histogram of a peer's objects feature distribution. Moreover, each peer also maintains *Multimedia Routing Indices (MRIs)* for each of its neighbors. Each MRI represents the aggregated description of the resources available in the subnetwork rooted at each neighbor

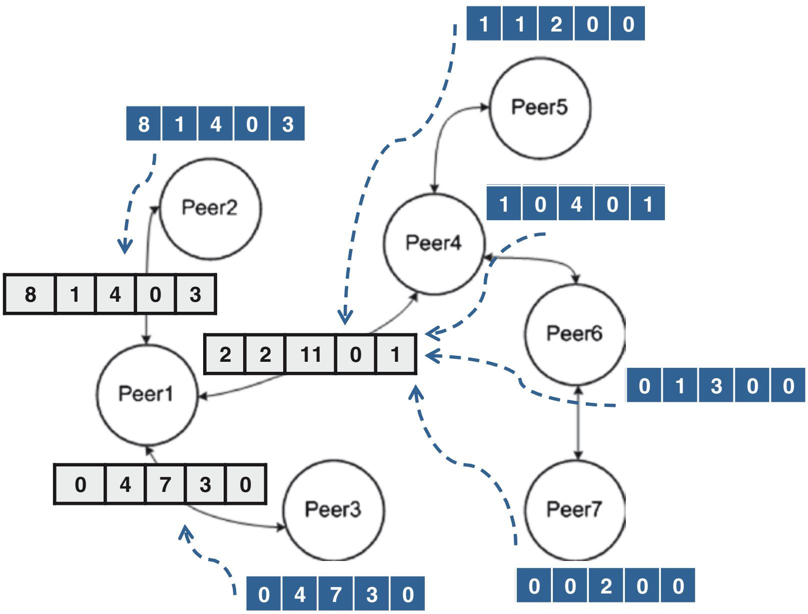


Fig. 4 Creation of Peer1's MRIs

and is built by summing up the global indices of the peers in the subnetwork (shown in light background in Fig. 4 for Peer1). More details on the process of construction and evolution of the MRIs can be found in [6].

When a query is issued to the network, the query object (i.e. the `LIKE` argument) is mapped into the same metric space, thus giving rise to as many bit vectors as the number of reference objects. Each peer that receives the query forwards it to the neighbors whose indices intersect the query ones. Further, since MRIs can be viewed as histograms, they allow peers to estimate the number of potentially matching objects in the neighbor's subnetwork. In particular, each neighbor is assigned a score in [0,1] reflecting that estimation and a ranking on the most promising directions can be computed. For example, going back to Fig. 4 and supposing the bit vector of the query w.r.t. reference object R_j^{Fi} is (0,0,1,0,0), the most promising neighbor for Peer1 would be Peer4.

Leveraging our experience on SRIs and MRoute, our final objective in the NeP4B Project is the development of an advanced routing mechanism that allows each peer to rank its own neighbors w.r.t. their ability to answer a given query both effectively (i.e. minimizing the information loss due to its reformulation along semantic mappings) and efficiently (i.e. minimizing the network load due to the exploration of useless subnetworks). At each query reformulation step, such a routing mechanism works by exploiting and properly combining the neighbor rankings computed by the two approaches. Indeed, when a peer p receives a query, both the SRI and MRoute approaches associate each p's neighbor a score in [0,1] quantifying the semantic

	SRI_{Peer1}	$MRoute_{Peer1}$	*min( )*
Peer2	0.65	0.38	0.38
Peer3	0.51	0.53	0.51
Peer4	0.48	0.76	0.48

Fig. 5 Peer1's scores for the sample query

relevance and the amount of potential matching objects in its subnetwork, respectively. These scores are homogeneous (i.e. graded in [0,1]) and can be combined by means of a meaningful aggregation function in order to obtain a unique ranking. In [7] it is stated that optimal aggregation algorithms can work only with monotone aggregation function. Typical examples of these functions are the min and mean functions (or the sum, in the case we are not interested in having a combined grade in the interval [0,1]).

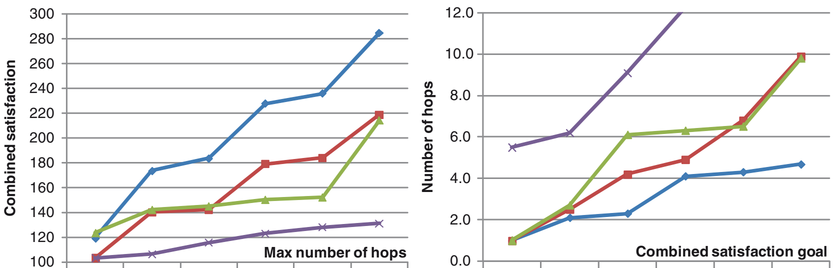
As an example of how the aggregation process works, let us go back to the sample query in Fig. 1 and suppose Peer1 obtains the scores in Fig. 5. The rankings computed by SRI and MRoute are thus Peer2-Peer3-Peer4 and Peer4-Peer3-Peer2, respectively. An example of straightforward aggregation function is the standard fuzzy conjunction *min(score1,score2)*. Thus, by using it, we compute the following final ranking: Peer3-Peer4-Peer2. As a result, the most promising subnetwork will be the one rooted at neighbor Peer3.

Notice that, in the computation, irrelevant subnetworks (i.e. subnetworks with a score of 0) can be safely pruned. The obtained ranking reflects the foreseen subnetworks ability in solving the received query both at schema (SRI-based information) and at multimedia (MRoute-based information) level and can thus be exploited in order to implement clever routing strategies like the ones proposed in [5].

Experiments

In this section we present an initial set of experiments we performed in order to evaluate our combined query routing approach. Notice that, since we are currently in the initial phase of our testing, the considered scenarios are not particularly complex; in the future we will enrich them with more complicated and larger ones. For our experiments, we exploited our simulation environments for putting into action the SRI [5] and MRoute [6] approaches. Through these environments we modelled scenarios corresponding to networks of semantic peers, each with its own schema, consisting of a small number of concepts, and a repository of multimedia objects. We chose peers belonging to different semantic categories, where the peers in the same category have schemas describing the same topic from different points of view and own multimedia data related to that topic. The schemas are distributed in a clustered way: This reflects realistic scenarios where nodes with semantically similar contents are often connected through semantic mappings. As to the multimedia contents, we use 1,300 images taken from the Corel Photo CDs and characterized by two MPEG-7 standard features: scalable color and edge histogram. We tested our techniques on different alternatives network topologies, randomly generated with the BRITE tool[10], whose mean size was in the order of few dozens of nodes. In order to evaluate the performance of our techniques we simulated the querying process by instantiating different queries on randomly selected peers and propagating them until a stopping condition is reached: We evaluated the effectiveness improvement by measuring the quality of the results (*combined satisfaction*) when a given number of *hops* has been performed or, in a dual way, the efficiency improvement by measuring the number of hops required to reach a given combined satisfaction goal. Combined satisfaction is a specifically introduced quantity which grows proportionally to the goodness of the results returned by each queried peer: Each contribution is computed by combining the semantic mapping scores of the traversed peers (satisfaction measure [3]) and the multimedia similarity scores of the retrieved objects. The search strategy employed is the depth first search (DFS). In our experiments we compare our neighbor selection mechanism based on a combination of SRIs and MRoute (*Comb*) with the two mechanisms which only exploit the SRI (*SRI*) and MRI (*MRI*) values and with a baseline corresponding to a random strategy (*Rand*). The employed aggregation function is the mean. Notice that all the results we present are computed as a mean on some query executions.

Figure 6 shows the trend of the obtained combined satisfaction when we gradually vary the stopping condition on hops (left) and the dual situation (right) where the number of hops required to reach a given satisfaction goal is measured. As we expected, both the *SRI* and the *MRI* strategies outperform the *Rand* one, but, as we can see, the winner is the *Comb* mechanism. In particular, the difference between *SRI* – *MRI* and *Comb* performance appears closer in the initial part of the graphs but becomes increasingly more significant at growing stop conditions. This means that *Comb* is indeed able to discriminate better subnetworks to explore and consequently increases the combined satisfaction and decreases the number of hops in a



	1	2	3	4	5	6
Comb	119,42	173,61	183,61	227,85	235,85	284,94
MRI	103,17	140,23	142,23	179,10	184,10	218,98
SRI	123,67	142,23	145,33	150,48	152,48	214,55
Rand	103,17	106,34	115,54	123,10	128,10	131,24

	100	125	150	175	200	225
Comb	1,0	2,1	2,3	4,1	4,3	4,7
MRI	1,0	2,5	4,2	4,9	6,8	9,9
SRI	1,0	2,7	6,1	6,3	6,5	9,8
Rand	5,5	6,2	9,1	12,3	15,2	17,7

Fig. 6 Obtained combined satisfaction for a given number of hops (left) and mean number of hops for a combined satisfaction goal (right)

[10] http://www.cs.bu.edu/brite/.

more substantial way. As an example of this behaviour, when we executed a query involving the concept Monument and a similarity constraint on an image of the Pisa tower, we observed that the *Rand* strategy worked by randomly selecting peers which were completed unrelated with the image and the concept required. On the other hand, the *SRI* strategy proceeded by firstly selecting some peers which have the concept Monument (and thus a very high SRI's score) but no image similar to the Pisa tower. Further, the *MRI* approach preferred some peers which store the images of some chimneys (whose multimedia features were very similar to the Pisa tower's ones) even if they were associated to the concept Factory. Only the *Comb* strategy was able to identify the best peers, i.e. the peers where the images of the Pisa tower are associated to concepts similar to the required one.

Conclusions

In this paper we presented our idea of query routing for the NeP4B Project which combines two strategies in order to answer queries both effectively and efficiently. The initial set of experiments we performed shows promising results. In the future we will deepen the testing of our techniques by using larger and more complex scenarios.

Acknowledgments This work is partially supported by the Italian co-funded FIRB Project NeP4B (Networked Peers for Business). http://dbgroup.unimo.it/nep4b

References

1. Arenas, M., Kantere, V., Kementsietsidis, A., Kiringa, I., Miller, R. J. and Mylopoulos, J. (2003). The Hyperion Project: From Data Integration to Data Coordination. *SIGMOD Record,* 32(3): 53–58.
2. Halevy, Y. A., Ives, Z., Madhavan, J., Mork, P., Suciu, D. and Tatarinov, I. (2004). The Piazza Peer Data Management System. *IEEE Transactions on Knowledge and Data Engineering (TKDE),* 16(7): 787–798.
3. Mandreoli F., Martoglia R., and Tiberio P. (2004). Approximate Query Answering for a Heterogeneous XML Document Base. In Proc. of the *5th International Conference on Web Information Systems Engineering (WISE)*: 337–351.
4. Mandreoli, F., Martoglia, R., Penzo, W. and Sassatelli, S. (2006). SRI: Exploiting Semantic Information for Effective Query Routing in a PDMS. In *Proc. of the 8th ACM CIKM International Workshop on Web Information and Data Management (WIDM):* 19–26.
5. Mandreoli, F., Martoglia, R., Penzo, W., Sassatelli, S. and Villani, G. (2007). SRI@work: Efficient and Effective Routing Strategies in a PDMS. In *Proc. of the 8th International Conference on Web Information Systems Engineering (WISE)*: 285–297.
6. Gennaro, C., Mordacchini, M., Orlando, S. and Rabitti, F. (2007). MRoute: A Peer-to-Peer Routing Index for Similarity Search in Metric Spaces. In *Proc. of the 5th International Workshop on Databases, Information Systems and Peer-to-Peer Computing (DBISP2P).*
7. Fagin, R., Lotem, A. and Naor, M. (2003). Optimal Aggregation Algorithms for Middleware. *Journal of Computer and System Sciences,* 66: 47–58.

User Realities and the Future of e-government Services

K. Kutsikos[1] **and G. Kontos**[2]

Abstract The focus of this paper is to provide a perspective on the next-generation of e-government services, by exploring what citizen needs are currently not covered and describe how these needs can be accounted for. We first describe certain e-government citizen adoption models, widely considered as the basis of development of the current generation of e-government services. Survey results are also presented, highlighting the level of user satisfaction relevant to the usage of such services. We then focus on certain new realities that affect adoption and further development of e-government services and describe how these realities can be addressed by a new service development model. The main properties of this model are presented and its differentiating characteristics are analyzed, from a systems theory perspective.

Introduction

E-government (electronic government) is increasingly a global phenomenon that is attracting the attention of a growing number of society participants – from politicians and businesses to ordinary citizens. As a scientific discipline, it is predicated on the capabilities offered by information technologies (IT) for delivering public services at local, national and international levels.

Beyond the focus on technology, e-government is an alternative and complementary approach to government administration and service delivery, as well as a means to redefine citizens' and private sector's participation in the government processes [1, 2]. Its success will be inevitably measured by how e-government services are adopted by citizens and how satisfied they are after using them. As a result, governments across the globe have adopted different e-government citizen adoption models for implementing their digital agendas. Interestingly, initial survey results on user satisfaction are rather disappointing: not only citizens tend to prefer

[1] University of the Aegean, Chios, Greece, kutsikos@aegean.gr
[2] University of the Aegean, Chios, Greece, g.kontos@aegean.gr

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_5,

offline channels for dealing with government agencies but even when they do use e-government services, their usage is mostly related to information retrieval.

The focus of this paper is to provide a perspective on the next-generation of e-government services, by exploring what citizen needs are currently not covered and describe how these needs can be accounted for. We first describe certain e-government citizen adoption models, widely considered as the basis of development of the current generation of e-government services. Survey results are also presented, highlighting the level of user satisfaction relevant to the usage of such services. We then focus on certain new realities that affect adoption and further development of e-government services and describe how these realities can be addressed by a new service development model. The main properties of this model are presented and its differentiating characteristics are analyzed, from a systems theory perspective.

E-Government Service Usage Today

The usage and user satisfaction stemming from the consumption of e-government services is directly related to two key parameters: (a) the capability of citizens to consume such services, given that the digital divide (especially, the educational and access-related aspects of IT) remains a key challenge for many governments across the globe; (b) the capability of government agencies (local, national, trans-national) to exploit information technologies and offer user-centric digital services.

These parameters point towards a piecemeal implementation of e-government services. Academics, practitioners and public sector agencies researching this field are modelling usage of e-government services in stages of increasing complexity of citizen interaction with digital services.

As a result, a large number of stage models have been proposed to date. Table 1 depicts certain widely adopted ones.

These models share the same goal of modelling how citizens can be guided towards an expansive adoption of e-government services. This is achieved through

Table 1 E-government user participation models

Author	Model	Year
Baum and Di Maio	Four-stage model	2000
United Nations	Five-stage model	2001
Deloitte Touche Tohmatsu	Six-stage model	2001
Layne and Lee	Four-stage model	2001
Hiller and Erlanger	Five-stage model	2001
Koh and Prybutok	Three-rings model	2002
Wauters and Van Durme	Four-stage scoring framework	2003
Siau and Long	Five-stage model	2004
Andersen and Henriksen	Public sector process rebuilding model	2005
Davison, Wagner and Ma	Transition model	2005
Goldkuhl and Persson	E-diamond model	2006

clearly defined stages of increasing complexity in citizen interaction with such services. The first stage usually refers to the simple consumption of governance information while higher stages point towards usage of integrated services provided by interconnected public agencies.

The Koh and Prybutok model is a typical one [3]. It categorizes the use of e-government services along three fundamental rings: informational usage, transactions and processes.

Ring 1 – Informational usage. Citizens can receive information through the Internet that is related to public services, as well as communicate with government agencies.

Ring 2 – Transactions. Citizens have online visibility of the procedural steps of their interaction with public services and can engage in value-adding services such as electronic payments. This stage implies that a strong online privacy and authentication infrastructure is in place.

Ring 3 – Processes. Citizens can directly engage with government agencies' processes, thus creating service provision networks that may involve the public sector, the private sector and citizens.

This model is also recognized as a reference framework for the use of IT within public sector. It aims to help government agencies map out the organizational elements that need to be addressed, as e-government services move from simple offering of web pages filled with static information, to a one-stop portal that provides (or is a gateway to) a number of digital services for e-governance users.

User Satisfaction Statistics

Many countries in the international e-government landscape have attempted to implement e-government citizen adoption models, such as those described earlier. Governments find themselves looking for the strategies that will drive high performance (better outcomes in a more cost-effective manner) and propel them towards the ultimate goal of e-government: whole-of-government service transformation together with the transition from the bureaucratic model to a flexible e-government model. In some cases, services have been transformed and improved so radically that old service models tend to disappear, while significant value is created. For example, a recent report from the UK National Audit Office [5] revealed that 20% of postal applications to the UK's Cattle Tracing System were inaccurate. The result has been that the UK Department for the Environment, Food and Rural Affairs has paid UK£9 million each year since year 2000 in extra staffing costs to rectify the errors. In contrast, the National Audit Office found that only 1% of electronic requests were inaccurate. As a result, the Department for the Environment, Food and Rural Affairs has called for more electronic applications to reduce mistakes, cut the number of extra staff required to correct errors and avoid potential fines from the European Union.

However, in 2005, Eurostat published survey results on the interaction of European businesses and citizens with e-government services [7].

An average of 51% of enterprises with Internet access interacted with public authorities for obtaining information. An average of 46% of enterprises downloaded forms from government websites but only 32% of them submitted (or were able to submit) completed forms. The report notes that few enterprises among the EU-25 have been involved in a "two way interaction" with public sector entities. This is probably caused by the lack of public services available online as well as the insufficient development of those which are online.

In terms of citizens' use of e-government services, an average of 45% of Internet users at European Union level obtained information online, while 20% of them downloaded official forms on such matters as income taxes, car registration, personal documents or certificates. An even smaller percentage (12%) file completed forms online. Based on these figures, the report concludes that most citizens interact online with public agencies mostly for obtaining forms and not for establishing a two way interaction with a government agency.

Equally disappointing are the findings from the "eCitizenship for All – European Benchmarking Report" [8], issued by Deloitte Touche Tohmatsu in 2005. The survey was contacted in 48 cities covering 18 European Union countries.

A key finding relates to user preferences for accessing government services. It appears that the traditional counter is still the most intensively used channel (receiving a rating of 4.0/5), closely followed by phone services (3.9/5). The Internet is the third preferred channel (3.6/5), slightly more intensively used than the postal service (3.4/5). The low level usage of online channels indicated that: (a) users are not satisfied enough to abandon the more traditional channels; (b) the usage of online channels seems to be limited to information retrieval.

From 'Now' to 'Next'

The survey results described in the previous section, point to a rather disappointing finding: no matter which citizen adoption model governments have implemented, current e-government services are accessed by users mostly for first-stage services, i.e. information retrieval. The underlying message is that citizens largely failed: (a) to experience tangible benefits from current e-government services, and (b) to differentiate them from their offline siblings. This may potentially lead to mistrust of citizens towards e-government services: from their perspective, many of these services have been implemented neither with them in mind nor for the benefit of the greater civil society but for the convenience and own bureaucratic goals of the government agencies themselves

At the same time, new realities emerge [9]. Civil society and corporations are now more involved in governance. The private sector, from individual corporations to entire industries, is increasingly focused on competing in a global economy where borders and national laws are seen as irrelevant or hindrances. Civil society - the collection of associations, trade unions, religious and cultural institutions, advocacy groups and people as individuals – is using network-based technologies to communicate and collaborate in ways previously unimaginable. Together, these actors are redefining the nature of public services. For example, civil society organizations, such as the group that created the US environmental initiative Scorecard, are providing new information services that are superior to those currently offered by government.

We note that the above realities exhibit the following characteristics: (a) on the demand side, users of e-government services have additional needs, desires and priorities to those captured by current e-government citizen adoption models; (b) on the supply side, responsibility for public service provision is distributed to multiple entities and "public" value no longer needs to be provided by government alone. It can be provided through a system comprised of various public agencies, the private sector, community groups, or citizens themselves, using communications networks as a mechanism for process management and conducting transactions.

The key issue in such a 'new world' will be the management of its intrinsic complexity, which stems from its collaborative nature: large numbers of heterogeneous components that exhibit a high degree of collaboration through interconnections, relationships and dependencies. Our research aims to model this complexity by applying lessons learnt on similar issues from other disciplines, such as Systems Science. In particular, we have based our work on the Viable Systems Model (VSM) which describes cross-organizational collaboration as a cybernetic control system, whose mission is to remain viable by ensuring stability in response to changes in its environment [10, 11, 12].

The major characteristic of VSM is the modeling of systems as recursive structures: every viable system contains and is contained in another viable system. Hence, collaboration in such an environment is expressed by interconnections among components built through recursion and hierarchy. A simplified diagram of a viable system is shown in Fig. 1.

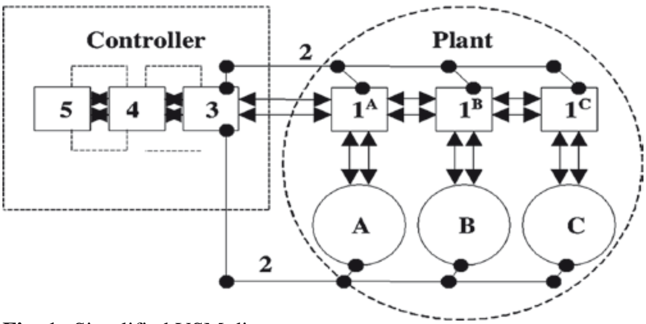


Fig. 1 Simplified VSM diagram
The numbered boxes and circles have the following function/role in the Viable System Model:
5: Executive: steering and policy; external interface.
4: Planning: anticipation of change caused by external environmental disturbances.
3: Operations: concerned with direct operation of the Plant.
2: Regulation: audit and inspection.
$1^{A\text{-}C}$: Controllers at the next level of recursion. A-C: Plants.

Developing the Next Generation of e-Government Services

In VSM, managing the complexity of collaboration is based on two key principles: adaptation and autonomy.

Adaptation is the ability of a system to acquire new components and discard others. This ability may range from simple maintenance of the current system structure to a continuous recalibration of the collaboration links, through restructuring of the system's components.

Autonomy corresponds to the degree of freedom that system controllers have, in terms of decision-making and adaptation. It is often specified via policies that grant permissions for different activities. Hence, autonomy may range from centralized control of the system's structure to fully distributed/localized decision making.

We believe that the future of e-government services will be driven by a balancing act between the above parameters. Our theoretical research and prior experience from our personal involvement in the development of e-government services in the UK has led us to the development of a three-stage model (shown in Fig. 2) that accounts for these characteristics. In this model, e-government services differentiate along two dimensions: Service Providers' Distribution, and Cross-Entity Collaboration.

In terms of Service Providers' Distribution (VSM's Autonomy principle), a Low value indicates that a small number (one or two) of statically contracted entities are involved in the development/provision of an e-government service. A High value indicates that responsibility for such service provision lies with a dynamically changing large group of organizations.

In terms of Cross-Entity Collaboration (VSM's Adaptation principle), a Low value indicates that collaboration among involved entities is limited to mostly

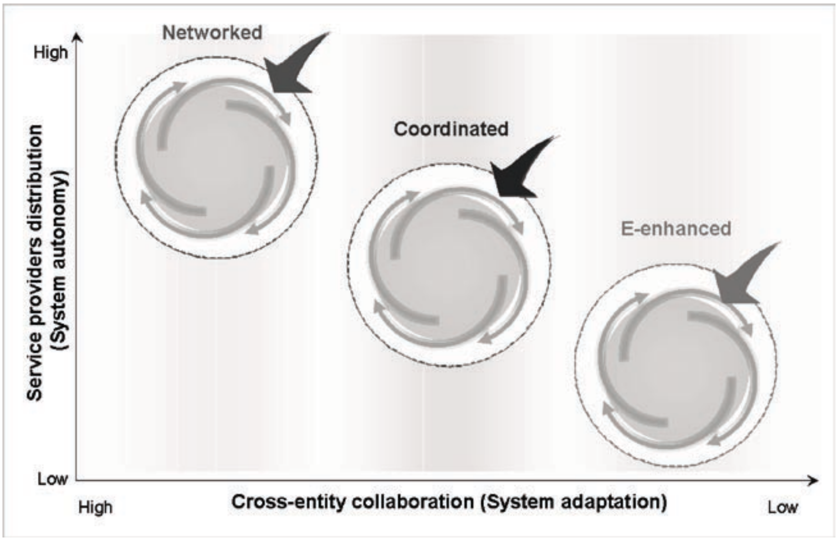


Fig. 2 Our e-government service transformation model

communication tasks for developing the e-service. In contrast, a High value points to the direction of market-like interactions among service providers.

Based on the above, we can group e-government services that correspond to our model in three major levels: E-enhanced services, Coordinated services, and Networked services.

E-enhanced services are under the exclusive auspices of a public sector organization. Usually, a small number of technology firms are contracted for a support role and for infrastructure development. The main focus is on mapping existing processes and organizational structures on the digital realm. Many of the current generation e-government services are of this type.

For delivering Coordinated e-government services, a lead entity (most often but not necessarily from the public sector) coordinates a larger but controlled group of government agencies, businesses and/or civil society groups in order to offer a single point of service. Collaboration among the participating entities is guided and prescribed, and may involve limited cross-entity process reengineering.

In Networked services, a large group of organizations (of any type) is participating in the development of the service and such participation can be dynamic and market-like. Cross-entity collaborative processes are in place, data standards have been adopted and there is ubiquitous application-level integration among all involved entities. E-government services of this type are most effectively developed when there is a sense of community among the distributed service providers and a culture of knowledge sharing and consensus can be established.

Conclusions and Future Work

The lackluster results from the first wave of e-government services, along with technological and socio-political developments of the recent years, are creating new realities for public service provision and the related design of e-government services. These realities point to a new direction of how governments will need to operate from now on and turn the spotlight on our twin concept of 'distribution – collaboration': (a) distribution of public service provision to multiple entities (which may not be public sector organizations), and (b) collaboration of multiple organizations for delivering public services.

Our research aims to address the complexity management issues of these new realities. Beyond the first-phase outcomes described in this paper, we are following a number of directions in order to fully develop our model. A key, relevant to the evaluation of the practical implications of our propositions, is the development of a service implementation model. Its main goal will be the understanding of critical deployment issues of next generation e-government services, for each level of our model. The development and testing of the service implementation model will be benefited by a parallel project for the design of an e-government service dealing with the issuance of building permits in Greece (this is a Coordinated service, as per our model).

References

1. Grant, G. and D. Chau (2005) Developing a Generic Framework of E-Government, *Journal of Global Information Management* 13(1): 1–29.
2. UNDESA (2002) Plan of Action – E-government for Development, Paper Prepared for the International Conference on e-Government for Development, April 10–11, 2002, Palermo, Italy.
3. Koh, C.E. and V.R. Prybutok (2003) The Three Ring Model and Development of an Instrument for Measuring Dimensions of E-Government Functions, *Journal of Computer Information Systems* (43)3: 34–39.
4. Siau, K. and Y. Long (2005) Synthesizing E-Government Stage Models – A Meta-Synthesis Based on Meta-Ethnography Approach, *Industrial Management and Data Systems* (105)4: 443–458.
5. Accenture (2005) eGovernment Leadership: High Performance, Maximum Value, Fifth Annual Survey – Executive Government Series, Accenture, New York, USA.
6. Burn, J. and G. Robins (2003) Moving towards eGovernment: A Case Study of Organisational Change Processes, *Logistics Information Management* (16)1: 25–35.
7. Eurostat (2005) e-Government 2004 – Internet Based Interaction with European Businesses and citizens, Statistics in Focus, n. 35.
8. Drewes, R. & M. Paulissen (2005) eCitizenship for All – European Benchmark Report, prepared by Deloitte Touche Tohmatsu for the EUROCITIES Knowledge Society Forum – Telecities, Liverpool, UK.
9. Tapscott, D. (2004) E-government in the 21st Century, Executive Series Report, New Paradigm Learning Corporation, Ontario, Canada.
10. Beer, S. (1981) *Brain of the Firm*, Chichester, Wiley.
11. Beer, S. (1985) *Diagnosing the System for Organizations*, Chichester, Wiley.
12. Herring, C. and S. Kaplan (2000) The Viable System Architecture, *Proceedings of the 34th Hawaii International Conference on System Sciences*.

Value Assessment of Enterprise Content Management Systems: A Process-oriented Approach

J. vom Brocke[1], A. Simons[2], C. Sonnenberg[3], P.L. Agostini[4], and A. Zardini[5]

Abstract Organisations are facing an incredibly increasing amount of content to be efficiently captured, organised and archived. As a result, Enterprise Content Management (ECM) has emerged as a top business priority during the past years. However, only a few academic reports present common guidelines for evaluating and justifying the choice for a certain ECM solution in terms of economic benefits. This paper is based on the perception that such guidelines particularly should take an organisation's business process structure into account, since an ECM adoption causes significant changes in work procedures. Consequently, we consider an established business process-oriented framework for profitability analysis of IS and apply it to the context of ECM. An application example serves as an illustration of the concept.

Introduction

Nowadays, organisations are more and more confronted with the challenge of efficiently organising the huge amount and diversity of digital information accessed and used within their business processes. As a result of this steadily increasing digital information flood [1], companies are in great need of concepts and technologies that support the management of their digital information assets [2]. A promising approach is represented by ECM – a relatively young field in Information Systems (IS) research [3–6]. ECM has been defined as the "strategies, tools, processes, and skills an organisation needs to manage all its information assets […] over their

[1] University of Liechtenstein, Vaduz, Liechtenstein, jan.vom.brocke@hochschule.li
[2] University of Liechtenstein, Vaduz, Liechtenstein, alexander.simons@hochschule.lit
[3] University of Liechtenstein, Vaduz, Liechtenstein, christian.sonnenberg@hochschule.li
[4] Università Cattolica di Milano, Milano, Italy, pietroluca.agostini@unicatt.it
[5] Università di Verona, Verona, Italy, alessandro.zardini@univr.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_16, © Springer Physica-Verlag Berlin Heidelberg 2010

lifecycle" [7]. That being said, the term "ECM" subsumes all kinds of digital information, e.g. documents, web content, and graphics. However, e-mails and even telephone calls can also be part of an integrative ECM implementation. On the one hand, ECM aims at efficiently administering content, e.g. by reducing search times or ensuring the quality and consistency of content. On the other hand, ECM also seeks to meet legal and contractual requirements, e.g. referring to archiving constraints. It is undisputed that ECM plays an important role for an effective knowledge management [8] and a sustainable information management [9]. Therefore, it is not surprising that the market for ECM software is rapidly growing. ECM vendors provide holistic systems subsuming established technologies such as Document Management (DM) or Web Content Management (WCM) systems. As a matter of fact, ECM systems (ECMS) are comprised of a huge number of technologies all supporting the administration of content in different ways. Due to this variety of applicable ECM technologies, organisations are not only confronted with the challenge of implementing the most appropriate solution(s), but also with justifying the choice of a certain solution in terms of its economic benefits. This calls for an approach which provides the means for assessing the economic value of an ECMS implementation. As prior work in the field of ECM underpins the importance of business processes for an ECM implementation [2,3], we present a valuation approach based on conceptual process models for analysing the economic consequences of adopting a particular ECM solution in terms of financial measures.

In the next section, we present the process-oriented evaluation framework for assessing the economic impact of IS implementations. Subsequently, we apply it to the context of a fictitious and exemplary ECM adoption. We finally conclude with a short summary and point out topics for future research in this particular field.

Measuring the Financial Performance of Business Processes

The proposed measurement system distinguishes three levels of evaluation: the operational level (1), the budgeting level (2), and the corporate level (3) (cf. Fig. 1 and [10] in the following). The operational level serves to collect relevant payments associated with a specific process design. The economic value of these payments is subsequently evaluated on the budgeting and corporate level. The budgeting level aggregates payments of process designs over time and the corporate level condenses the data to key performance indicators that can form the basis for decision-making. (1) The operational level provides the foundation for the entire evaluation of the financial performance of a process design (specified by means of process models, e.g. Event-driven Process Chains; EPC). On this level, payments (out-payments) and receivables (in-payments) are calculated. They can directly be assigned to decisions regarding the process design (consider, for instance, payments driven by the process performance). Obviously, these payments – or cash flows (CF) – considered to be relevant in a specific situation may vary according to different decision situations. Research in the field of value-based business process

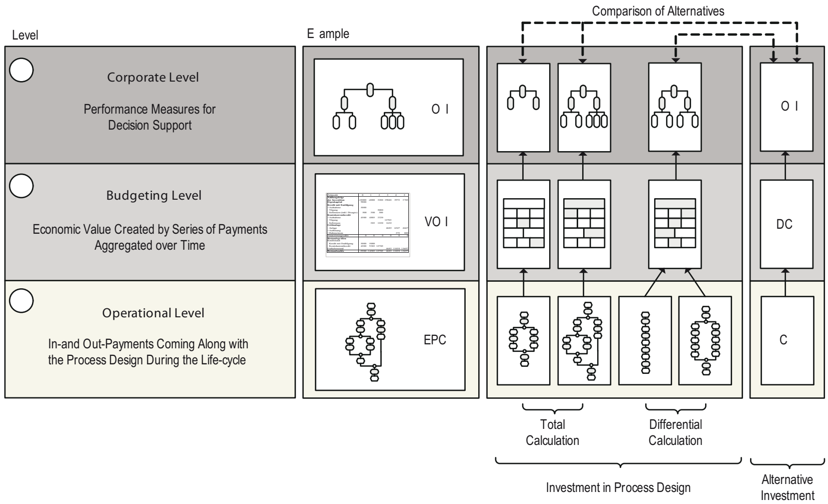


Fig. 1 Framework for measuring the financial performance of business processes

management focuses on the analysis of typical measurement patterns on the operational level to be selected and used within a specific decision situation [11]. (2) On the budgeting level, additional parameters are taken into account for calculating the economic value created by the respective series of payments on the operational level. Relevant parameters are derived from specific conditions of funding and tax obligations that a company has to meet. These series of payments are consolidated over time by applying methods of capital budgeting (e.g. the Discounted Cash Flow (DCF) method) [12,13]. In particular, the method of "Visualisation of Financial Implications" (VOFI) can be applied here [14]. Using VOFI, the financial consequences of long-term decisions are structured and calculated by means of spreadsheets that can serve as a database for further analysis of financial implications. (3) Finally, on the corporate level, the profitability of a process design and execution has to be judged by condensing the aggregated economic process data into key performance indicators (e.g. the Return on Investment; ROI) [12,13,15].

The framework described is not restricted to the assessment of single business processes. In fact, it can be used to facilitate decision-making between different process designs. In comparing alternative process designs, two different approaches can be applied: a total and a differential calculation (cf. Fig. 1). According to a total calculation scheme, each process is measured independently. The comparison takes place on the corporate level by evaluating the performance measures for each design. This approach provides a high flexibility, as numerous alternatives can be compared. However, the effort of establishing precise value measurements for each design alternative is substantial. As for the differential calculation scheme, the idea is to focus on two alternatives at a time, appoint a reference alternative (e.g. the status quo) and take only those payments into account which additionally accrue when realising the second alternative (e.g. not the total but only the additional expenditure for the implementation of a to-be model, compared to the current state are reported). In this case, the comparison already takes place on the operational level, so that only one financial plan and set of measures is calculated on the budgeting and on the corporate level that represent the added value of one alternative compared to another. The differential approach, however, is limited to pair-wise design comparisons. When comparing more then two alternatives, the amount of comparisons to be assessed grows exponentially. Following either of the two approaches, the resulting measures should be compared with those resulting for alternative allocations of internal funds (the ‘opportunity’).

Referring to the budgeting and corporate level, there is a multitude of well-established measurement systems [12,13,15]. The framework is designed to integrate these methods from financial management into the context of process re-design [10]. This allows for the measuring of the financial implications of individual process designs. In doing so, however, one major challenge is to find relevant in- and out-payments on the operational level. Thus, in the following, we focus on the calculation of out-payments within business processes. Therefore, input factors for both consumption and usage have to be distinguished. Factors of consumption are objects that are consumed by functions. Factors of usage (also referred to as processors), however, are objects of input that serve as resources for processing a function. The concept of calculating out-payments based on these factors is shown in Fig. 2, using the EPC [16]. Out-payments of a function are assembled by payments for the required objects of usage as well as the objects of input that were consumed in the execution of the function. The approach assumes that the pay-

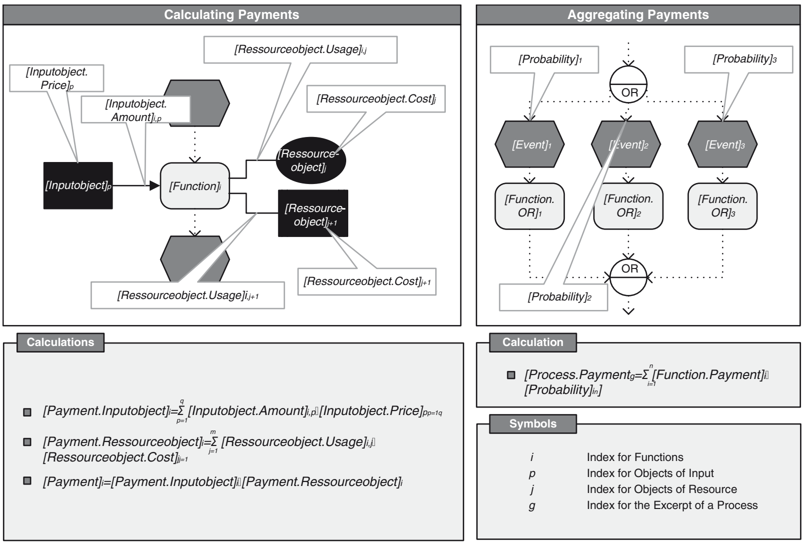


Fig. 2 Principles for calculating and aggregating payments associated with a process design

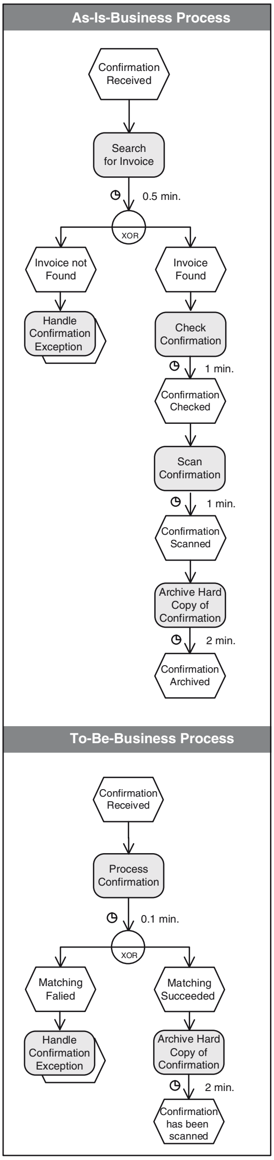
ments are aggregated per period so that they capture the operational inventory. In order to calculate objects of input, the amount (and type) of the objects applied in the function have to be accounted for. In order to assess out-payments, the amounts have to be multiplied by the cost per unit. The payment for objects of usage is calculated according to the frequency-of-utilisation principle. This procedure is similar in application to the procedure of activity-based costing [17]. That is, the percentage of resource-utilisation of a function is calculated. For this calculation, resource-utilisation is defined as a percentage or relation between resource units that are used by a certain function and the total sum of all units provided by this resource. Payments related to functions have to be aggregated for each specific process and each period within the planning-horizon. In the case of process branches in which an alternative processing takes place, the probability of branches has to be considered. In order to investigate the probability, relative frequencies can be estimated in which events re-occur when instantiating the process multiple times.

In the next section, we present a simplified application example of the framework that has been derived from a real-life ECM implementation project. However, due to the confidentiality of the underlying process structures, we only use fictitious data and refer to a nonexistent oil company called StarOil.

Exemplary Application

StarOIL operates several petroleum refineries spread around the globe and delivers its petroleum to a mayor oil corporation, called Energy. In the status-quo, all invoices from StarOIL are sent to Energy in paper format. After the invoice has been processed by Energy, confirmation is sent back to StarOIL via postal mail. Just recently, Energy has developed an e-invoicing application offering financial services to its suppliers, enabling them to electronically forward their invoices and receive the booking confirmations via Electronic Data Interchange (EDI). Efficiency improvements within related accounting processes are expected for both Energy as well as its suppliers due to a significant reduction in out-payments for postal mailings as well as a higher degree of automation. However, StarOIL is currently not able to participate in the e-invoicing initiative, as it lacks sufficient digital information processing capabilities. Accordingly, StarOIL just recently set up an internal ECM initiative. Therefore, a pilot project has been scheduled within the accounting department. For justifying the choice of a certain ECM solution in terms of economic benefits, StarOIL has started the project by analysing whether the expected savings earn the anticipated investments. Therefore, the process structure of the accounting department was analysed first (cf. Fig. 3 for an exemplary process "Process Invoice Confirmation").

For each activity of both the as-is- and the to-be-process, individual lead times and cost charges have been specified. Since the to-be-process is designed to be supported by the ECMS, the activities "Search for Invoice" and "Check Confirmation"



Period of Time	0	1	2	3
As-Is-Business Process				
Activities				
Search for Invoice				
Lead Time (Min.)		0.5	0.5	0.5
* Employee Cost Charge ($)		40	40	40
= Payments per Execution ($/Min.)		20	20	20
Check Confirmation				
Lead Time (Min.)		1	1	1
* Employee Cost Charge ($)		40	40	40
= Payments per Execution ($/Min.)		40	40	40
Scan Confirmation				
Lead Time (Min.)		1	1	1
* Employee Cost Charge ($)		40	40	40
= Payments per Execution ($/Min.)		40	40	40
Archive Hard Copy of Confirmation				
Lead Time (Min.)		2	2	1
* Employee Cost Charge ($)		40	40	40
= Payments per Execution ($/Min.)		80	80	40
= Out-Payments per Process Execution ($)		180	180	180
*** Frequency of Process Execution**		3'000	3'300	3'630
= Direct Out-Payments of Process Execution		**540'000**	**594'000**	**653'400**
To-Be-Business Process				
Activities				
Process Confirmation				
Lead Time (Min.)		0.1	0.1	0.1
* Employee Cost Charge ($)		40	40	40
= Payments per Execution ($/Min.)		4	4	4
Archive Hard Copy of Confirmation				
Lead Time (Min.)		2	2	2
* Employee Cost Charge ($)		40	40	40
= Payments per Execution ($/Min.)		80	80	80
= Out-Payments per Process Execution ($)		84	84	84
*** Frequency of Process Execution**		3'000	3'300	3'630
= Direct Out-Payments of Process Execution		**252'000**	**277'200**	**304'920**
Savings		**288'000**	**316'800**	**348'480**
Overall Series of Payments				
Savings		**288'000**	**316'800**	**348'480**
Investment in ECM Solution				
Software	100'000			
+ Hardware	25'000			
+ Training	25'000			
+ Contracting	5'000			
+ Consulting	50'000	20'000		
+ Licensing		15'000	15'000	15'000
+ Support and Maintenance		10'000	10'000	10'000
– = ECM Payments	205'000	45'000	25'000	25'000
Implementation of Processing Functionality				
Development	50'000			
+ Testing	10'000			
+ Maintenance		5'000	2'000	1'000
– = Payments for Customizing	60'000	5'000	2'000	1'000
Total Payments of ECM Adoption	**–265'000**	**238'000**	**289'800**	**322'480**

Fig. 3 Exemplary measurement of payments ("process invoice confirmation")

are automatically executed and combined into a new activity "Process Confirmation." Due to legal restrictions, hardcopies of received confirmations still need to be archived. By applying the principle of differential calculation (cf. the previous section), additional savings from the ECM pilot project have been calculated. Therefore, the out-payments of the to-be-process have been subtracted from the out-payments of the as-is-process. In addition to these savings (resulting from the execution of the to-be-process activities), further out-payments have to be considered which can be charged to infrastructure investments (e.g. hard- and software, employee training, or consultancy) and to the implementation of the processing functionality (e.g. testing or maintenance). On the operational level, both additional savings and required out-payments are summed up to an overall series of payment.

This series of payments has been aggregated for a planning horizon totalling three years on the budgeting and on the corporate level. As for the economic value of this exemplary process, a positive financial performance has been reported: The final value amounts to 153,856 $ and the ROI amounts to 13.76% (both measures derived from a corresponding VOFI spreadsheet). However, as the scope of the analysis was restricted to this single business process, both the positive final value and the ROI observed in this example may be misleading. Taking into account multiple processes and additional investments, the superior profitability of the ECM project may decrease.

Summary and Outlook

In this paper, we applied an established framework for IS profitability analysis [10] to assess the economic value of ECMS. Business processes are considered to play a vital role for an ECM adoption and, accordingly, the chosen framework is primarily based on business process analysis. Therewith, we intend to contribute to a field of research that has received only little attention in the IS discipline so far – ECM [3]. In order to illustrate the practical applicability of the framework in the context of ECM, a fictitious and simplified example has also been presented. The exemplary application showed that the framework may serve as a suitable means for assessing the ROI of an ECM implementation and its impact on business process efficiency. Currently, the framework is applied to an ECM implementation project of a large-scale international enterprise. Therewith, we intend to gain a deeper insight into its applicability in the context of ECM. Furthermore, we are working on the development of a framework for content analysis, a modelling technique for specifying an organisation's individual content situation, and reference processes for ECMS implementation – fields that may also contribute to the assessment of the economic value of ECMS.

References

1. Frank, U. and H. Schauer (2001) Potentiale und Herausforderungen des Wissensmanagements aus Sicht der Wirtschaftsinformatik, Schreyögg, G. (ed.) Wissen in Unternehmen: Konzepte – Maßnahmen – Methoden, Erich Schmidt Verlag, Berlin, 163–164, in German.
2. vom Brocke, J., Simons, A. and Cleven, A. (2008) A Business Process Perspective on Enterprise Content Management – Towards a Framework for Organisational Change, Proceedings of the 16th European Conference on Information Systems, Galway, Ireland.

3. Tyrväinen, P., Päivärinta, T., Salminen, A. and Iivari, J. (2006) Characterizing the evolving research on enterprise content management, *European Journal of Information Systems*, 15(6): 627–634.
4. O‘ Callaghan, R. and M. Smits (2005) A Strategy Development Process for Enterprise Content Management, Proceedings of the 13th European Conference on Information Systems, Regensburg, 1271–1282.
5. Reimer, J.A. (2002) Enterprise Content Management, Datenbanken Spektrum, 2(4): 17–35.
6. Rockley, A., Kostur, P. and Manning, S. (2003) Managing Enterprise Content: A Unified Content Strategy, New Riders, Berkeley, CA.
7. Smith, H.A. and J.D. McKeen (2003) Developments in Practice VIII: Enterprise Content Management, *Communications of the AIS*, 11(33): 1–26.
8. Davenport, T.H. and L. Prusak (2000) Working Knowledge: How Organizations Manage what they know, 2nd Edition, Harvard Business School Press, Boston, MA, USA.
9. Päivärinta, T. and B.E. Munkvold (2005) Enterprise Content Management: An Integrated Perspective on Information Management, Proceedings of the 38th Hawaii International Conference on System Sciences (HICCS’05), IEEE Computer Society, Big Island, HI, USA.
10. vom Brocke, J. (2007) Service Portfolio Measurement, Evaluating Financial Performance of Service-Oriented Business Processes, *International Journal of Web Services Research (IJWSR)*, 4(2): 1–32.
11. vom Brocke, J., Sonnenberg, C. and Thomas, O. (2008) Towards an Economic Justification of Service Oriented Architectures. Measuring the Financial Impact, Proceedings of the 14th Americas Conference on Information Systems, Toronto, Canada.
12. Seitz, N. and M. Ellison (2004) Capital budgeting and long-term financing decisions, 3rd Edition, Gale Group, Farmington Hills, MI.
13. Shapiro, A.C. (2004) Capital Budgeting and Investment Analysis, Upper Saddle River, NJ, Prentice Hall.
14. Grob, H.L. (1993) Capital Budgeting with Financial Plans, an Introduction, Galber, Wiesbaden.
15. Gartner Group (2003) A Report and Estimating Tool for K-12 School Districts: Why Total Cost of Ownership (TCO) Matters, Gartner, Inc, Stamford, Connecticut.
16. vom Brocke, J., Mendling, J. and Recker, J. (2008) Value-Oriented Process Modelling. Towards a Financial Perspective on Business Process Redesign. Proceedings of the 14th Americas Conference on Information Systems, Toronto, Canada.
17. Sapp, R.W., Crawford, D.M. and Rebischke, S.A. (1998) Activity – Based Information for Financial Institutions, *The Journal of Bank Cost and Management Accounting*, 3(2): 53–62.

Virtual Enterprise Transactions: A Cost Model

A. D'Atri[1] **and A. Motro**[2]

Abstract A transaction is a bilateral exchange between two parties in which goods are delivered in return for payment. In virtual enterprise environments, transactions are the principal means of collaboration among the enterprise members, as well as the mechanism with which the enterprise provides its products to its external clients. In this paper we examine the concept of transactions in virtual enterprises. We define transactions as recursive processes (similar to supply chains), and we formalize the concept of transaction cost. We then examine transaction failure and transaction risk, which lead us to the concept of transaction expected loss. The overall goal is to allow enterprise members to launch those transactions that minimize their expected losses. We also discuss how initiating redundant transactions can further reduce expected losses.

Introduction and Background

A transaction is a bilateral exchange between two parties in which goods are delivered in return for payment. In a virtual enterprise environment, transactions are the mechanism with which the enterprise provides products to its external clients. Such transactions are termed *external* transactions. To fulfill an external transaction, the contracted enterprise member may procure necessary products from other members of the enterprise. These exchanges are termed *internal* transactions. The supplier of an internal transaction may, in turn, initiate other internal transactions (termed subtransactions). Altogether, the execution of an external transaction is a *distributed* effort of a group of enterprise members.

In this paper we examine the concept of transactions in virtual enterprises. We begin by defining transactions as recursive processes (similar to supply chains), and then we formalize the concept of transaction cost. Later on we examine transaction failure and transaction risk, which lead us to the concept of transaction expected loss,

[1]Università LUISS Guido Carli, Roma, Italy, datri@luiss.it
[2]George Mason University, VA, USA, ami@gmu.edu

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_20, © Springer Physica-Verlag Berlin Heidelberg 2010

described afterwards. The overall goal is to allow enterprise members to launch those transactions that *minimize their expected losses*. We also discuss how initiating redundant transactions can further reduce expected losses. This effort is within the framework of the VirtuE model for virtual enterprises that we defined in earlier works [3].

The concept of transaction has been discussed extensively in economics and related disciplines (business, banking, etc.); and (with a considerably different interpretation) in computer applications such as database systems [5] or workflow systems [6]. In the area of virtual enterprises [2], the VirtuE model introduced a concept of transaction that combines elements from both distributed database systems and economics. In other words, it used the structures of computer transactions to implement concepts borrowed from economics. The work here continues in this vein, with the introduction of a cost model. This cost model, which borrows concepts from transaction cost theory (for example, search and information cost [7]), enables us to discuss formally concepts such as transaction failure, transaction risk, and transaction expected loss – in virtual enterprise environments.

Transaction Model

A *transaction* is a bilateral exchange between two parties in which goods are delivered in return of payment. The party initiating the transaction, requesting the goods and providing the payment is the *client*; the party responding to the request, providing the goods and receiving the payment is the *supplier*. Transactions consist of distinct phases, and in this paper we shall assume transactions have three phases: (1) *order* is the request by the client to the supplier that describes the goods needed; (2) *manufacturing* is the phase in which the supplier prepares the goods; and (3) *fulfillment* is the delivery of the goods by the supplier to the client. Thus, orders initiate transactions, and fulfillments conclude them.

In a virtual enterprise environment, transactions are the mechanism in which the enterprise provides products or services to its clients. In the virtual enterprise environment described in VirtuE [1], such transactions are termed *external* transactions. To fulfill an external transaction, the enterprise member may procure necessary products or services from other members of the enterprise. These exchanges are termed *internal* transactions. In an internal transaction both the client and the supplier are members of the enterprise. The supplier of an internal transaction may, in turn, initiate other internal transactions. Altogether, the execution of an external transaction is a *distributed* effort of a group of enterprise members.

As described in VirtuE,[3] when receiving orders (in either internal or external transactions), enterprise members consult two resources to determine how to respond to the transaction. These resources help the member determine *what is needed* to fulfill the order, and *how to obtain it*.

[3] VirtuE considers goods that are either products or services. For simplicity, and without loss of generality, we shall assume here goods that are products.

1. *What is needed: production plan*. A production plan is a local resource that enumerates the products that the member must procure from other enterprise members to manufacture a given product.[4] Note that a given product may have multiple (alternative) production plans.
2. *How to obtain it: the product catalog*. The product catalog is an enterprise-wide resource in which members advertise the products that they supply. Each record in this catalog describes a product, a supplier of the product, and additional information, notably the price.

Once the member decides on the production plan and selects the suppliers of the necessary component products, it launches a set of transactions to procure these components. When these transactions have been fulfilled, the member can assemble the product and deliver it to the client. A transaction is therefore a recursive process. We assume that the process *terminates* with transactions that procure *primitive* products: products whose manufacturing does not require importation.

Transactions can be illustrated with tree diagrams, in which nodes represent manufacturing of products by suppliers, and edges indicate initiation of sub-transactions. In a transaction tree the root node models the manufacturing of the ultimate product (the product ordered by the external client), internal nodes model the manufacturing of component products, and leaf nodes model the manufacturing of primitive (import-free) products. Each transaction is assumed to have a unique identifier, which is assigned to the manufacturing node. A simple transaction tree is shown Fig. 1. In this example, an external client submits a transaction t_0 to order product p_0 from member m_0. To fulfill this order, m_0 submits two sub-transactions: t_1 orders product p_1 from member m_1, and t_2 orders p_2 from m_2. m_1 fulfills t_1 locally; but m_2 submits two additional sub-transactions: t_3 orders p_3 from m_3, and t_4 orders p_4 from m_4. Both m_3 and m_4 fulfill their orders locally.

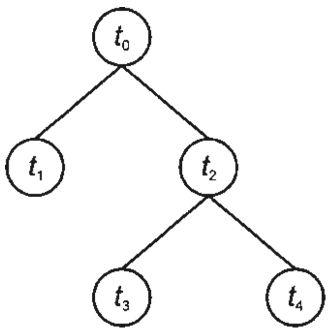


Fig. 1 A transaction tree

[4] VirtuE's production plans consider also component parts that are available to this member locally. Without loss of generality, we shall assume here that all component parts are procured externally.

Transaction Cost

There are different costs associated with the execution of a transaction, and we adopt a simple cost model, in which each transaction has an associated *price*. This is the amount paid by the client to the supplier in return for the product (this price is advertised in the catalog). We assume that *price*(t) is the sum of three cost components. Let t_1, …, t_n be the sub-transactions of t.

1. *Procurement cost*: *price*(t_1), …, *price*(t_n). This is the amount paid by the manufacturer (the client) to each of its suppliers.
2. *Transaction overhead cost*: *overhead*(t_1), …, *overhead*(t_n). This is the cost associated with the execution of each sub-transaction and borne by the client.
3. *Manufacturing cost*: *manufacture*(t). This is the cost of manufacturing the product from its n components (it incorporates the manufacturer's profit).

Altogether: $price(t) = manufacture(t) + \sum_{i=1,n} (price\ (t_i) + overhead\ (t_i))$.

The cost of executing transactions is generally split between the client and the supplier. Here, the client is the member executing t, and the suppliers are the members executing t_1, …, t_n. We assume that the part borne by each supplier i has been incorporated into *price*(t_i). Similarly, we could have assumed that the part born by the client has been incorporated into *manufacture*(t). Yet, for reasons that will become apparent later, we prefer to keep this cost separate, as *overhead*(t_i).

Let t_0 denote the root of a transaction initiated by an external client, then *price*(t_0) is the amount the external client pays for the ultimate product. As price is always a recursive summation of manufacturing costs and transaction overhead costs, it is sufficient to record the latter two. Hence, we label each node of a transaction tree with the associated manufacturing cost, and we label each edge with the associated overhead cost.

We illustrate costs in Fig. 2, which shows the example of Fig. 1 with example costs. In this figure, node labels denote the transaction identifiers and the manufac-

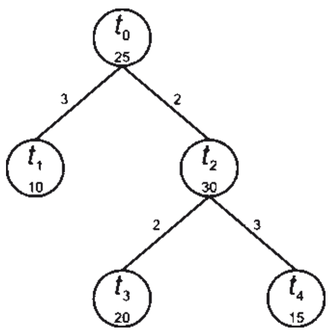


Fig. 2 A transaction tree with its associated costs

turing costs, and edge labels denote the transaction overhead costs. The derived transaction prices are then: $price(t_1) = 10$, $price(t_3) = 20$, $price(t_4) = 15$, $price(t_2) = 70$, and $price(t_0) = 110$.

Transaction Failure

Until now we assumed that all orders are fulfilled, and transactions complete successfully. We consider now the possibility of transaction failure. A transaction fails when an order that has been placed is not fulfilled. Failure could be due to a variety of different reasons: a communication failure, sudden withdrawal from the enterprise, refusal to honor prior commitments, and so on. Failure can be modeled as a disconnection of an edge in the transaction tree.

To analyze the *cost* of transaction failure, we make several assumptions. First, payment is part of fulfillment. Second, all the sub-transactions of a given transaction are placed simultaneously, and it is not possible to *cancel* orders that have already been placed. Finally, transactions cannot be *reversed*; i.e., goods may not be returned for a refund.[5]

Under these assumptions, the client of a failed transaction does not pay for the cost of the product (as fulfillment never took place), and it bears only the cost of the transaction overhead (as this cost was already invested). The client, however, still pays for all the other component products that have been delivered, and for the cost of manufacturing (although manufacturing was not completed). Assuming the supplier of the failed transaction completed all its sub-transactions promptly,[6] it bears the complete cost of the product it committed to produce.

Consider the transaction tree in Fig. 3. For simplicity, assume that all manufacturing costs are 5, and all transaction overhead costs are 1. The overall price is then 107. Assume now two failures: in t_7 and in t_{11}. The former failure propagates to t_2, and the latter propagates to t_5 and t_1, and consequently t_0 fails. The external client does not pay the virtual enterprise the price of 107, and this loss is distributed as follows: t_{11}: 5, t_5: 12, t_1: 12, t_7: 17, t_2: 24, and t_0: 37. Thus, only members on a failure path bear the price of failure (t_0, t_1, t_5 and t_{11} are on the path of the first failure, and t_0, t_2 and t_7 are on the path of the second failure). Essentially, the price they pay is their overhead for the sub-transactions they launched, and the price of products that were delivered but proved unnecessary because the product for which they were intended was not manufactured.

Because the price of the ultimate product is the sum of all the node costs and all the edge costs, and our distribution of the costs assigned each of these costs to exactly one member, *the losses borne by the participating members add up to the price of*

[5] In VirtuE, these assumptions can be expressed by means of *constitutional rules*.
[6] If not, then there had been an earlier failure.

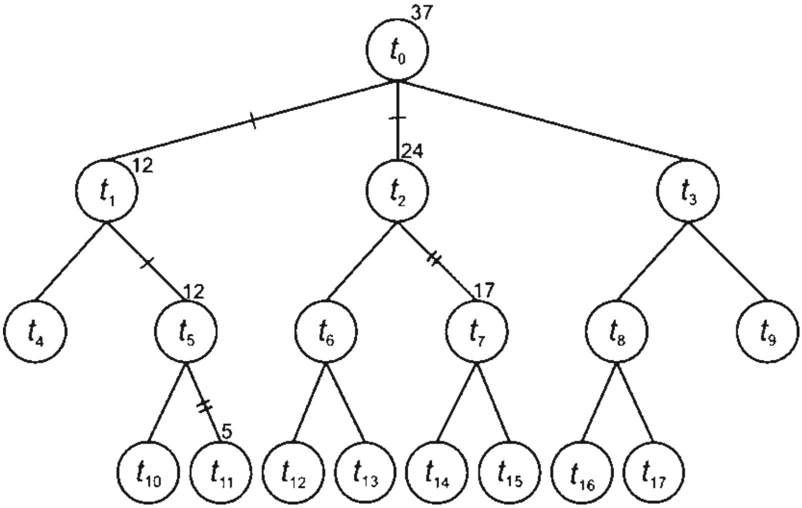


Fig. 3 The distribution of failure costs

the ultimate product. An obvious conclusion is that because the price of products increases along the supply chain, "high level" suppliers tend to pay a higher share of the loss. Although this higher risk would normally be mitigated by higher profit margins, it is important to minimize the risk of failure. This issue is discussed next.

Transaction Risk

We define *transaction risk* as the probability that a transaction fails; that is, the probability that a supplier will not fulfill an order for a particular product. *risk*(t) denotes the risk in transaction t. We assume that *risk*(t) combines two different components: (1) *Supplier risk* measures the risk associated with a particular supplier m; it is the proneness of the supplier to fail. (2) *Product risk* measures the risk associated with the manufacturing of the particular product p. We interpret this risk as the probability that at least one of the transactions to procure components for p fails. With this definition, product risk increases with the complexity of the product (its number of components): If a product is changed to require an *additional* component, product risk will increase. Altogether, the risk of a transaction t, in which supplier m is requested to manufacture a product p, is the probability that m fails, or at least one of the sub-transactions to procure components for p fails.

For a transaction t that orders a primitive (import-free) product from supplier m, the risk is simply that of supplier failure. It is convenient to view supplier failure as the probability of *node failure*, and transaction failure as the probability of *edge failure*.

In general, it cannot be assumed that the $n+1$ events that define *risk*(t) (the failure of m or of one of the n sub-transactions it issues) are *mutually exclusive*; i.e., it may not be assumed that there is at most one failure. In such cases, *risk*(t) must be calculated according to De Moivre's *inclusion-exclusion principle* [4]. In practice, however, unless n is small, it is normally impossible to calculate *risk*(t) in this way, and one must settle for lower and upper bounds, such as those suggested by the Bonferroni inequalities [1]. If we assume that the $n+1$ events are *independent* (i.e., the failure of a node and the failure of each incoming edge are unrelated), then *risk*(t) may be calculated from supplier risk values only. That is, risk values may be propagated from the leaf nodes to the root of the transaction tree.

As an example, consider the previous transaction tree and assume that the risks of member failure are 0.01 for primitive manufacturers, and 0.03 for the others.[7] Then, in the three phases of propagation (shown in Fig. 4), we derive that the risk of the external transaction is *risk*(t_0) = 0.29197. As the example demonstrates, the risk increases with the number of primitive products (in this example, 10), and the number of intermediate suppliers (in this example, 8).

Thus, to calculate transaction risk, our model requires the complete transaction tree and the supplier risk values for each participating member. We may assume that these risk values are calculated by the enterprise (and updated after each completed or aborted transaction), and are available to its members.[8] In terms common in the Internet today, supplier risk corresponds to the supplier's "reliability rating".

A feature of the transaction model introduced earlier is the possibility to procure a product from different suppliers. This suggests initiating the sub-transaction with the lowest risk. We showed how transaction risk can be propagated upwards the transaction tree, but it cannot be assumed that a client knows in advance the subtree that will be associated with each of its orders (information necessary to calculate

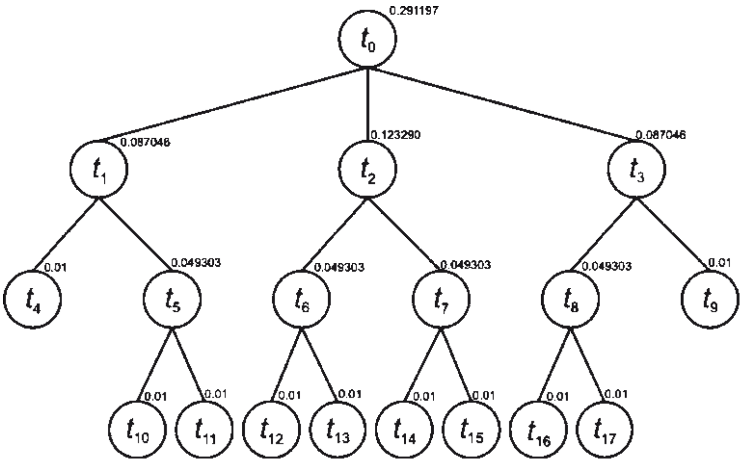


Fig. 4 The propagation of risk

[7] In general, it should not be assumed that manufacturers are divided into these two types.
[8] VirtuE handles these values as *member-specific performance indicators*.

risk). This could be addressed by assuming that each supplier associates with each its products an *estimate* of the transaction risk.

A second flexibility built into our transaction model is the possibility of alternative production plans for a given product (different production plans require different sets of components). The availability of risk values for each sub-transaction will also allow clients to estimate the risks of alternative production plans.

Altogether, we sketched how enterprise members can apply knowledge of transaction risk to either (1) choose among alternative suppliers (for a product they need), or, more ambitiously, (2) choose among alternative production plans (to fulfill an order they received). Yet, choosing the option with the lowest risk may not always be the best choice, as the least-risky transaction may have a much higher price. Considering both price and risk is discussed next.

Expected Loss and Redundant Ordering

Assume member m initiates a transaction for product p for price c with risk r. In the previous section we discussed how m could optimize its operation to minimize the risk r. Similarly, m could optimize its operation to minimize the cost c. Yet, both these approaches may be unattractive: Minimizing risk could come at high cost, and minimizing cost could come at high risk. A more balanced approach is to minimize transaction *expected loss*.

Recall that when a transaction initiated by m fails, m bears only the cost of its overhead; yet m is obligated to pay the cost of the other transactions that were issued in parallel for the same manufacturing task, and completed successfully, and for the cost of manufacturing. Denoting these costs l, the transaction expected loss is $r \cdot l$.

For example, consider a manufacturing task for which m needs two parts, p_1 and p_2, and each part has two alternative sources: p_1 can be obtained for cost 10 with risk 0.4 or for cost 20 with risk 0.2, and p_2 can be obtained for cost 30 with risk 0.3 or for cost 60 with risk 0.1. For simplicity, we ignore transaction overhead and the cost of manufacturing. Assume m chooses the first option for each part. There are four distinct possibilities: The first transaction succeeds and the second fails – the probability is $(1–0.4) \cdot 0.3=0.18$, and the loss is 10. The first transaction fails and the second succeeds – the probability is $0.4 \cdot (1–0.3)=0.28$, and the loss is 30. There is no loss to m if both transactions succeed (probability $(1–0.4) \cdot (1–0.3)=0.42$), or if both fail (probability $0.4 \cdot 0.3=0.12$). Hence, the expected loss of this choice of options is $0.18 \cdot 10+0.28 \cdot 30=10.2$. Similarly, the expected loss for choosing the first option for p_1 and the second option for p_2 is 22.2, the expected loss of choosing the second option for p_1 and the first option for p_2 is 9, and the expected loss for choosing the second option for each part is 12.4. This suggests preferring high cost with low risk for p_1, and low cost with high risk for p_2.

To minimize expected losses, members could find advantage in placing *redundant orders*. That is, m could procure a product p from two members: from m_1 with cost c_1 at risk r_1, and from m_2 with cost c_2 at risk r_2. The cost increases to c_1+c_2 but (assuming independence) the risk is reduced to $r_1 \cdot r_2$. Expected loss may be reduced as well.

A similar approach could be followed for complete production plans. We can calculate the expected loss of an entire production plan. Members could then choose the production plan that minimizes their expected losses, and they could consider redundant ordering that will reduce their expected losses even further.

Conclusion

We described a simple yet powerful cost model for transactions in virtual enterprises.

Simplicity is maintained with several assumptions, including: (1) Transactions involve only three phases: ordering, manufacturing and fulfillment; (2) all sub-transactions are placed simultaneously (e.g., it is not possible to choose the second sub-transaction after the first has been completed); (3) orders may not be cancelled or reversed (no refunds); (4) transaction cost is the sum of external procurement, transaction overhead, and local manufacturing; (5) transaction risk is the combination of manufacturer risk and product risk, where the latter is the risk in procuring the product components; and (6) the failure of a node (a manufacturer) and any of its incoming edges (the sub-transactions it issued) are independent events, allowing for simple calculation of risk based on probabilities of individual events only.

The *power* of the model is in its ability to represent appropriately many real-world situations and perform several optimizations, including: (1) The freedom to order a part from different sources, and to assemble a part according to different schemes; (2) the just distribution of the cost of a failed transaction among the suppliers on the failure path, with higher costs being borne by suppliers higher on the supply chain; (3) the positive correlation between product complexity and product risk; (4) the propagation of product risks upward the supply chain; (5) the optimization of individual member operations to reduce costs, risks, or expected losses; and (6) the ability to place redundant orders to further improve any of these variables.

Much work remains to be done, with future work to be focused on: (1) Relaxing some the abovementioned model restrictions; (2) allowing members to maintain stock, thus allowing "economics of scale" (for example, transaction overhead would be paid less frequently); and (3) devising efficient algorithms for optimizing members' operations (in particular, how to deploy redundant ordering efficiently).

References

1. C.E. Bonferroni. Teoria statistica delle classi e calcolo delle probabilità. *Istituto Superiore di Scienze Economiche e Commerciali di Firenze,* 8: 1936, 1–62.
2. L.M. Camarinha-Matos and H. Afsarmanesh. The Virtual Enterprise Concept. In *Proceedings of the IFIP TC5 WG5.3 / PRODNET Working Conference on Infrastructures for Virtual Enterprises: Networking Industrial Enterprises*, IFIP Conference Proceedings, Vol. 153, 1999, pages 3–14.

3. A. D'Atri and A. Motro. VirtuE: a Formal Model of Virtual Enterprises for Information Markets. *International Journal of Intelligent Systems*, Vol. 30, No. 1, February 2008, pages 33–53.
4. A. De Moivre. *Doctrine of Chances – A Method for Calculating the Probabilities of Events in Plays.* Pearson, London, 1718.
5. A.K. Elmagramid. *Database Transaction Models for Advanced Applications.* M. Kaufmann Publishers, San Mateo, California, 1992.
6. P. Grefen. Transactional Workflows or Workflow Transactions? In *Proceedings of DEXA 02, 13th International Conference on Database and Expert Systems Applications*, Lecture Notes in Computer Science, Vol. 2453, Springer, 2002, Pages 327–349.
7. G.E. Smith, M.P. Venkatraman , R.R. Dholakia. Diagnosing the Search Cost Effect: Waiting Time and the Moderating Impact of Prior Category Knowledge. *Journal of Economic Psychology*, Vol. 20, 1999, pages 285–314.

Visualizing Geographic Data on Mobile Interfaces: The Strategic Use of Colors and Color Intensity as Information Clues

L. Paolino[1], M. Sebillo[2], G. Tortora[3], and G. Vitiello[4]

Abstract Maps provide people with the ability to visualize and analyze the world as they perceive it, in terms of geographic objects and relationships among them. However, when maps are delivered on mobile devices, where viewing a wide portion of the map may conflict with displaying features in a detailed manner, a complete and exhaustive evaluation of a region may become difficult. In the paper, we describe a visualization technique, named Framy, which exploits an interaction metaphor for painting frames, to provide hints about off-screen objects, in a mobile GIS application. In particular, we explain how Itten's theory of colors has been taken into account to improve user's visual perception of items on the mobile device interface.

Introduction

In the last decade, two phenomena have dramatically changed the society where we live in and the role played by information technology, namely the global diffusion of the Internet and the introduction of innovative mobile handheld devices. These technologies have had a deep impact on everyday lives. We are now witnessing a tremendous growth of mobile handheld devices, able to connect to the Web relying on Wi-Fi connectivity and letting the users experience innovative, attractive and usable interfaces. These new ways of communicating stimulated researchers to propose several approaches [10, 11] and guidelines [14] for developing innovative interfaces for mobile devices [3, 5, 8], capable of providing users with minimal and exhaustive visual information, meant to overcome both hardware and software

[1] Università di Salerno, Fisciano (SA), Italy, lpaolino@unisa.it
[2] Università di Salerno, Fisciano (SA), Italy, msebillo@unisa.it
[3] Università di Salerno, Fisciano (SA), Italy, tortora@unisa.it
[4] Università di Salerno, Fisciano (SA), Italy, gvitiello@unisa.it

A. D'Atri and D. Saccà (eds.), *Information Systems: People, Organizations, Institutions, and Technologies*,
DOI 10.1007/978-3-7908-2148-2_59,

limitations such as small visualization areas [7, 13] and interaction modalities permitted by mobile devices [12, 15].

Also in the area of Geographic Information Systems (GIS), mobile service designers and developers are presently investigating new design and development strategies supporting the challenges coming from the combined use of wireless technologies and advanced Internet GIServices [6, 9]. In particular, designers have to face:

- The need to re-design interfaces of well-established GIS applications considering the limited screen size of mobile devices.
- The general requirements of mobile device users, which should take into account of possible diversity among users' skill and expertise.
- New and growing user expectations in terms of quality of services.

One of the major causes for the common adoption of mobile devices for querying spatial data is related to the use of maps in a number of tasks. These include finding the nearest relevant location, such as a gas station, or for hand-optimizing a route. Using a map, users can easily compare alternative locations, such as the selection of restaurants. A user can see how far away a restaurant is from his/her current location, and whether it lies close to other locations he/she considers visiting. Advantages deriving from maps are uncountable, they provide people with the ability to visualize and analyze the world as they perceive it, in terms of geographic objects and relationships among them. However, when maps are delivered on mobile devices, where viewing a wide portion of the map may conflict with displaying features in a detailed manner, due to the small dimensions of screen, a complete and exhaustive evaluation of a region is possible just in case users are able to: (1) have a global or wide enough view of the geographic area they are taking into account, and (2) have a detailed enough vision of the map, where objects of interest can be well distinguished. If either is missing, people may not be able to properly use the map, due to not sufficient or confused information.

As an example, if we perform a search for the closest hotel from our current location, the result may fall either inside or outside the screen. In the first case, we do not have problems to reach the hotel because we can distinguish it on the map. Vice versa, in the second case, the map focus (i.e., our current position) is moved so as to capture into the screen area the target hotel, hence failing to visualize at the same time our position and the direction to the hotel.

Visualizing the entire map by a zoom-out action is not always the right solution. As a matter of fact, objects resulting from a query task might appear improperly overlapped, if a reduced map scale is adopted. As an example, if we are visualizing a layer showing the locations of farmhouses located in a given region and we want to see all of them together, we might want to represent the entire region on the screen, hence using a reduced scale for the map. In that case, there is a high probability that, below a certain proximity threshold, farmhouses will be overlapped and will then be hard to distinguish.

In the literature, several techniques have been proposed to display large information spaces on desktop screens. An interesting paper by Chittaro classifies the different approaches adopted so far to visualize maps and images on small screens [2].

The author argues that the techniques traditionally adopted to combine panning and zooming with either compression (the so-called *overview-detail* approach) or distortion operations (known as *focus-detail* approach) may still present severe limitations when applied to mobile devices, due to the very small screen dimensions. A promising approach, specifically conceived for visualizing distance and direction of off-screen locations, consists in providing visual references to off-screen areas, by augmenting the detail view with interactive visual references to the context. Such an approach has been successfully adopted in systems like Halo to enable users to complete map-based route planning tasks [1]. This suggested us that a similar idea could be adopted and extended for performing more complex GIS activities on a mobile device, which also involve spatial queries on different map layers.

Thus, in order to provide an appropriate tradeoff between the zoom level needed to visualize the required features on a map and the amount of information which can be provided through a mobile application, in recent work we have proposed a new visualization technique, named *Framy*, which exploits an interaction metaphor for painting frames, to provide hints about off-screen objects [6].

In this paper we will present an improved *Framy* prototype which results from an accurate study we have conducted on Itten's color theory. With respect to the initial prototype, an optimization step in the color choice associated with layers has been applied in order to avoid problems with color intensities which cannot be distinguished. The new version of *Framy* is now being experimented on a prototype of a mobile GIS application, called *MapGIS*, designed to perform typical GIS operations and queries, and combines common mobile interaction controls with the proposed visualization technique.

The paper is organized as follows. In Section "The Theory of Color Contrasts" we recall some basic guidelines taken from color theory that have been considered to improve the frame visualization technique adopted in *Framy*. Section "The Framy Visualization Techique" describes *Framy* visualization technique, enhanced with the application of appropriate rules for color combination. Section "Conclusion" concludes the paper.

The Theory of Color Contrasts

In this section we recall some basic concepts taken from Itten's theory of colors, which concern the effects created by color contrasts [4].

In order to explain such concepts, we primarily recall the underlying Hue-Brightness-Saturation (HBS) model. The model defines a color space in terms of three constituent components:

– *Hue*, the color type (such as red, blue, or yellow): Ranges from 0 to 360 in most applications. Each value corresponds to one color. Examples: 0 is red, 45 is a shade of orange and 55 is a shade of yellow (see Fig. 1a for the complete color scale). Hue is the perceptual attribute associated with elementary color names. Hue enables us to identify basic color categories such as blue, green, yellow, red and purple.

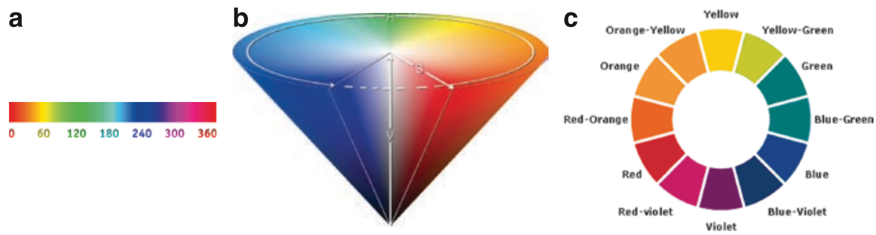


Fig. 1 (**a**). The hue scale. (**b**). The conical representation of the HSB model is well-suited to visualizing the entire HSB color space in a single object. (**c**) Itten's color wheel

– *Saturation*, the intensity of the color ranges from 0 to100%. 0 means no color, that is a shade of grey between black and white. 100 means intense color.
– *Brightness*, the brightness of the color ranges from 0 to 100%. 0 is always black. Depending on the saturation, 100 may be white or a more or less saturated color. Brightness corresponds to how much light appears to be reflected from a colored surface in relation to nearby surfaces. Brightness, like hue, is a perceptual attribute that cannot be computed from physical measurements alone. It is the most important attribute in making contrast more effective.

Hue, brightness and saturation - the three perceptual attributes of color - can be envisioned as a solid as shown in Fig. 1b. Hue varies around the solid; brightness varies from top to bottom and saturation is the distance from the center.

The basic point of Itten's theory is the study of the effects created by color contrasts. In order to describe his results, Itten uses a spherical color order system with a chromatic circle of twelve hues, namely color types – three primary hues, namely red, yellow and blue, three secondary hues, namely orange, violet and green and three tertiary hues, as shown in Fig. 1(c).

Through his research, Itten devises seven methodologies for coordinating colors utilizing the color contrasting properties. The first and most common contrasting technique is referred to hues: when a high *contrast of hues* is required, then the selection of a minimum of three very different hues, may be accomplished. The contrast is formed by the juxtaposition of such different hues. The greater the distance between hues on a color wheel, the greater the contrast.

Hue contrasts may be accompanied by other variations with respect to the intensity and/or brightness of the chosen hues. Thus, other typologies of contrasts are specified as follows:

– The *contrast of saturation* (*intensity*): the contrast is formed by the juxtaposition of light and dark values and their relative saturation.
– The *contrast of light and dark*: the contrast is formed by the juxtaposition of light and dark values, best exemplified by *white and black*. This could be a monochromatic composition.
– The *contrast of extension*: also known as the Contrast of Proportion. The contrast is formed by assigning proportional field sizes in relation to the visual weight of a color.

- The *contrast of complements*: the contrast is formed by the juxtaposition of color wheel or perceptual opposites.
- *Simultaneous contrast*: the contrast is formed when the boundaries between colors perceptually vibrate. Some interesting illusions are accomplished with this contrast.
- The *contrast of warm and cool*: the contrast is formed by the juxtaposition of hues considered ‘warm’ or ‘cool’, a purely psychological association mostly used for color compositions.

Besides these typologies of contrasts, some other parameters may affect the way human eyes perceive the real world. *Proportion & intensity* may be used depending on the proportions of allocated areas in order to emphasize some specific objects within a set, or to properly balance the foreground with respect to the background. Analogously, *Contrast & Dominance* may be used to determine the final impact of the whole presentations. By varying the contrast of the dominant elements the impact may be enhanced or minimized. Finally, using a color wheel divided into various shades and tints allows designers to identify possible options for color schemes. In particular, by varying the saturation and experimenting with shades and tints within the hue relationship, a variety of palette options may be achieved, which satisfy a wider range of requirements and combinations.

The *Framy* Visualization Technique

In this section we describe the *Framy* visualization methodology, which was initially introduced in [8] and has now been enhanced with suitable strategies for color and color intensity choices, that should improve usability.

The rationale behind *Framy* visualization approach is to display semi-transparent colored frames along the border of the device screen, which provide information clues about different sectors of the off-screen space. For a given query, the color intensity of each frame portion is proportional to the number of resulting objects located in the corresponding map sector outside the screen. Thus, the frame may indicate both the distance and the direction of specific Point Of Interests (POIs), as in Halo [1] but it may also represent the amount of POIs located towards a specific direction. In general, the frame portion color intensity represents a summary of data located besides the screen border. Moreover, the number of frame portions can be interactively increased so as to refine the query results, indicating, e.g., the exact direction where certain objects can be found. If several layers are displayed on the map, nested frames may be visualized along the borders, each one corresponding to a different layer, with a different color.

We illustrate the adoption of *Framy* on a mobile application *MapGIS*, which allows users to perform typical GIS operations and queries. Users may gather information about localities on the considered map by querying the data pre-loaded and stored in a structured repository of the mobile device. The application manages the browsing of the map by using a specific pointer that is moved all around the screen using the directional keys of the device. Basic spatial operations, such as mapping and zooming, as well as advanced selection operations, are available on *MapGIS*. Besides the usual route planning functionalities, which also rely on some optimization algorithms, *MapGIS* provides an advanced search functionality, which allows to localize points of interest of specific categories (theaters, parks, museums, etc.) by specifying some descriptive information set up by users.

Once the user performs the spatial requests, results are visualized on the map by applying the *Framy* visualization method which helps users to discover results located off-screen. The user may choose to divide the map into any number n which is a power of 2. Starting from the center of the screen a fictive circle is drawn and the map is divided into n sectors of equal width ($360°/n$). Figure 2 gives an idea of this subdivision using $n=8$, that is we divide the screen in 8 sectors. We use the notation *Ui* – invisible- to represent the parts within a sector which lie outside the screen, whereas *Vi* – visible- represents the inside screen parts.

The idea underlying this approach is to inscribe a semi-transparent area (*frame*) inside the screen. This area is partitioned in *C1, …, Cn* portions, each identified by the intersection between the *frame* and the *Vi* parts.

Once the user has posed a query, each *Ci* is colored with a different intensity on the basis of an aggregate function *f* applied on the resulting set associated with *Ui*.

In order to make information clues coming from the frame portions more effective, we have enhanced the *Framy* visualization technique with color and color intensity rules derived from Itten's theory of contrasts. Such rules concern three aspects of the mobile application interface, namely:

- The color combination of the frame and the map background.
- The color combination of the frame and the corresponding features.
- The color combination of possibly nested frames.

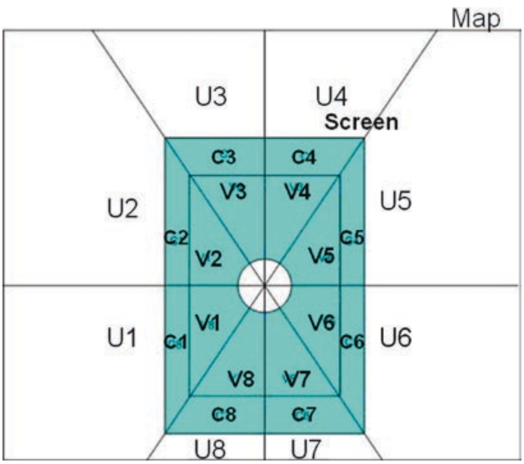


Fig. 2 An example of (off-)screen subdivision accomplished by *Framy*

As for the former, we have adopted the *Proportion* & *Intensity* approach and provided the following rules:

R1. If *D* is the color of the map background, *D* is considered the dominant color (the largest proportional area on the interface) and colors for juxtaposed frames should be chosen uniquely among subdominant colors of *D*.

The features involved in a query result should be assigned the same color as the corresponding frame:

R2. If *F* is the hue used for a frame corresponding to layer *L*, then the map features on *L* resulting from a query should use *F* too.

As for the color combination of nested frames, we have adopted the *contrast of hues* technique:

R3. If *F* is the hue of an existing frame, then the color of any inner and adjacent frame should be chosen from the color wheel among the most distant and still available hues, provided that rule *R1* still applies.

As an example, let us consider a scenario, where *Framy* is used to compare values resulting from spatial aggregations. In the example two layers have been added to the map of Sydney, showing hotels and monuments, respectively. Besides taking a glance at the map, the user wishes to achieve hints on the best direction to go in order to find a zone dense with hotels as well as with monuments. As shown in Fig. 3, the data distribution is visually summarized on the mobile device screen by two concentric frames, green for hotels and purple for monuments, respectively. The two colors are hue contrasting colors (rule *R2*) and are both subdominants of

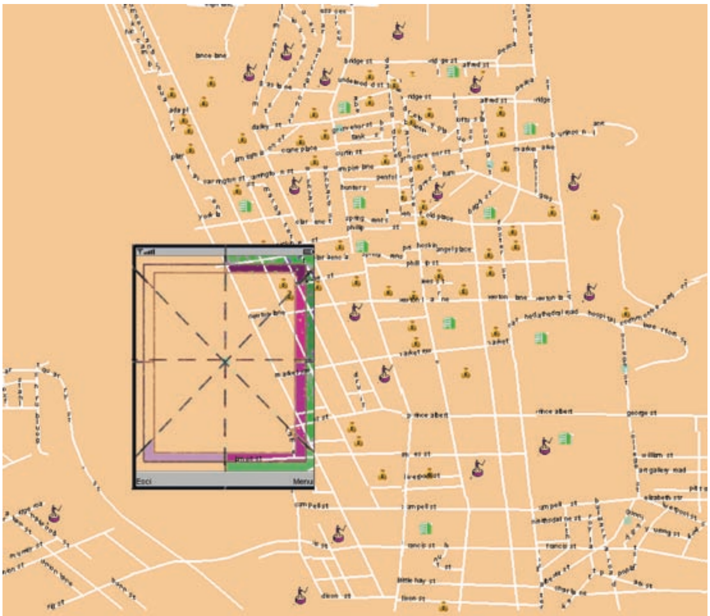


Fig. 3 An example of color selection for the Framy technique in the case of multiple layers

the pink map background (rule *R1*). The user will notice that the outer frame has the highest color intensity on the right side of the map, whereas on the same side, the inner purple frame has the highest intensity in the upper sector. This indicates that, in response to the request, the user may expect many POIs moving the map focus towards the upper-right direction. In agreement with rule *R3*, hotel features are green-colored and monument features are purple-colored.

Conclusion

In this paper, we presented *Framy*, a visual application which allows users to describe information about the objects located over the visible space of a mobile screen device. With respect to the previous version of the technique, more attention has been devoted to the choice of colors for layers and frames taking into account some basic guidelines coming from Itten's theory of colors. In particular, thanks to the application of three color combination rules, issues deriving from the low visual perception of items on a mobile device interface have been overcome.

In the future, as we did in our initial work, we plan to evaluate the prototype against usability, by involving authors (in the role of experts) and two groups of sample users in a comparative experimental study meant to verify the benefits in efficacy, efficiency and subjective satisfaction coming from the adoption of Itten's color theory in the new version of *Framy.*

References

1. P. Baudisch, and R. Rosenholtz, "Halo: A Technique for Visualizing Off-Screen Locations," in *ACM CHI Conference on Human Factors in Computing Systems (CHI'03) Proceedings*, New York: ACM Press, pp. 481–488.(2003).
2. L. Chittaro, "Visualizing information on mobile devices, " in *IEEE Computer*, 39(3), pp. 40-45. (2006).
3. E. Costanza, , S.A. Inverso, R. Allen, "Toward subtle intimate interfaces for mobile devices using an emg controller,". In *CHI 2005: Procs of the SIGCHI conference on Human factors in computing systems*, pp. 481–489. ACM, New York (2005).
4. J. Itten, *The Art of Color*, New York, Wiley 1961.
5. K.J. Lee, S.C. Ahn, H. –G. Kim, "Using a mobile device as an interface tool for hmd-based ar applications," in: *ACE 2006: Procs of the 2006 ACM SIGCHI international conference on Advances in computer entertainment technology*, p. 7. ACM, New York (2006).
6. P.A. Longley, M.F. Goodchild, D.J. Maguire, D.W. Rhind. *Geographical Information Systems and Science*. 2001. Wiley, New York.
7. B. MacKay, C. Watters, "The impact of migration of data to small screens on navigation,""in *IT and Society*, 1(3), 90–101 (2003).
8. L. Paolino, M. Sebillo, G. Tortora and G. Vitiello, "*Framy* – Visualising geographic data on mobile interfaces," to appear in *Journal of Location Based Services*, Taylor & Francis Group.
9. Z.-R. Peng and M.-H. Tsou, *Internet GIS: Distributed Geographic Information Services for the Internet and Wireless Networks.* Wiley, New York, March, 2003.

10. K. Pulli, T. Aarnio, K. Roimela, J. Vaarala, “ Designing graphics programming interfaces for mobile devices”, *IEEE Comput. Graph. Appl*. 25(6), 66–75 (2005).
11. J.A. Sanchez, O. Starostenko, E.A. Castillo, M. Gonz´alez,, “Generation of usable interfaces for mobile devices”, in *CLIHC 2005: Procs of the 2005 Latin American conference on Human-computer interaction*, p. 348. ACM, New York (2005).
12. T. Sohn, K.A. Li, W.G. Griswold, J.D. Hollan, “A diary study of mobile information needs, “ in *CHI 2008: Procs of the twenty-sixth annual SIGCHI conference on Human factors in computing systems*, pp. 433–442. ACM, New York (2008).
13. L. Wang, A.S.M. Sajeev, “ Roller interface for mobile device applications,” *in AUIC ’07: Procs of the eight Australasian conference on User interface*, pp. 7–13. Australian Computer Society, Inc, Darlinghurst, Australia (2007).
14. S. Weiss, *Handled Usability,* Wiley, Chichester (2002).
15. L. Zhou, M. Shaikh, D. Zhang, Natural language interface to mobile devices, in *Procs. International Conference on Intelligent Information Process* pp. 283–286 (2004).