FIELD GUIDE TO PROJECT MANAGEMENT

SECOND EDITION

EDITED BY

DAVID I. CLELAND

Field Guide to Project Management

Second Edition

DAVID I. CLELAND

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Contents

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The preparation and content of this Field Guide required the cooperative effort of many well-known people in the field. The authors who provided the chapters are all experts in the discipline of project management. Their contributions reflect a kaleidoscope of the theory and practice of project management, expressed in pragmatic terms for the use of people who practice project management in their work.

The people who contributed to the 2nd Edition of this book are many of the same ones who contributed to the ''first of its kind'' lst Edition of this book. I am deeply indebted to all of these people who supplied updated material for their chapters, as well as those who provided new chapters for the book.

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Preface

This Field Guide provides basic and useful guidance on the practice of project management in a wide variety of applications. A who's-who roster of expert authors present explanations and advice on all aspects of project management. The book provides fundamental blueprints for successful project planning and execution. A must-own volume for project managers, product and service developers, team leaders, and executive personnel in all industries will find the information useful and pragmatic.

The primary change in this 2nd Edition is the updating of the chapters in the original book. In addition, several new chapters have been added, viz., Effective Project Information Systems; Project Management Software: A Guideline for Project Selection and Use; Implementing Earned Value; Project Leadership; Building the Project Statement of Work; Building High Performance Teams, and Project Management Maturity.

There are five major sections in this book. Section I sets the stage for project management through chapters on the strategic management of organizations, the rationale for project management, what constitutes project success, and the design and implementation of the project management process.

Section II covers a range of different subjects related to planning techniques such as project selection, life cycle choice, developing the work-breakdown structure, project costs, achieving on-time performance, developing winning proposals, and risk assessment.

Section III deals with the general topic of project leadership. Motivation of stakeholders, the use of the matrix organization, political strategies, the role of senior management, communications, negotiating skills, and developing project management skills for the future are all provided in this section.

Section IV looks at project oversight through how to monitor projects, use project software and information systems, quality management, project evaluation, the timely termination of projects, and legal considerations in the management of projects.

Section V, the last section in the book, extends the use of project management concepts and processes into non-traditional use of project teams such as reengineering teams, product development teams, and self-managed production teams.

I wish the users of this book the best of success in the management of their projects!

David I. Cleland
Professor Emeritus
University of Pittsburgh

SECTION I

Project Management

Chapter

1

Strategic Planning

David I. Cleland

Biographical Sketch . . .

Dr. David I. Cleland, is Professor Emeritus in the School of Engineering, University of Pittsburgh, Pittsburgh, PA. He is a Fellow of the Project Management Institute (PMI) and has received PMI's Distinguished Contribution to Project Management Award three times. Dr. Cleland has been described as ''The Father of Project Management'' and has been honored through the establishment of the annual David I. Cleland Excellence in Project Management Literature Award sponsored by PMI. He is the author/editor of 36 books in the fields of Project Management and Engineering Management. His current research interests are in the evolution of project management and the strategic context of projects in the management of enterprises.

Projects are the building blocks in the design and execution of strategies for an organization. Projects provide an organizational focus for conceptualizing, designing, and creating new or improved products, services, and organizational processes. Failure to create and maintain a portfolio of projects in the strategic management of an organization means the decline and ultimate failure of that organization. The successful organization maintains a portfolio of projects centered around the operational and strategic needs of the organization.

The changes organizations face today have no precedent. Companies must keep up with legal, social, economic, and technological changes as well as changes brought about by competitors' advances and new needs of customers. The organization must offer extraordinary modifications in products and services to ensure survival in the competitive marketplace.

Senior managers, who have the most direct responsibility for the future of the organization, must develop the ability to assess opportunities, eval-

Field Guide to Project Management, Second Edition. Edited by David I. Cleland

uate risk and uncertainty, and make informed decisions concerning which strategies and projects best prepare the organization for its future.

In a successful organization, the portfolio of projects is under constant change. Some projects are preliminary ideas, some are under development, and some are nearing completion to join the inventory of products and services maintained by the organization as well as to provide supporting organizational processes such as manufacturing, engineering, and marketing. As the preliminary project ideas are evaluated, some will survive and undergo development; others will fall by the wayside.

Why Projects Fail

A project may fail for reasons such as the following:

- Inadequate senior management oversight
- Ineffective planning
- Inappropriate organizational design
- Lack of well-defined and delegated authority and responsibility
- Inefficient system for monitoring, evaluating, and controlling the use of resources on the project
- Ineffective contingency planning
- Limited team member participation in the making and execution of decisions on the project
- Unrealistic cost and schedule objectives
- Lack of customer commitment to project
- Limited customer oversight
- Inadequate management information system

Senior managers must maintain surveillance over the portfolio of projects, develop insight into the probable success or failure of individual projects, and determine whether projects support the strategic and operational purposes of the organization. Several considerations can guide such surveillance.

Project Evaluation Considerations

As senior managers maintain surveillance over the adequacy of the project portfolio, answers to the following questions need to be considered:

- Are the project results innovative and effective?
- Do the project results reflect state-of-the-art technology?
- Does the cost of the resources used on the project permit the company to competitively price the results?
- Are there customers for the expected project results?

- How do the project results compare with identified customer needs?
- What unique customer attributes and benefits will the project results reinforce?
- How do these unique attributes and benefits compare to what the competitor is likely to provide?
- Do the project results reflect the unique strengths and capabilities of the organization?
- Does the organization have the resources—both human and nonhuman—to develop, produce, and market the project results?
- What is the probability that the project results can be successfully achieved in time to support organizational strategic purposes?
- Will the project results provide a suitable return on investment for the organization?

Senior managers can use this evaluation guide to gather data that will sharpen their insight into which projects are the most promising, which are likely to survive, and which might best be terminated. As senior managers conduct their regular review of the ongoing projects and deal with the issues likely to arise in seeking answers to questions in the guide, an important message will be sent throughout the organization: Projects are important in the design and execution of competitive strategies in this organization.

There are other performance standards by which to judge organizational project management.

Performance Standards

An organization can also employ other performance standards to determine how its project and other resources are being used.[1] Key strategic performance standards are listed in Figure 1–1.

Vision: A Picture of the Future

A vision for the organization sets the stage for performance standards and all that follows. Vision, according to Jonathan Swift, is the art of seeing things that are invisible to others. Senior managers with foresight, competence, and discernment have the opportunity to develop a vision for the strategic direction of the organization along with its supporting projects.

A vision is in a sense a dream of what the future should be for the organization—the general direction in which the organization should travel to be what the leaders want it to be. The expressions of vision by senior managers offer a dream of what the future of the organization should be. For example:

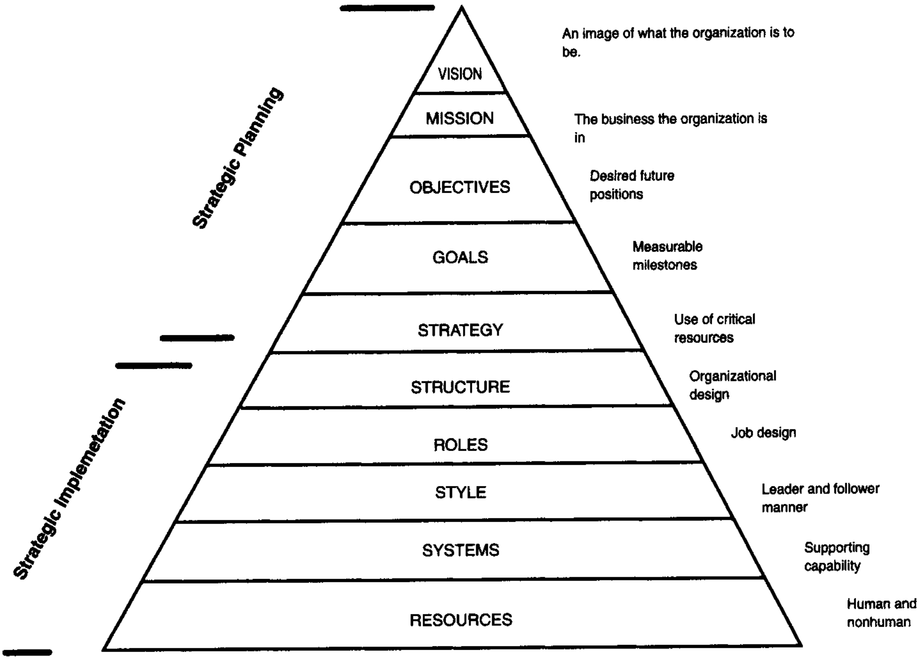

Figure 1–1 Key Strategic Performance Standards

- "A corporation that will look gigantic but have the dynamics of little teams" (Motorola, Inc.).
- "PP&L will be he energy supplier of choice" (Pennsylvania Power & Light Company).
- "A vision for growth based on critical mass in large product categories, geographic diversity, brand leadership, and marketing nnovation" (H. J. Heinz Company).

How important is it for an organization to have a vision? One study that benchmarked the performance of business teams found compelling evidence on the importance of a vision for high-performance project teams. Team members stated that it was the most important factor for high performance.[2]

Mission: The Strategic Purpose

The mission statement declares what business the organization is in. It is a broad declaration of the overall strategic purpose toward which all organizational resources are directed and committed. An organization's mission is the final strategic performance standard for the enterprise. All organizational activities have to be judged on how well individual activities ultimately contribute to the mission.

Some examples of mission statements by contemporary organizations include the following:

- ‘‘To be the number one aerospace company in the world and among the premier industrial concerns in terms of quality, profitability, and growth’’ (The Boeing Company).
- ‘‘Our mission is to develop, manufacture, market, and sell and distribute a broad line of high quality generic drug products at competitive prices’’ (Marsam Pharmaceuticals Inc.).

Objectives: What Must Be Achieved

Organizational objectives pinpoint what must be achieved to ensure the accomplishment of the mission. These objectives are stated in quantitative or qualitative terms, or in a combination of both. Examples of objectives follow:

- ‘‘Providing customers with quality goods, and making the goods available when and where customers want them’’ (Wal-Mart).
- ‘‘Meeting or exceeding the state-of-the-art of competitors in machining capability’’ (Machine tool builder).

Attaining objectives provides strong evidence that progress is being made toward accomplishing the organizational mission. An organization’s goals provide milestones for evaluating whether that organization reached its objectives.

Goals: Measurable Milestones

Goals are milestones in meeting organizational objectives. Projects play an inescapable role as the building blocks for accomplishing those goals. For example, an auto-parts manufacturer established a goal for the enterprise to ‘‘conceptualize, design, build, and put in operation an automated factory on a green-field site by December 31, 2002.’’ Another example of a goal, by an electronics company, includes ‘‘attaining financial performance capability of fifteen percent return on investment by the end of 2001.’’

An example of how a project team attained a goal is provided by Fiat in Italy. In the agricultural region of Basilicata in southern Italy, this auto maker used project teams to design, build, and open a $2.9 billion plant designed to eliminate traditional, inefficient work practices. A major $64 million program was launched to train workers and engineers to operate in independent, multiskilled project teams. Factory workers and office staff worked together under the same roof. Top-down decision-making was eliminated so that problems and opportunities were explored by teams actually working on specific problems in areas such as manufacturing, purchasing, marketing, and customer service.[3]

In the strategic management of an enterprise, executives find the concept of objectives easy to accept. However, when dealing with a time-sensitive goal, many executives are uncomfortable making a commitment. Failure to reach a goal could be the basis for criticism as well as an unfavorable performance rating. Nevertheless, goals can provide effective criteria to measure progress in the strategic management of an enterprise. Goals evaluation also tests whether the strategy for the organization is working.

If a project lags behind schedule, accumulates overrun costs, or is unlikely to attain its expected results, then the goal of the enterprise will be impaired.

Strategy: Use of Critical Resources

A strategy uses critical resources to reach goals and to accomplish the mission. The following are used in the design and execution of strategies: project plans, policies, procedures, resource-allocation schemas, organizational design, motivational techniques, leadership processes, and evaluation and control systems. To implement strategies, project teams use such things as benchmarks, new product and service development, facilities and equipment construction, enhanced procurement techniques, recapitalization, and information systems.

Some examples of strategies used by organizations include the following:

- ''Concentrating on improved earnings from Kodak's core photography business and building a future with digital technologies such as all-electronic cameras, thermal printers, and image-storage devices'' (Kodak Company).
- ''Develop an interlocking computer/information support system augmented by a private satellite-communication system to video link connecting all stores, distribution centers, truck fleets, and corporate headquarters''(Wal-Mart).

Survival and growth must be deliberate and planned, not serendipitous. How human resources are aligned is critical.

Structure and Organizational Design

Corporate America is implementing many changes that affect the use of human resources. These changes include reduction of staff, new boundaries for individual jobs, employee empowerment, closer relationships with suppliers and customers, improved information systems, better telecommunications capabilities, new organizational structures, and globalization of products and services.

Another innovation, organizing around project teams, has had a noted impact on the access of companies. For example, *Fortune* magazine reports, ''The ability to organize employees in innovative and flexible ways and the enthusiasm with which so many American companies have deployed self-managing teams [are] why U.S. industry is looking so competitive.''[4]

As project teams evaluate new technologies and resources, they gain insight into the need for making changes. Projects provide a central point where new knowledge, skills, and attitudes can be developed. A revisit to the definition of a project is required.

Project Defined

A project is any undertaking that has a defined objective, a cost parameter, and a time element for its development. A project can be defined as a cluster of activities that are pulled together to deliver something of value to a customer. The use of a project to define the cluster of activities needed to develop a new product or service has particular appeal, because a key characteristic of a project is the creation of something that does not currently exist, but is needed to create something of value for the organization—a new product, service, or organizational process.

A project is a miniature of the complete organization composed of team members from different disciplines of the organization, including customer representatives and suppliers. In some cases, representatives from unions, the local community, and other interested and relevant stakeholders may be team members. Project teams provide for the integration of the disciplines, technologies, and resources needed to take a project from concept through to delivery of the results to the customer. Through the workings of the project team, the use of resources, management systems, strategies, values of the whole enterprise, and so forth are studied and pulled together.

Why Projects Benefit the Organization

Some of the advantages projects provide in preparing the organization for its future include the following:

- An organizational and stakeholder focal point for integrating the resources required to bring to pass something for the organization that does not currently exist
- A strategic pathway element for the commitment of people and resources dedicated to creating value in future products and processes

- A learning opportunity for the development of knowledge, skills, and attitudes needed to support future organizational purposes
- A model through which progress can be measured in positioning the organization for its future

Teams can reduce the number of management layers. Traditional management levels, according to Peter Drucker, manage nothing. Instead, they merely amplify faint signals coming from the top and the bottom of the infrastructure. Drucker points out that every relay doubles the noise and cuts the message in half. According to Drucker, most management levels neither manage nor make decisions—they serve only as relays. In the future, Drucker believes, few businesses will have more than two or three layers.[5]

Individual Roles

No longer can individuals perform their work without giving thought to how they are expected to work with other people, many of whom can be outside of their local organizational environment. Organizations fail or succeed because members of the organization fail or succeed in their work. If people are unclear about what is expected of them, the chances for difficulties or even failure exist. In cases where employees have control, authority, and responsibility to do their jobs, employees' roles must be specific. People will do a good job if they know what is expected of them and receive feedback on how well they are doing their jobs.

Management Style

The most important variable in the strategic management of an organization is the leadership, which develops a vision, marshals resources, and provides direction for the organization. Style has to do with the overall excellence, appearance, skill, and grace in performing the leadership role. A manager's style can be autocratic, dictatorial, democratic, participative, empathetic, caustic, friendly, or abusive. Followers tend to unknowingly emulate the manager's style. Some significant examples of leadership style follow:

- ''People at Goodyear headquarters say that CEO Stanley Gault's presence 'permeates' the corporate headquarters. . . . He is perceived as seldom giving orders, but everyone knows what he wants done. . . . He runs the company based on trust.''[6]
- At Siemens Company in Germany, ''the management style is tailored to Germany's consensus-style corporate culture. . . . Rigid hierarchy is out and an entrepreneurial drive is in.''[7]

Systems and Resources

The systems and resources that support the organization, such as software, hardware, accounting, information, marketing, production, and design, also support ongoing projects. The technology offered by computer and information systems has changed the traditional role of managers and other employees. Technicians are becoming core employees. According to the Bureau of Labor Statistics forecasts, one of every four new jobs is going to a technical worker. Technicians are gaining new importance because of increasingly powerful, versatile, and user-friendly technologies. As companies become more dependent on these technicians, cultural support is required to keep them productive and satisfied with their work environment.

Project management can be defined in a systems context.

Key Elements of a Project-Management System

Several important subsystems are found in a project-management system. They include the following:

- ***Matrix***. A matrix organization subsystem establishes the formal authority and responsibility patterns and reporting relationships among the general managers, the project manager, the project team members, the functional managers, and other key stakeholders of the project. In Chapter 16, the matrix organization is presented in detail.
- ***Project-planning subsystem***. This begins with a work-breakdown structure (WBS) that shows how the total project is broken down into its component parts. In Chapter 8, the development of a WBS is presented, and in Section II, project-planning techniques and processes are described.
- ***Information systems***. These systems may be informal or may involve the use of formal retrieval programs to determine the status of the project. Information provides those involved with a project the ability to plan, organize, and control the use of resources on the project. Project managers—and other key stakeholders—need information to determine the status of the project and to make informed decisions on how to plan and implement the use of resources on the project. Chapter 27 describes a project-management information system.
- ***Project-control system.*** The most basic standards for project evaluation include project cost, schedule, and technical performance. By comparing planned progess with actual performance,project managers can determine the need for corrective action. Because projects are linked to the goals of the organization, knowing the status of projects gives insight into how well or how poorly progress is being made to attain enterprise goals. Overall project monitoring, evaluation, and control means are described in Section IV.

- ***Cultural ambience***. The emotional patterns of the social groups, their perceptions, attitudes, prejudices, assumptions, experiences, and values, all go to develop the project and cultural ambience of the organization. This ambience influences how people act and react, how they think and feel, and what they say and do concerning the project and the organization. There are no organizations without people—and project organizations are no exception. This field guide stresses the need to be aware of people issues when managing projects, as stated in Section III, Project Leadership, and in Section V, Team Management.

Summary

Throughout this book, the key topics involved in the mangement of projects will be identified and described. These topics are presented in the spirit of practical guides for those stakeholders associated with the management of projects in the enterprise's strategy. This chapter has set the stage for project management in the context of strategic planning for the organization.

ENDNOTES

1 Material on the strategic performance standards is stated in a somewhat different context in David I. Cleland and Lewis R. Ireland, *Project Management: Strategic Design and Implementation*, 4th Edition. New York: McGraw-Hill, 2002. Also, I have drawn additional material from my book, *The Strategic Management of Teams.* New York, John Wiley & Sons, 1996

2 Larson, Carl and LaFasto., Frank. *What Must Go Right/What Can Go Wrong.* Newbury Park, CA: Sage, 1989

3 Sasseen, Jane A., Neff, Robert, Hattangadi, Shekar, Sansoni, Silvia and bureau reports. The winds of change blow everywhere. *Business Week*, Special Report, October 17, 1994, p. 92

4 Jacob, Rahul. Corporate reputations. *Fortune*, March 6, 1995, pp. 54–64

5 Drucker, Peter. Infoliteracy. *ForbesASAP,* August 29, 1994, pp. 105–109

6 Nulty, Peter. The bounce is back at Goodyear. *Fortune*, June 29, 1992, pp.76–79

7 Schares, Gail E., et al. The new generation at Siemens. *Business Week*, March 9, 1992, pp. 34–39

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Chapter

2

The Elements of Project Success*

Jeffrey K. Pinto

Biographical Sketch . . .

Jeffrey K. Pinto, Ph.D., is the Samuel A. and Elizabeth B. Breene Professor of Management in the Black School of Business at Pennsylvania State University, Erie. A two-time winner of the Project Management Institute's Distinguished Contribution Award, Dr. Pinto has served as Editor of the *Project Management Journal,* the scholarly journal of the Project Management Institute, the largest professional project-management organization in the world. He has published 14 books and over 100 research articles on a variety of topics, including project management, information-systems introduction, innovation and change, leadership, and learning theory. His most recent book, *Frontiers of Project Management Research,* coedited with D. I. Cleland and D. P. Slevin, was published in 2002 by the Project Management Institute.

I would like to start this chapter with a quick quiz. Listed below are the primary characteristics and outcomes of three projects. Which of these projects was considered a ''success?''

Project A. This personal computer project, completed in the mid-1970s, literally redefined the technical capabilities of an entire industry. Produced in record time, using the cream of IT scientific talent, the project ultimately produced the technological innovations that have become benchmarks in the microcomputer industry up through the turn of the century.

*Portions of this chapter were adapted from *Successful Information System Implementation: The Human Side*, by Jeffrey K. Pinto, PMI Publications (1994) and *Successful Project Managers*, by Jeffrey K. Pinto and O. P. Kharbanda, Van Nostrand Reinhold (1995).

Project B. This large construction project was initiated with no clear defining guidelines, poor or nonexistent schematic diagrams or other engineering details, and uncertain technical features that had to be reengineered several times over the course of the construction. A project that was expected to take about 3 years to complete ended up taking over 10; its initial budget of $7 million dollars eventually topped $100 million. Bickering on the project among the developers was so bad that when the building was finally finished and dedicated, the architect refused to attend the grand opening.

Project C. A technologically sophisticated aircraft that was designed to be Europe's entry into the commercial airline business, this project was completed within acceptable schedule parameters and received tremendous press coverage and enough initial orders to encourage the company that it had tapped into the wave of the future and been first to market in doing so. By internal company measures, the project seemed very positive, the future bright, and the organization poised to reap huge financial benefits.

The three projects described above are: A) The Xerox Alto personal computer—never introduced by Xerox because the technology was so leading-edge they could not conceive of how to market and sell the product; B) the Sydney Opera House—a project so bedeviled by cost and schedule overruns and technical problems that Australia was finally forced to institute a national lottery to pay for its completion; and C) the DeHavilland Comet—the first commercial jet airplane, whose rush to market led the company to cut quality corners and forgo adequate testing, only to discover that some of their innovations were deadly, resulting in scores of deaths before the aircraft was withdrawn from the market in 1955. Oddly enough, of the three projects described above, only Project B could even be argued to be successful. While it is true that the project was a technical and cost-control disaster from the beginning, it was a ''national prestige'' project, and thus many of these traditional metrics of project performance ultimately were discounted. To this day, the Sydney Opera House remains one of the enduring symbols of Australia.

As the above examples suggest, the process of developing a method for analyzing and predicting the likelihood of success or failure of an ongoing project is by no means a simple one. There are a number of reasons why this process presents a challenge. One obvious reason is that words like ''success'' and ''failure,'' like beauty, are often in the eye of the beholder. Put another way, until we can establish a set of criteria that have some generally accepted basis for assessing projects, then at best we run the risk of mislabeling as failures projects that may, in fact, be successes. A second problem with accurately predicting project outcomes lies in the often incomplete nature of the data itself. Many times a project's development is surrounded by a great deal of ambiguous and even contradictory data that makes midstream assessments problematic. Project assessment may be influenced by individuals having biases for or against the project. The subjective nature of project assessment makes it difficult to develop objective measures that offer a reasonably reliable method for judging project outcomes. To address some of these issues, this chapter provides a field reference for project managers to use in tracking the status of their projects.

The Unique Setting of Project Management

Almost all innovative new products developed within companies are created by using project-management techniques. Because projects play such an increasingly significant role in organizational profitability, it is vital to have an understanding of their unique properties.

Project managers' careers often hinge on their ability to deliver the goods in the form of successfully completed projects. Consequently, in the absence of disaster (e.g., structural collapse in construction or banned or abandoned pharmaceutical development), it seems that for every detractor of a specific completed project there is often a champion singing its praises.

As the examples that started this chapter demonstrate, project success is not always as clear-cut as we sometimes believe. Any one of a number of confounding issues can cloud our ability to view a project's outcome in an objective light. For example, the point in time when a project is evaluated can make a very real difference in its evaluation. Likewise, egos and personal agendas of top managers in a company can serve to obscure the true outcome of a project, because these powerful individuals seek to protect themselves and their turf from the side effects of bumpy projects.

It is often the case that while successful projects are trumpeted throughout the organization and publicized externally, the majority of project failures are quietly swept under the carpet. People naturally tend to promote the positive. If this is not possible, they adopt a simple philosophy: out of sight, out of mind. The irony, of course, is that all organizations experience project failure far more often than rousing success. Consider, for example, the results of a recent study by Peat Marwick of 300 large companies attempting to implement computer software development projects. Fully 65 percent of the organizations reported experiences where their projects were grossly over budget or far behind schedule, or the technology was nonperforming. In some cases, the companies experienced all these factors. Perhaps more impressively, over half of these firms considered this state as ''normal'' or ''of no concern.''

A working definition of project success may help to clear up the confusion about what success is. In the old days, project managers commonly made use of a concept known as the ''triple constraint'' to evaluate a project at completion. This triple constraint offered a three-legged stool as a metaphor for a project's viability. The three constraints were:

1. ***Time.*** The project had to come in on or under its initially scheduled time frame.
2. ***Money.*** The project had to be completed within its budget limits.
3. ***Performance.*** The end result had to perform in the manner that was intended.

Seen in this light, it was relatively easy to make some initial value judgments about a project. Project control consisted of tracking these milestones of any particular project. One had only to consult the project's timeline to assess schedule constancy, review the cost accountant's report to determine budget adherence, and see if the project worked.

Although simple, the triple constraint does not work in the modern business world. In an era of tremendous competition and enhanced concern for customers, the triple constraint has become a dangerously out-of-date convention. In considering the three components of the triple constraint, it is clear that the primary thrust of each of these measures is internal; that is, each measure is intended to satisfy some interest group internal to the organization rather than in the outside environment. For example, satisfying time and budget considerations is often the concern of cost accountants who must keep costs down. Likewise, the performance criterion has often been seen as primarily an engineering concern for making a product that works.

Historically, what was lost in the confusion was any real concern for the customer, that is, the desire to satisfy the concerns of the client for whom the project was intended. Within many companies, a fundamental conceit emerged in the assumption that once a project was completed, the public would be offered a fait accompli that they would naturally buy or use. The underlying theme of this position seemed to be an arrogant assertion: *Don't tell us what you need. Trust us to know what you want.* The result of such attitudes was predictable: Customers went increasingly to companies whose projects and products reflected a concern for the customer, as illustrated by the phenomenal success of the Ford Taurus.

The new rules governing global business require that project management adopt a new standard by which future success will be measured: the so-called quadruple constraint. The additional feature of the quadruple constraint requires us to include *customer satisfaction* as one of the pillars of project success. Customer satisfaction refers to the idea that a project is only successful to the extent that it satisfies the needs of its intended user. This addition has tremendous implications for the way companies manage projects and the manner in which the success or failure of both past and future projects will be assessed. With the inclusion of customer satisfaction as a fourth constraint, project managers must now devote additional time and attention to maintaining close ties with and satisfying the demands of external clients. In effect, project managers must now become not only managers of project activities, but sales representatives for the company to the client base. The product they have to sell is their project. Therefore, if they are to facilitate acceptance of the project, and hence its success, they have to learn how to engage in these marketing duties effectively.

ASSESSING INFORMATION TECHNOLOGY (IT) PROJECT SUCCESS

Information technology (IT) projects have a notoriously checkered history when it comes to their successful implementation. Part of the problem has been an inability to come to concrete terms in defining exactly what properties comprise successful IT projects. The criteria for IT project success have been quite vague, leading to the obvious problem that without clear guidelines for IT project success, it is hardly any wonder that multitudes of these projects do not live up to their predevelopment advertising. In 1992, DeLone and McLean[1] analyzed numerous previous studies of IT projects to try and identify the key indicators of IT project success. Their findings, synthesized from previous research, suggest that at a minimum, IT projects should be evaluated on the basis of six criteria, including:

- ***System quality***—the determination that the implemented system performs as intended; that is, the system is easy to operate and client-friendly.
- ***Information quality***—the actual information generated from the implemented IT must be that which is required by the users and of sufficient quality that it is ‘‘actionable.’’ In other words, information quality requires that generated information does not require additional layers to sift or sort the data. System users can perceive quality in the information they generate.
- ***Use***—the IT must be used, once installed. Obviously, the reason for the existence of any IT is that it be used as a problem-solving, decision-aiding, and networking mechanism. ‘‘Use’’ assesses the actual utility of a system by determining the degree to which it is employed, once implemented.
- ***User satisfaction***—following the creation of the IT, some effort must be made to determine user satisfaction with the system. Simply using ‘‘use’’ as a surrogate for satisfaction is dangerous. Many times, employees are forced to use outdated or poorly designed systems because no reasonable alternative exists or use is in keeping with company policy. User satisfaction goes one step further: does using the implemented system lead to greater satisfaction on the part of project clients?
- ***Individual impact***—is there a ‘‘bottom line’’ somewhere with regard to how using the IT affects its customer base? That is, beyond the questions of system and information quality and usage, it is necessary to ask some hard questions regarding the impact that using the IT makes upon its clientele. Is decision-making faster or more accurate? Is in-

formation more retrievable, more affordable, or more easily assimilated? In short, does the system benefit its users?

- ***Organizational impact***—finally, at the end of the determination of an IT project's "success" there must come some attempt to see how the overall organization is positively impacted through use of the system. Beyond individual impact, is there a collective, or synergistic effect on the overall corporation? Is it some amorphous sense of good feeling, or are there measurable surrogates that demonstrate the effectiveness or quality of the system?

DeLone and McLean's work forms an important framework for establishing a sense of IT project success. Companies that are designing and implementing IT must begin to pay early attention to each of these criteria and take necessary steps to ensure that they have considered ways that their IT can positively measure up to each standard of system performance.

An alternative assessment of project success has recently been put forth to suggest that project success is meaningless unless it also factors in the promise of potential future possibilities a project can generate.[2] In this scheme, project success takes on a time-dependent dimension that must be factored into how we assess the effectiveness of a project. In other words, it is not enough to look at the results of a project in the present day; we must also evaluate it in terms of its commercial success as well as the future potential it offers a firm in terms of generating new business and new opportunities. Figure 2–1 illustrates this alternative project success scheme, in arguing that the four relevant dimensions of success should be:

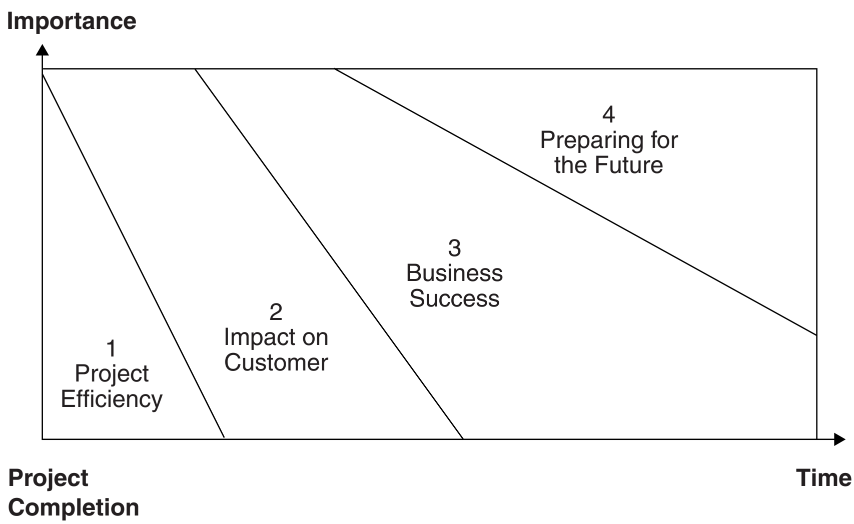

Figure 2–1 Time Dependence and Importance of Project Success Dimensions
Source: Shenhar, Levy, and Dvir, 1997

- ***Project efficiency***—meeting budget and schedule expectations
- ***Impact on the customer***—meeting technical specifications, addressing customer needs, and creating a project that is used by the client and leads to enhanced satisfaction on the part of the customer
- ***Business success***—asks whether the project achieved significant commercial success or generated a large market share
- ***Future potential***—the project opened new markets or new lines of products or developed a new technology

The intriguing aspect of these findings is to solidify futher the notion that the old image of successful projects being those that only satisfied the triple constraint is becoming increasingly difficult to justify. Projects, as they gain importance in business operations, are also gaining a higher level of expectation from top management. The corporation expects its projects not only to be run efficiently (at a minimum), but to have been developed in such a manner that they meet customer needs, achieve commercial success, and best of all, are the conduit by which the firm develops new business opportunities and future potential.

A final conceptualization of project success has recently been offered by Atkinson,[3] who also argues against the use of the overly simplistic triple constraint as a measure of success. In his model, success requires multiple assessments by all affected groups (stakeholders) that the project impacts. Further, the context, or type of project is relevant to specifying the criteria that most clearly define its success or failure. Table 2–1 shows his model, with the traditional ''iron triangle'' of cost, quality, and time viewed as merely one element in an otherwise more comprehensive set of success measures. How a project is to be measured is a decision that needs to be addressed before the project is undertaken. As the old corporate axiom

Table 2–1 Understanding Success Criteria

Iron Triangle	Information System	Benefits (Organization)	Benefits (Stakeholders)
Cost	Maintainability	Improved efficiency	Satisfied users
Quality	Reliability	Improved effectiveness	Social and environmental impact
Time	Validity	Increased profits	Personal development
	Information quality	Strategic goals	Professional learning, contractors' profits
	Use	Organization learning	Capital suppliers, content project team, economic impact to surrounding community
		Reduced waste	

Source: Atkinson, R. Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management* 17(6):337–342, 1999

"What gets measured, gets managed" suggests, when project teams understand the standards to which their projects are being held, it reinforces the appropriate emphasis that gets placed on project performance. For example, in an information system setting, if the criteria of improved efficiency and effectiveness, satisfied users, and quality are clearly identified as key, the project team will focus its efforts along these lines more exclusively, to the benefit of the project's outcome.

Assessing Success over Time

One of the truly difficult tasks confronting any project manager lies in making reasonable and accurate assessments of a project's viability early in its development. Part of the problem lies in the fact that many projects do not proceed in a perfectly linear fashion from start to finish. In other words, it is an error to assume that a project's progress can be tracked according to a well-understood path, particularly if that project represents a unique technical challenge or employs features that company has never dealt with before. The perfect world follows a linear development path; that is, when 50 percent of the project's resources are expended, one expects the project to be 50 percent completed and so on.

The true project activity line often follows a far different path. For example, it is not atypical to find that far into the project (from an expense and time point of view), little actual progress has been made. In fact, when 50 percent of the resources have been spent or the schedule has elapsed, it is not uncommon to find less than 20 percent of the activities completed. Such a progress sequence presents a true test of nerves and savvy for many project managers. The natural response to such a state is either to panic and find scapegoats who can be removed from the team, or to throw additional resources at the project in the hope of "buying" progress. Either approach, though understandable, is almost always counterproductive.

In his landmark book, *The Mythical Man-Month*,[4] Frederick Brooks describes the sequence of events leading to the development of IBM's 360 operating system in the mid-1960s, a project for which he was responsible. He discovered a fascinating effect caused by belatedly adding additional resources to ongoing, late activities. Additional personnel simply caused the project to slip further behind schedule. Rather than make up for lost time, the net effect was to delay the project even more.

According to Brooks, all project activities are subject to delays caused by the learning curve. The rapid ramp-up in progress that occurs near the activity's completion date is a result of the initial learning that had to take place prior to adequately performing the necessary tasks. Assume that the team has just completed this activity, using the learning-curve model. If the same personnel were then asked to immediately replicate the process with a new project, in all likelihood their progress line would much more closely match the linear, perfect-world path. Why? Because they have now charted this activity sequence and learned the appropriate lessons. Hence, any new activities would simply involve replicating the old sequence, with the learning curve completed.

The underlying point that project managers need to understand is that projects, which usually involve new or untried technologies or development processes, require a natural learning curve as part of the implementation process. As a result, when attempting to assess the viability of a project and make a reasonably accurate determination of the likelihood of its successful completion, project managers must first acknowledge that they are operating in uncharted territory filled with misleading and even contradictory indicators. This point should be kept in mind when facing the decision of whether to terminate a project that is over budget or behind schedule.

The decision whether to terminate a project is never easy. We may be making such decisions on the basis of misleading indicators. A recent study of research and development (R&D) projects sheds some important light on the termination decision, arguing that many times the seeds of future disaster are sown early in the project's development. The difficulties do not typically stem from technical problems, but from decisions and assumptions of the top-management team. The study measured a number of factors that, it could be argued, help or hinder a project's development, including the priority assigned to the project, the viability of its commercial objectives, and the authority given to team members and the project manager. The study findings are intriguing: Within the first six months of an R&D project's existence, there are often clear signs that the project may be a good candidate for termination. For example, the research suggests that terminated projects "were seen by their team members to have a low probability of achieving commercial objectives, did not have team members with sufficient authority, were targeted at fairly stable markets, were given low priority by R&D management, but were managed efficiently and were receiving valuable information from a business gatekeeper."[5]

The final two points are particularly important: Unsuccessful projects may end up that way regardless of the efficiency with which the actual development process is managed. The best management in the world cannot obviate the other determinants of project success or failure. Likewise, even having someone in top management consistently providing valuable information is not, in itself, sufficient to ensure that a project will succeed.

Another frequent error many organizations slip into when assessing the performance of their project development is to make inadequate allowances for the impact of time on a project's viability.

EXAMPLE. A company was determining the success of a recently completed hardware computer-development project. Based on internal cost-accounting data, the project looked good: It had come in on time and only slightly over budget. Further, the hardware performed as it was intended to perform. As a result, the project manager was given a performance bonus and a reassignment as a reward for a job well done. Unfortunately, the story does not end there. The project, although internally efficient, was a disaster in the marketplace from its first introduction. The technology that the company had assumed would be adequate turned out to be so user-unfriendly that the product was withdrawn within nine months.

This story illustrates a number of the problems faced in making judgments about projects as either successes or failures. First, it was clear that from the company's point of view, this project was not seen as a failure at all; in fact, just the opposite was the case. The second problem had to do with the incomplete picture of project expectations that top management painted. Obviously, client satisfaction was never held up as a concern of the project manager, who naturally devoted his time to the measures that *did* matter for his performance appraisal: schedule, budget, and performance. Third, the story demonstrates a subtler point: It is important, in the absence of full information, to refrain from assuming that a project is a success or failure too early in its life, before the final returns have had an opportunity to come in.

This conclusion suggests that many projects deemed successes are, in fact, failures. The reverse, however, is also true: Many projects that give every evidence of being instant failures may actually demonstrate themselves to be long-term successes.

EXAMPLE. One example that comes immediately to mind is the well-known English Channel tunnel project, known simply as the Eurotunnel, or ''Chunnel.'' Opening in 1994, nearly eighteen months behind schedule, the Chunnel project was originally budgeted for £7.5 billion. The final bill, at £15 billion, was twice the initial projection. From an internal auditing perspective, the Chunnel represented a financial nightmare, particularly in light of news that it defaulted on the bond financing made by the initial investors in the venture. Nevertheless, looking at the project's long-term potential, one must admit that its contribution to society may be significant. In effect, the judgment of project success or failure is in the hands of future generations.

This case illustrates the importance of balancing immediate assessment against long-term project viability, similar to Shenhar, Levy, and Dvir's argument cited previously. Clearly, there are definite benefits involved in waiting until after the project has been completed and has been introduced to its intended clients before assessing the success and impact of the system. On the other hand, one must be careful in not prolonging a project that probably won't be a success in the market.

Almost every researcher who has studied the impact of internal and external factors on project outcomes has concluded that it is the human, rather than the technical, factors that are the primary determinant of whether a project will succeed.[6] Although no one will deny that computers, scheduling, and budget models are important elements in controlling a project, the research suggests that the larger, *managerial* issues are typically the key determinants of a project's likelihood of success. Project management has always been and remains, a people-management challenge first and foremost.

A Ten-Factor Success Model

A study of critical success factors (CSFs) in the project implementation process looked at over 400 projects varying greatly in terms of the basic characteristics.[7] A wide range of representative samples included R&D projects, construction projects, and information-system projects. Their study validated the following model of CSFs for project implementation.

PROJECT MISSION
Most people intuitively understand the importance of conducting a feasibility study prior to project kickoff. Further, it is vital that project managers answer some fundamental questions not only at the start of a new project, but throughout its development. Two key questions are: Are the goals clear to me and the rest of the organization? Are the goals of the project in line with the general goal of the organization?

TOP-MANAGEMENT SUPPORT
Management support is extremely important for the success of any new project. Project managers not only depend on top management for direction and authority in running their projects, they rely on them as a safety valve as well. That is, when the project is undergoing difficulties, it is vital that top management be aware of the problems and be willing to offer necessary additional aid or resources for the project manager and team. Top management's support of the project may also consist of the project manager's confidence in their support in the event of crisis.

PROJECT PLANS AND SCHEDULES
Project planning refers to the importance of creating a detailed outline of the required stages in the implementation process, including work breakdown, resource scheduling, and activity sequencing. Scheduling, on the other hand, is generally understood to refer to the tasks of creating specific time and task-interdependent structures, such as critical path and Gantt charts. The schedule should include a satisfactory measurement system as a way of judging actual performance against budget and time allowances. Project managers need to identify the important personnel skills required for successful project completion and make contingency plans in case the project is off schedule.

CLIENT CONSULTATION
The client is anyone who will ultimately use the final project, as either a customer outside the company or a department within the organization. The degree to which clients are personally involved in the implementation proc-

ess will cause great variation in their support for that project. It is, therefore, important to determine whether clients for the project have been identified. Once project managers are aware of the major clients, they are better able to determine accurately if their needs are being met.

PERSONNEL

In many situations, personnel for the project team are chosen with less than full regard for the skills necessary to actively contribute to implementation success. Project managers need to recruit, select, and train members of the project team so they have the requisite skills and commitment to perform their functions. Team members need to be committed to the project's success and understand the lines of authority.

TECHNICAL TASKS

Companies have to ask themselves if they have the necessary technology and training to support project development. The decision to initiate a new project must be predicated on the organization's ability to staff the team with competent individuals and to provide the technical means for the project to succeed.

CLIENT ACCEPTANCE

This refers to the final stage in the implementation process, at which time the overall efficacy of the project is to be determined. Too often, project managers make the mistake of believing that if they handle the other stages of the implementation process well, the client will simply accept the resulting system. In fact, client acceptance is a stage in project implementation that must be managed like any other. Project managers must be prepared to sell the project to clients.

MONITORING AND FEEDBACK

At each stage of project implementation, key personnel should receive feedback on how the project is comparing to initial projections. Within many organizations experienced in running projects, there is little general agreement on how to track projects, what features to track, and how to report these data. However, making allowances for adequate monitoring and feedback mechanisms gives the project manager the ability to anticipate problems, oversee corrective measures, and ensure that no deficiencies are overlooked.

COMMUNICATION

The need for adequate communication channels is extremely important in creating an atmosphere for successful system implementation. Communication is essential within the project team, between the team and the rest of the organization, and with the clients. Typical communication involves issues such as the project's capabilities, the goals of the implementation process, changes in policies and procedures, and status reports.

TROUBLESHOOTING

Problem areas exist in almost every project-implementation effort. The measure of a successful project-implementation effort is not how well problems are avoided, but knowing the correct steps to take once problems develop. Regardless of how carefully the implementation effort is initially planned, it is impossible to foresee every problem that could possibly arise. As a result, it is important that the project manager make adequate initial arrangements for troubleshooting mechanisms to be included in the implementation plan. Such mechanisms make it easier to react to problems and forestall potential problem areas in the implementation process. Project managers should spend a part of each day looking for problems that have just begun or that have the potential to begin.

Finding a Balance

The client, not the project manager, is the ultimate arbiter of successful project implementation. However, overemphasis on client concerns and sacrificing internal constraints such as budgets, schedules, and performance is not the answer either. What is required is a balance that allows one to prioritize activities correctly while ensuring that the project is not done in by a factor that could have been controlled but was not addressed. If such a balance is achieved, it will go far toward creating an atmosphere in which project priorities are well understood and serve as guideposts to reduce the manageable reasons for projects to fail.

ENDNOTES

1 DeLone, W. H. and McLean, E. R. Information systems success: The quest for the dependent variable. *Information Systems Research* 3(1):60–95, 1992
2 Shenhar, A. J., Levy, O., and Dvir, D. Mapping the dimensions of project success. *Project Management Journal* 28(2):5–13, 1997
3 Atkinson, R. Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management* 17(6):337–342, 1999
4 Brooks, F. P. *The Mythical Man-Month: Essays in Software Engineering,* 3rd Edition. Reading, MA: Addison-Wesley, 1995
5 Green, S. G., Welsh, M. A., and Dehler, G. E. Red flags at dawn or predicting R&D project termination at start-up. *Research-Technology Management* 36(3):l0–12, 1993
6 Baker, B. N., Murphy, P. C., and Fisher, D. Factors affecting project success. In *Project Management Handbook,* 2nd Edition (D. I. Cleland and W. R. King, eds.), pp. 902–919. New York: Van Nostrand Reinhold, 1988
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Chapter

3

Why Project Management?

Carl L. Pritchard

Biographical Sketch . . .

Carl Pritchard is a veteran project-management lecturer, author, and instructor. As an author and researcher, he has published articles on project-management maturity, the international trends in PM, advances in risk management, and the nuances of training on the Internet. His work as an instructor has taken him around the world, training with some of the leading international training organizations, as well as for private clients and the Project Management Institute. He is the U.S. correspondent for the U.K. project-management journal *Project Manager Today*. Carl has authored several texts, including *Risk Management Concepts and Guidance* (2nd Edition), *Precedence Diagramming: Successful Scheduling in the Team Environment* (2nd Edition), *How to Build the Work Breakdown Structure,* and *The Project Manager's Drill Book—A Self-Study Guide.*

Why Project Management? Project management makes money. That's the heart of it. For all of the potential posturing and for all of the arguments over the leverage that project management may or may not afford an organization, project management makes money. Some of the business best-sellers of the past decade make the case extremely well. In Jim Collins's *Good to Great,* he provides metric evidence that principles of consistent leadership, excellent personnel selection, clear objectives, disciplined practices and staff, and consistency are the cornerstones of taking businesses from good performance to long-term *great* financial performance.[1] For anyone versed in best-practice project management, those practices sound familiar. They are also practices common to project management.

In another best-seller, *Execution: The Discipline of Getting Things Done,* Bossidy and Charan look at the operations process and, in essence, spend a chapter discussing the vital link between operations, strategy, and people.[2] Again, without using the terminology, they describe many of the practices of quality project management, ranging from project leadership to risk management.

Project management should be an easy sell because it enhances business performance. Yet some organizations still only approach the practice half-heartedly, or remain skeptical about its long-term value. Because of this unenthusiastic approach, project management is not implemented fully or is only implemented in extreme instances, minimizing the amount of help that the practices and processes of project management could bring to bear for the organization.

Project Management Enhances Business Performance

In conventional business and government organizations alike, project management is a proven means of improving business performance. The state of Michigan (U.S.A.) learned this during its three-year excursion into building better practices in project management. The state was driven to try project management improvement because of a series of failed technology implementations. By institutionalizing its project management practices and applying them consistently, the state saw a significant decline in the number of technology projects that failed early in their implementation.[3] Now other states are seeking Michigan's advice and support to improve their technology records.

In Michigan's case, the effort was to improve the success rate of software and information technology implementations. Other organizations have other distinct goals they are trying to achieve. The case for project management can only be made effectively if there are clear goals identified that project management is to achieve. In the U.S federal government, some sectors are now establishing project success criteria to establish the goals of specific projects.[4] The value of project management will only effectively be determined (and shared) where the organization can identify what the practice is *supposed* to accomplish.

In most organizations, the overarching goals of project management are similar:

- They want to apply a proven practice.
- They want to save time.
- They want to save money.
- They want to optimize their resources.
- They want to serve customer needs.

Over time, numerous organizations have recognized these qualities but have been reluctant to implement modern project management because of the perceived challenges and barriers associated with putting it to work.

Project Management Is a Proven Practice

Project management has been in practice for anywhere from 50 to 5,000 years. As a modern management practice, project management evolved out of World War II and U.S. Department of Defense projects.[5] These projects required organizations to break the existing functional boundaries and find new ways to accomplish complex work. Resources from a variety of skill areas had to be drawn together toward a common goal. Objectives were carefully outlined, including performance criteria, schedules, and budgets. The foundations were set for modern project management.

During the past 50 years, more public and private organizations have embraced project management. The construction industry was among the earliest to take on the trappings of modern project management, with network diagrams, work-breakdown structures (WBS), and Gantt charts. Other major sectors of commerce also came in the first wave, including the aerospace and pharmaceuticals industries. As the technologies for project management became more refined, other types of business joined in the practice, ranging from technology firms to the telecommunications industry. With the ongoing refinement of project-management tools, few business sectors are untouched by project management.

What makes project management progressively more attractive to such a broad industrial and commercial base? In addition to claims that project management saves time, money, and organizational effort, project management is rapidly being recognized as a value-added profession from the customer perspective. Customers recognize and want project management to support their projects. Several organizations have taken the lead in promoting project management around the world.

The International Organization for Standards (ISO)

The International Organization for Standards (ISO) is a thought leader in determining how many types of business operate today. Originating in Europe, this group has developed ISO standards for a variety of industries and practices, with a heavy emphasis on the need for consistent practice on an ongoing basis. The ISO standards are recognized as assurance that a business can perform effectively and consistently. Whenever an ISO standard is developed, it is a signal that the business practice involved is significant enough to warrant consistent practice. ISO-10006 is the project-management guideline. While not a full-blown standard with auditors and performance criteria, the project-management ISO does provide guidance on the essential processes of project management. And it also sends a clear signal that project management warrants attention as a critical business process.

Professional Associations

In the United States, the foremost organization is the Project Management Institute (PMI), founded in 1969 to draw the industry together.[6] PMI faced a unique challenge in building its professional association because the members came from a variety of practices. Approaches to project management varied widely, and industries were not ready to change those approaches readily. In 1981, PMI's Ethics, Standards and Accreditation (ESA) group took a major step forward, making an effort to create an umbrella of practices that would lead to professional accreditation. By 1984, the first certified Project Management Professionals were recognized. Since that time, the PMP certification has become a standard worldwide, with more than 50,000 PMPs certified through the early 2000s.

Just as project management professionalism was evolving in the United States, project managers in the United Kingdom had similar aspirations. The Association of Project Managers (APM) was founded in 1972 to promote project management in the United Kingdom. Today, APM offers its own multilevel certifications, with over 6,000 practitioners certified under their APM Practitioner certification.

The International Project Management Association (IPMA) was founded in 1965 and is based in Denmark. With a membership of over 20,000, the organization provides leadership for national project-management associations in 30 countries.

These professional associations add value to organizations, allowing them to speak a common project management language with their customers, whether internal or external. Such common understanding encourages intelligent dialogue and improves overall customer relations. By providing some measures of professional consistency, the various associations encourage project managers to carry similar skill sets and a consistent lexicon. With those parallels across organizations and industries, project managers enable and encourage clear communication and more effective overall management.

Project Management Today

Project management today is a far cry from where it was in the 1960s, when only the best-financed organizations could afford to integrate project information into software applications. Only massive projects could be evaluated against heuristic measures. Only organizations supporting massive capital-spending efforts could afford full-time project managers dedicated solely to the advancement of projects. Project management was the preserve of a small cadre of individuals who alone possessed the dark secrets of network diagrams, Monte Carlo analysis, and earned-value interpretation.

As the tools and practices slowly migrated away from huge capital projects, project-management software products became progressively more affordable. Organizations began to test project management to see how well it could function in their environments. Today, organizations of virtually every description practice project management, and they are taking full advantage of certified professional project managers. Project-management professions, who were once locked into their respective areas of expertise, are now branching out and becoming more skilled as generalists.

Project Management as a Time- and Cost-Saver

One of the major reasons that project management has become increasingly popular is its role as an organizational time-saver. In many modern projects, time is a consideration equal to, or more important than, money. However, with the attention to details required by project management, it can also cost time and money for an organization. A 1994 study of electrical utilities projects show that even with professional project management, schedule targets were more consistently exceeded than not—from about 20 percent under the projected duration to about 100 percent over.[7] Although the study concluded that companies were less sensitive to schedule targets, the analysis may also be a tribute to organizations' general optimism in setting schedules. In many (if not most) organizations, however, project managers do not even participate in the negotiation process when it comes to establishing budgets and schedules. Instead, project managers are assigned to projects only after the initial time and cost budgets have been clearly established.

EXAMPLE. A project manager at a telecommunications company tells of her dismay at being assigned to a project with an unrealistic schedule. Undaunted, she went to her management, diligently reporting that the project would take two weeks longer than the schedule allowed, unless significant additional resources were provided. Management expressed confidence in her capabilities but refused to grant the additional time or resources. They told her that they were sure she would ''figure out a way.'' At project completion, the project was four days late, based on the original schedule. As the project manager, she was ecstatic. She had been able to trim six days off a very tight schedule. Management did not reward her, however, preferring to acknowledge only the fact that the customer's schedule expectation had been exceeded. Based on a realistic schedule, the project manager had saved the organization time (and the associated cost of the resources for the additional days). Based on the preordained schedule, the project manager—and the application of project management—looked less than effective.

EARLY INTERVENTION

Project management saves time and money most effectively when it is used from the beginning of a project. At Sun Microsystems, Dr. William Scally defends the need for early intervention of the project manager in their educational project to ensure the success and effectiveness of testing and test criteria.[8] Scally points out that early intervention is crucial in terms of establishing tests that will ultimately serve operational and organizational objectives. At the National Aeronautics and Space Administration (NASA), the administration's Continuous Risk Management policy is driven in some measure by the need for early intervention and identification of risks.[9] The policy adds a third dimension of ''time frame'' to the conventional perspective of risk as probability and impact. By emphasizing that some risks have near-term implications (less than 30 days), the authors drive home the need for timely application of project management practice if cost- and time-consuming risks are to be avoided.

In other words, project managers need to be brought in at the very beginning of projects because project managers are supposed to *plan* the projects on which they work. They're supposed to outline the work to be done and then work to that plan. For project managers to save time on projects, they must have some measure of control at the outset.

AUTHORITY AND CONTROL

Control is a critical issue in developing project management as a time- and cost-saving practice. The project manager who is simply assigned to monitor tasks and oversee personnel performance will not have the opportunity to maximize the project schedule. If the project manager is granted some measure of control early in the process, and allowed to monitor it (and take action on it) over time, the odds for success increase greatly. In many cases, it is the project manager who first identifies impending (costly) delays, as well as the causes for those delays. Many are not the fault of the project manager or the project, but instead rest with the organization, which dilutes the resource pool or modifies the project approach in the middle of the effort.[10] Chapter 32 covers legal reasons for giving project managers authority and control in contract agreements.

ORGANIZATIONAL SUPPORT

Project management as a time-saving practice involves a variety of organizational support functions. In the proposal-analysis phase, the project manager has the opportunity to contribute to the project approach, the promotional methodology and the technical solution. In developing the schedule, the project manager has the opportunity to establish what time-saving workarounds will function and which time-saving approaches are overly optimistic. Historically, many of these tasks have been taken on by functional specialists or by proposal writers, neither of whom may understand the intricacies of the work involved. The project manager can both inject realism and facilitate their efforts.

As the project evolves, the project manager saves time for the organization by tracking which activities are ahead of or behind schedule. Although that sounds like a simple task on the surface, it is the nuts and bolts of project management. Project managers must take it upon themselves to review failures and successes, taking home the lessons learned from each. Prior to the evolution of project management, such activities were the province of the functional managers. These activities, however, detracted from what they perceived as their ''real'' job.

Project managers save time for upper management as well, serving as buffers between the executive suite and members of the project team. In any organization, team members sometimes feel the need to address issues with the upper echelons of the organization. Although project managers cannot universally resolve such concerns, they can shield upper management from some of the day-to-day issues raised by the team members. Conversely, project managers may also serve as shields for team members against executive intervention. Some higher-level managers like to intervene in team member activities, providing insight and guidance. Although such guidance may be helpful, it can also detract from team-member performance (and from the project manager's authority). Project managers save team members' time by serving as communications conduits.

EXAMPLE. The classic proof of project management as a time-saver came in 1992 in San Diego, California, where the local Building Industries Association set out to prove its effectiveness by constructing a home in world-record time. Prior to the San Diego construction, the world record for conventional home construction was just over four hours. After six months of extensive project planning and analysis, the implementation phase was ready to begin. For the San Diego project, the actual construction (including pouring concrete, frame construction, roof-truss construction, heating, plumbing, wiring, wall placement, and landscaping) lasted less than three hours.[11] Three hundred and fifty team members on-site were perfectly coordinated. With each project phase detailed to the minute, the project ran almost flawlessly. Project management can save time. But, as this example points out, investments have to be made in planning and providing resources for the project to ensure that the schedules can be met.

The old adage says *time is money.*[12] But project management saves money in other ways, in planning, resource deployment, tracking, use of reserves, and project close-out. If the project manager is allowed to pursue these basic practices, project management can be an effective money-saver. By doing a project right the first time, an organization can avoid rework and warranty service that can prove cost-prohibitive.

PLANNING

Planning costs are historically the lowest costs an organization faces during the project life cycle. Virtually all project cost models begin with a low, smooth, slow gradient during the planning phase (see Figure 3–1). Costs are

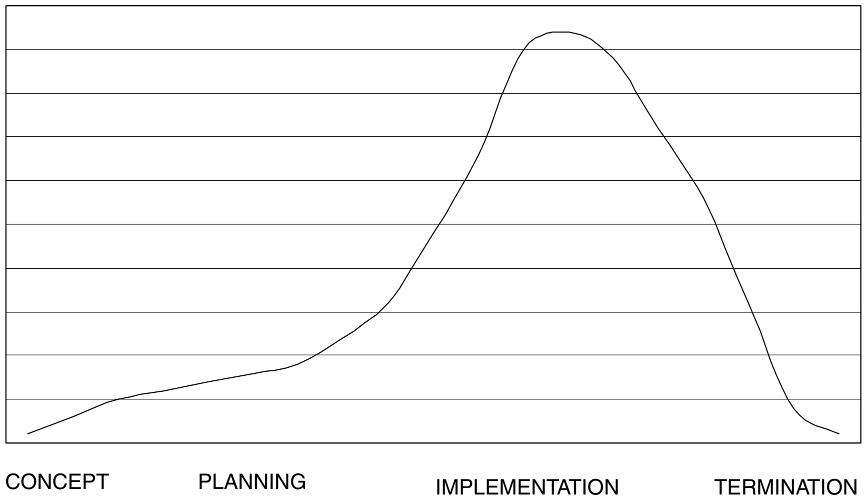

Figure 3–1 Project Cost Utilization Curve

low because most of the costs in this phase are personnel, rather than material.

Careful and extensive planning allows for intelligent use of resources later in the project. It also allows for more thorough project reviews.

The project plan must be made early, but it must also be based on sound business judgment.[13] If the business plan is weak, it will lose integrity because the project will be evaluated against a false model through its life cycle. If the plan is not realistic, it cannot be used as a barometer for project success. A good business plan is not a guarantor of success. But if the plan is sound and maps to reasoned business judgment, the chances of success improve significantly.

Without a clear, well-defined plan, there can be no honest baseline. Without an honest baseline, there can be no objective evaluation of project success. Without an objective evaluation of what constitutes project success, success (or failure, for that matter) can never be achieved. Before project management became an accepted practice, functional managers were, in large part, responsible for establishing the baselines. Although they proved highly skilled in their own areas, they lacked the cross-functional frame of reference essential to building a valid baseline for a project as a whole. Project management affords organizations that frame of reference.

RESOURCE DEPLOYMENT

Project management also saves organizations money by deploying resources more effectively. In an era of downsizing and corporate efficiency, each individual must be encouraged to broaden his or her skills and knowledge by participating in a broader portfolio of projects. Although training and on-the-job development are still broadly applied, the project manager often takes on the responsibility of a mentor to foster personnel development. Functional managers have the knowledge and skills to build insight within their functional areas, but project managers encourage greater cross-functional understanding and capability.

The importance of the project manager's role in resource deployment can be seen in the range of commercially available software. Virtually every project-management software package is built, in large part, around resource loading. With this level of attention given to employees' tasks and responsibilities, the organization is assured that individual team members are being fully deployed. Project management allows for greater tracking and understanding of employees' roles and responsibilities both in the project and in the organization as a whole.

TRACKING

Project managers save money by tracking project progress. "That which is not documented does not exist" is a maxim long supported by project managers. Early identification is often touted as the key to effective risk management, as well as effective cost management. Since project problems often turn into small-scale projects on their own, early identification of those problems allows for greater planning. Better planning means lower overall costs for implementation. Tracking also encourages increased accountability from all project participants.

USE OF RESERVES

One way in which project management can save money is through the deployment of reserves. Project managers in the field rarely get access to a contingency reserve account, even though such practice is acknowledged and encouraged time and again in the project-management literature.[14] Reserves allow project managers to reduce or eliminate the tendency to build padding into the project budget at the work-package or control-account level. Reserves allow project managers to manage problems by applying funds as appropriate.[15] Organizations that establish reserves provide project managers with a valuable tool to identify specific problem areas and respond accordingly.

PROJECT CLOSE-OUT

One other way project managers save organizations money is by ensuring a thorough, effective close-out. Project termination is a key role for the project manager and ensures that all parties involved are aware that the project has drawn to a close. As simple as that may sound, it is actually a process that is forgotten or lost on some projects, prompting them to linger beyond their time and drain an organization's resources.

Project Management Optimizes Resources

Project management drives organizational efficiency. As far back as 1959, project managers were lauded for their ability to corral organizational resources from a task-oriented (rather than a function-oriented) perspective.[16] Project managers enable cross-functionality, team development, and employee growth while maximizing use of employees' time.

CROSS-FUNCTIONALITY

Project management evolved out of a need to draw upon the resources and insights of the entire organization. Throughout the early 1900s, the need for functional organizations evolved, affording businesses a structure to bring together the individuals capable of performing a single mission and doing it effectively. Functional organizations allowed individuals to develop within their areas of expertise and encouraged upward mobility through the ranks. The mid-twentieth century brought new diversity, challenges, and possibilities. To achieve these possibilities, it was essential to draw on the capabilities of individuals from a variety of functions. Customers were demanding more from their product providers. They began to expect service as well. Integration became a buzzword.

In the past decade, the term *mass customization* has come into vogue, sufficiently that there is now an international symposium on the topic, the Interdisciplinary World Congress on Mass Customization and Personalization, with a focus on how to integrate professionals and team members from a host of disciplines into a customized, uniform solution specific to a single customer need. Management guru Tom Peters has not been left out of the mix, promoting the notion of ''Wow! Projects'' and the need for team integration and collaboration. Peters takes the notion of cross-functionality a step further, contending that virtually all work can be reconfigured into projects.[17]

Modern project management is flourishing in this environment. For any integration effort, it is essential that there be a focal point of responsibility, insight, and oversight. Project management takes the pressures of cross-functionality off the backs of functional managers. Project managers are responsible now as second bosses for many of the employees they oversee. In this role, project managers become both blessing and curse to functional managers. No longer must functional managers learn the business of the other line organizations. But they must now cope with the project managers, who make demands for resources and support.

As a result, project managers become versed in the policies, politics, and protocols of each organization with which they deal. They become conduits for both information and corporate attitude. They serve as the bellwethers of conflict or calm between the factions within the organizational hierarchy.

TEAM DEVELOPMENT

On a much smaller scale, project managers also provide organizations with opportunities for extensive employee development. In the functional organization, employees might spend their entire careers wedded to a single function. With promotions built on a blend of politics, longevity, and capabilities, long-term stability within an organization bodes well for the individual hoping for the executive suite. In today's organizations, however, that is changing. Careers are built in a series of organizations, rather than a single employer. Organizations grow and shrink rapidly. Today's opportunity may become tomorrow's reengineering project.

The project manager is compelled to create temporary oprganizations and encourage team members to function as effectively as groups that have worked together for years.[18] In the video *Four-Hour House,*[19] the narrator notes that this massive team was brought together for one purpose but ''they're working together like they've been doing this for years.'' It is evident that the clear sense of direction, the well-defined objective, and the potential for significant accomplishment all worked together to motivate the 350 people to function as a team. These lessons can be learned and applied outside this context. Project managers have the opportunity to build teams using the same approaches. The team members must have a clear understanding of the project objective, a sense of responsibility, and a role in the process. Each time the project manager succeeds in drawing together a team and making it function effectively, a significant stride is taken toward making the entire organization completely cross-functional.

EMPLOYEE GROWTH

Project managers take on a great deal of responsibility when it comes to their team members. In addition to accounting for their time, the project manager must prove that something has been accomplished through an individual's participation in the project. Without such proof, it will be far more difficult to garner resources for the next project. But optimization goes beyond whether the organization is being served. The individual team member must be served as well. Team members must have a sense that they contribute to and participate in the success (or failure) of the project.

To accomplish this, the project manager must ensure that the team members are working in the same direction, that they have contributions to make, and that they are implementing toward those goals. Working in the same direction is an issue that relates closely to cross-functionality. In many organizations, team members must serve two or more bosses. As such, the project manager's direction may be at odds with the functional manager's direction. Unifying that direction is the joint responsibility of the project and functional managers, but in many cases it falls to the project manager. Similarly, the project manager must ensure that all team members have contributions to make to the project. Although functional managers may determine which team members are assigned to the project, the project manager must validate those determinations both before and during implementation.

During implementation, the lines of authority must be clear, and anything the organization can do to support the project manager will serve both the project and the organization well. Granting project managers tools of influence, such as performance reviews, opens the door for project managers to exercise increased authority during the project. This role is crucial to the organization that hopes to evolve with the times and meet specific customer needs (through processes like "mass customization").

The project manager needs to be highly adaptive in building project teams. As projects are unique, the team structures are unique for each project.[20] That means the project manager needs to be able to create teams that can function well together and can adapt to a new type of project or project environment without the simple, clear templates that have evolved through years of functional thinking. It is yet one more area where the project manager adds value to the organization—by ensuring that team members have a sense of team in a novel environment and by ensuring they understand their roles and responsibilities (and have an opportunity to grow within those roles).

PROJECT MANAGEMENT MEETS CUSTOMER NEEDS

Customer expectations are established from the very first contact with an organization. Every meeting, every connection between the organization and the customer helps to further establish those expectations.

EXAMPLE. A project manager walked into the client site wearing khaki slacks and a polo shirt. Because the company had a dress code of "business casual," no one said a word or thought anything of it. However, several months later a new project manager took over. This project manager arrived in a suit and tie. The new project manager was quickly assaulted with questions about his attire and whether it represented a shift in the relationship with the project organization.

Every word, every appearance, every element of presentation works together to generate expectations. Customers have expectations, but in many ways the project organization is responsible for establishing them. If the first project manager had always worn a suit and tie, no one would have said anything to the second. Similarly, had the second project manager come to work dressed casually, there would have been no questions asked.

PROJECT MANAGERS BUILD CUSTOMER LOYALTY

Although sales and marketing teams are paid specifically to set the customer expectations, many of the real-world, day-to-day expectations are established by the project management and project manager team. It goes well beyond attire. If a project manager shows a willingness to introduce minor changes at no cost, that becomes a customer expectation. If a project manager directs project team members always to leave the client facility at 5:00 p.m., that becomes an expectation as well. The project manager establishes the major tenets of the relationship, and it is up to the project manager to ensure that information is communicated across the organization.

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Chapter

4

Implementing the Project-Management Process

Lewis R. Ireland

Biographical Sketch . . .

Dr. Lewis R. Ireland consults in project-management applications to support organizations' efforts to enhance productivity and efficiency. He has worked in the telecommunications energy, healthcare, and information technology industries, providing project-management coaching, mentoring, and system analysis. Dr. Ireland is active in advancing the state of the art of project management through service as president of the American Society for the Advancement of Project Management (asapm). He is a veteran of 20 years' service with the Project Management Institute and recipient of several awards, including being elected a Fellow of the Institute. He resides in Clarksville, Tennessee.

Introduction

Successful organizations rely on a disciplined process to implement project management and to prosecute work opportunities. Working in a random fashion or through a haphazard set of procedures typically results in random project product quality. A process is needed to ensure that consistent and continual dedicated effort is applied in the right manner.

As more organizations adopt project management as the system of choice to design, develop, and deliver products, services, and organizational change, the need is recognized and emphasized to ensure growth and profitability. Project management has emerged in many sectors as the primary system of choice to use projects as building blocks to greater success. Many companies are converting work effort to projects and developing their project-management capability. Others are recognizing the power of project management as the means of being competitive and are implementing a project-management capability.

 Field Guide to Project Management, Second Edition. Edited by David I. Cleland

Whereas any new system implementation typically takes time and dedicated effort, organizations can start the implementation process by understanding the fundamental principles and models for a project-management process. Designing the process that best fits an organization's strategic direction and provides for continuity of work during the transition can lead to success. Immediate benefits can be realized and capitalized on during the transition process.

What Is the Project-Management Process?

Project management was born in antiquity and has continued to evolve for more than 5000 years. It can be traced through time by the artifacts generated, such as the Great Wall of China, the pyramids of Egypt, the cathedrals of Europe, the Suez Canal, the Panama Canal, the Pennsylvania Turnpike, and the St. Lawrence Seaway.

The process that has evolved for project management today is a description of the actions needed to identify, select, plan, execute and control, and close out project work. The growth of project-management tools has materially aided in the speed at which projects are planned, controlled, and closed out. Still, the fundamental process has not changed.

The project-management process is widely accepted as the foundation for projects, but there are many different applications of the components of the process. Depending upon industry, project size, project complexity, project duration, and other critical factors, organizations modify the process to meet their need to deliver products and services to clients. The author's description of the project-management process will, therefore, vary from other processes in use, but serves as a model for initiating a project-management process.

The project-management process is defined here as: "a system of operations that guides a project from its inception to completion." This definition does not include the use of tools to automate or accelerate the components, but recognizes that certain functions are better accomplished when the tools of the profession are applied.

Projects require structure in the form of a life cycle to properly support an organization.

Project Life Cycle

Developing or adopting a project life cycle that meets the organization's needs, based on industry and products or services produced, is the first step in accepting project management as the system of choice. Projects have lifespans that are divided into phases, each phase having a definite output that represents completion of that phase. The phases are most often sequential, but may overlap for compressed project schedules. Phases are:

- ***Project-definition phase.*** The time period when an idea, need, or desire is converted into a statement of project description. This typically will result in defining project goals, the general approach to the project, and the product or service that results from the project, and establishing the organization for the project. This phase results in a Project Charter—the brief statement of who, what, where, when, why, and how for the project. This document forms the basis for subsequent planning documents.
- ***Project-planning phase.*** The time period when the project charter and associated project documents are converted into detailed guidance for the execution, control, and closeout of the project. The level of detail for the project's work is driven by: (1) the need for definition of the work to ensure understanding by the project-approving authority; (2) the need for guidance to the performing person, team, or organization; and (3) the amount of information available for planning. Details for control of the project are also included to identify frequency, location, and collection of information with which the project's progress will be measured and reported. This phase results in a comprehensive project plan that forms the baseline for actions and any subsequent changes to the project's objectives.
- ***Project-execution and control phase.*** The time period when the project plan is implemented and actions are taken to converge on the development and delivery of the project's products and services. This phase relies heavily on the project plan to guide the actions of the project team and identification of actions that are not feasible. Small, simple projects typically will not have the detailed guidance that is required for a complex, large project. The result of this phase is the delivery of the product or service and acceptance by the client.
- ***Project-closeout phase.*** The time period when actions are taken to close contracts, reassign team members to new positions, transfer tools and materials used in the project, and file any required reports. Project closeout may or may not have a formal closeout plan or checklist, depending upon the complexity of the project. The result of this phase is a report to the approving authority for the project that all actions have been completed and all resources accounted for.

Reasons and Uses for a Project Life Cycle

Project life-cycle models are tailored for an organization and its products or services. The basic model should entail all functions for a large project and be scaleable to use only those functions needed for projects of a lesser size. For example, a large project would require a life cycle that includes all areas of project planning, to include risk management, procurement management, and communications management. A small project, because of its low dollar value, probably would not have these three functions fleshed out in formal plans, but would be exercised through a less formal process.

A life-cycle approach to project management divides a project into distinct, sequential components. Some of the benefits of dividing the work into smaller parts are:

- It ensures that one phase is completed before another is started.
- Project planning is improved with a focus on stages or phases.
- Phases can be control points where management reviews the progress to determine if the project is meeting its goals.
- Different phases may require different resources, and this permits scheduling and release of skills.
- Control is exercised more judiciously when each phase has a deliverable product or service that can be evaluated and approved and release given for continuing the project.

Types of Project Life Cycles

Project life cycles vary by industry and the type of work that is being accomplished. Generally, the simplest life cycle would be used to meet planning and execution requirements. Complexity, where not needed, only causes additional work and makes the project more difficult to understand for those performing the work.

When the product being built has a high degree of uncertainty, it may be best to have many short phases or stages to control the flow and assess progress as the project moves forward. It may also help to make termination decisions early on when a project is not meeting intermediate goals.

An example of a life cycle might be a research project to develop an electric car that must travel 500 miles at speeds between 50 and 75 miles per hour. Weight is a key component of the storage batteries, and studies show that the technical performance cannot be achieved when battery weight exceeds 475 pounds. The phases for this project could be:

1. ***Product definition.*** Defining the performance specifications for a prototype electric car
2. ***Planning.*** Preparing the project plan based on the performance specifications and project goals
3. ***Execution and control for battery***
   a. Conduct a study of battery alternatives.
   b. Identify and test the top three battery alternatives.
   c. Select the best alternative that meets the performance specifications or stop the project.

4. ***Execution and control for the electric Car.*** Build the car with the selected batteries from phase 3
5. ***Test, evaluation, and demonstration phase.*** Conduct a test and demonstration of the car's capability
6. ***Project closeout.*** Deliver the car and close out all paperwork

In this example, the project has six primary phases and one phase with three subphases. The critical nature of the battery dictates that detailed control be exercised over the work. The project's life cycle phase give a high degree of control by dividing the execution and control phase into two distinct phases.

Keep the planning as simple as possible, but cover all necessary items.

Whereas this example focuses on a special product, an industry example is illustrative of the function and nature of the work. In the construction industry, erecting buildings is a mature technology with some advances in the methods and types of materials used. The life cycle could be as simple as four phases:

1. Plan the project.
2. Construct and control.
3. Commission and transfer the building.
4. Close out the project.

This example assumes that the design of the building and the blueprints are developed by another organization, such as an architectural engineering firm. These design documents are provided to the performing contractor as the technical specifications for the building. Any changes to the design of the building must be made by the architectural engineering firm. The contractor's planning (phase 1) may be limited to the tasks of converting the blueprints to a schedule and resource listing. Construct and control would, in this example, be implementing the contractor's plan according to the specifications in the blueprints and following the planned sequential use of resources. Commissioning and transfer would be putting the building into service. Closeout of the project is the accounting for property and reassignment of people.

Well-defined requirements give projects a good starting direction.

Product or Service Requirement Definition

One of the major weaknesses in planning today when definitive project requirements are lacking or poorly communicated. A shortfall in developing an accurate and precise statement of the requirement lets the project start with ill-defined directions. The lack of solid direction for the project may not be recognized until major work has been accomplished and significant expenses incurred.

The customer is the one who defines the needs, either through statements that specifically identify the product or service, or through statements of a characteristics for the product or service. If the customer defines the need in terms of a product or service description, the performing contractor can then work toward that specification. If the customer defines the needs in terms of characteristics, the contractor may need to design the product or service to ensure the design meets the customer's needs.

When uncertainty is associated with the requirement, one needs to proceed slowly until the customer's needs are converted into something tangible for which work can be productively applied. Randomly chasing the requirements can only result in wasted effort.

Project-Planning Considerations

Planning is typically very difficult for individuals. One survey in 1977 showed that less than 1 percent of the group was planning their individual lives. Out of 535 individuals, only 5 had any plan beyond the immediate time frame, which was defined as more than one week in the future. Those responding that they had plans were able to identify specific goals such as vacations, retirement, and family reunions.

Because planning is not second nature, one must leverage those strengths available to focus on doing the planning as well as the performing. Some considerations for planning are listed below:

- Have a planning model to work from that fits your organization.
- Use a disciplined approach to planning projects.
- Understand the end goals for the project and work toward accomplishing the goals.
- Use a team approach to planning so everyone knows what is happening.
- Document the goals, objectives, mission, purpose, and other guiding items.
- Focus on successfully planning the most likely course of actions.
- Plan as many items as needed in the appropriate level of detail and anticipate changes to the plan during execution.

Facts or assumptions—know the difference.

Planning often must be accomplished with less than perfect knowledge of the future or even past events. This uncertainty gives rise to two areas of special interest in any planning—facts and assumptions.

Facts are known events that have taken place and are not changed by any action within the project. While accepted ''facts'' are not changed by events, they can sometime be misstated through less than good communications. The probability of misstated facts should not deter one from accepting facts and listing them as such. List only facts that relate to the project's success or failure.

Assumptions are assumed results of future actions. Assumptions can either become facts after events take place or they can be erroneous. Events that do not follow the assumptions can cause major problems for a project. There is a need to monitor and validate that assumptions come true. List only assumptions that relate to the project's success or failure.

An example of the confusion between facts and assumptions was demonstrated in a 1995 project in Chicago, Illinois. The planners of the project and the performers were the same people. Planners were asked to generate assumptions and incorporate them in the project plan, which resulted in nearly 300 assumptions. Progress on the project had slowed to a crawl and the project team held a review among themselves after the customer complained about the lack of progress. One team member stated, ''I know why the project is not going well. One of our assumptions states that the customer will continue to like us and he no longer likes us.''

An examination of the assumption in this example reveals several flaws in planning. First, ''like us'' is a personal attribute and the result of the performing contractor's inability to perform at the planned rate. This assumption focuses on the result of poor performance. Second, the number and type of assumptions were often unrelated to the project's success or failure. Collection and incorporation of assumptions on a random basis were not assumptions, but excuses that had no place in the plan.

Stable project requirements are easier to plan than those that are changing.

Another planning consideration is the stability of the requirements for the project. While there are often changes to the requirements—either because the work cannot be accomplished in the stated manner or because the customer's needs have changed—one must recognize the need for adjusting the plan. This does not detract from complete planning of a project, but suggests that more planning is needed to start the process.

Individuals who have not performed a lot of planning often ask, ''Why plan when it will change anyway?'' An example often quoted is from the military. General Dwight Eisenhower reputedly stated, ''Once the operation starts, one can throw the plan out the window.'' To counter these statements, it should be recognized that planning includes both the guidance for performing the project and the elimination of paths that are certain failures. The planning process reveals both success and failure paths.

Valid, reliable, and accurate information is essential to project success.

Planning requires that a lot of information be collected and validated. The first consideration for use of information is its accuracy. Inaccurate information can lead to the wrong approaches and give erroneous guidance to performers. It is essential that the quality of information be validated, especially when the information is critical to the success or failure of a project.

Validating the accuracy of information relies on several factors, some more important than others. These factors include the following:

- Age of the information—how current is the information and does currency matter?
- Source of information—who provided the information or from where was it retrieved?
- Relevance of information—how relevant is the information to the project, or is it ''nice to know'' information?
- Context of information—in what context was the information developed, and is it appropriate for the context of this project?

Project-planning considerations involve thinking through the process and touching on essential elements of the project work. The plan should be as simple as possible while covering all performance and procedure items that support successful completion of the project. The simplest plan may be a schedule with a list of resources for a small project, whereas the plan for a major project may have volumes.

The planning sequence is critical to avoid errors and confusion—scope of work or product description, schedule development, and cost estimation.

Project-Planning Sequence

The sequence of events for planning is often flawed when a schedule of work is prepared before the full scope of the project is known. The first area to cover in planning is describing the work to be accomplished. This may be a statement of work or a scope statement that adequately addresses the work to be accomplished—and, not to be forgotten, the work that is not a part of the project. To have a workable plan, when there is a question of whether the work is included in the project, this must be clarified to determine work in scope and out of scope. Some areas that may be used in describing the work are as follows:

- ***Product description.*** A physical and functional narrative of the product. This may include pictures, diagrams, functionality, parametric numbers, and performance criteria.
- ***Product features.*** A listing of features or attributes. These may be physical, functional, aesthetic, or other descriptive qualities.
- ***Product quality.*** A statement of performance requirements or reference to a performance standard. Performance standard in this context includes reliability, durability, functionality, and other features.

> ***Project scheduling is perhaps the most mature function of project management.***

Second in the sequence of planning is preparing a schedule. Once the scope of work in known, work elements can be laid out over time. Scheduling, perhaps the most mature aspect of project management, is typically dictated by the delivery goal. One must fit the planned work accomplishment within a given time frame to meet the project's deliver date.

There are different levels of schedules, depending upon the need for control and work package assignment. The two typical types are as shown below:

- ***Master schedule.*** A high-level summary of the work plan that depicts work activities in logical groups and high-level milestones. This type of schedule is to give the general picture of work accomplished and work to be accomplished. Senior management will often review this on a routine basis to track the progress.
- ***Detailed schedule.*** A complete work plan that depicts all work activities and all milestones. This complete work plan is used for the daily assignment, tracking, and measuring of work progress. Although the ideal schedule is a complete roadmap to the project, complex projects may be scheduled by life-cycle phase.

Cost-estimated sums become the project's budget.

The third element in the planning sequence is developing a budget. The budget is an estimate of what the project manager believes the project will cost when completed. Developing the budget is accomplished by estimating the cost of all resources at the lowest level of the decomposed work, typically the detailed level of the schedule, and summing all the parts.

The budget, or estimated cost of the project, is the final of the prime components because long-duration projects must factor in price escalations for such items as labor, materials, and facilities. Future prices are typically more than today's prices, and changes in demand for a commodity may make a significant difference. Of course, the project duration is derived from the schedule and the resources are derived from the product description with accompanying labor requirements.

Project control must be planned to ensure successful implementation.

Planning for Control

Project planning includes those actions to be taken to collect, collate, format, analyze, and disseminate information necessary to measure the rate of progress of the project. It is essential that the desired information for control purposes be planned for collection at points in the project and at specified times. Collection of information is costly and time-consuming. The collection plan should address only that information required to measure progress and to satisfy the needs of senior managers.

Collating, formatting, and analyzing information is essential to understanding the significance of data, that is, information that has not been assessed. This process places the resulting information in context with the project environment and gives meaning to information that is viewed by project participants. Random data must be organized to give the data the proper context and promote understandability.

Dissemination of project information is typically prescribed in the *communication plan*—the document that lists participants, stakeholders, senior managers, and other concerned or involved individuals. Project information may be disseminated by a routine report or a special briefing to senior management. To whom and how frequently the information is provided is a decision that needs to be made early in the planning process.

In-process project reviews give visibility to the project's achievements.

In-Process Project Progress Reviews

In-process project progress reviews are periodically held for the project team and at prescribed times for senior managers. The purpose of the reviews is to ensure that progress is being made according to the project plan's detailed roadmap. Special reviews may be held when dictated by circumstances such as the project's progress lagging, the need for the project in its currently planned configuration being questionable, and senior management wanting to emphasize or redirect the efforts of the project team.

In-process reviews may be scheduled based on the rate of progress of the project, or they may be periodic, such as monthly or quarterly. The need for visibility into the project may be dictated by its importance to the organization or uncertainty as to whether the project remains viable. In-process project progress reviews are important to assess the following:

- Progress made toward technical solution and whether it matches the planned progress
- Resolution of issues that may negatively impact the project, such as technical performance shortfall, resources/skill unavailability, stability of the project's requirements, and continuing requirement for the project's product
- Progress achieved on completing scheduled work and the degree of difficulty associated with meeting the schedule
- Rate of expenditure of funds as compared to the budget, to include use of the contingency reserve and management reserve against unanticipated work or work inefficiencies
- Ability of the project manager to resolve major issues that jeopardize the project's successful completion
- The project manager's plans for the future and whether they are success-oriented

Project reviews are often conducted by the project team on a weekly basis, although the depth of the reviews is limited to current situations. Monthly, quarterly, and special project reviews are attended by senior managers such as the project director, vice president of projects, the project steering committee, and the customer. Each has a required role to play in the review, even though the roles may overlap. The project-management process recognizes the needs of all stakeholders to ensure that all these needs are met.

Cultural Aspects of Implementing Project Management

Cultural aspects of an organization bring strength and stability to the people. During times of change, the culture may oppose doing things differently unless the reasons for change are explained and demonstrated. Implementing a project-management process is a kind of change, and it changes the way people respond to work situations. It is no longer work as usual, but following a new set of procedures to achieve benefits for the organization.

Changes to an organization must consider the historical development of a culture, and the people and their individual and collective expectations must be recognized and dealt with.

An example of an organization establishing a project-management process highlights the challenges encountered. Ten engineers were appointed as project managers for projects ranging in cost from $1,000 to more than $15,000,000. Each was a working project manager and a fully qualified engineer. No one had training in project management or fully understood project management. A consultant was brought into the organization to support the development of the project-management process.

The consultant first identified the types of projects being pursued and the limitations on project work imposed by environmental considerations. Three generic models of a project schedule were developed for use for drafting the duration of each project. Fortunately, all projects were similar in content, but varied by size. While the project managers worked on projects, the consultant developed parts of the project-management process and implemented them as soon as the parts were completed. This allowed the project managers to benefit from components of the system while it was being constructed.

The results of this implementation provided a framework for the project managers to use and involve senior managers to ensure the process was being used. Within a year, the organization was able to achieve 17 percent gain in the amount of work being accomplished without additional expenditures. This direct increase in productivity was dramatic; the expectations of senior managers had been to realize a 10 percent increase in productivity.

Summary

The project-management process and its successful overlay on an organization will often determine whether the organization is competitive with similar deliverers of products and services. The project-management process is a disciplined process that needs to be tailored for an organization to fit its products, services, project sizes, and environmental context. Successful organizations will typically have the process either fully implemented or be making a concerted effort to improve the existing process.

This project-management process has fundamental tools that are essential to project work and define the process for conducting work. The project life cycle is one primary tool that must be defined and improved over time to best match an organization's business

An organization must have a planning process in place as part of the project-management process. Planning is not intuitive for many individuals. Planning is a major part of project management, and the project participants, especially the project manager, must know how to design the road-map to project success. Considerations include knowing the difference between facts and assumptions, as well as knowing when to use them.

Another aspect of project planning is knowing and following the proper sequence for the various components. Defining the requirement for the project first means scoping the technical aspects. Business processes, such as scheduling and budgeting, follow and use the technical definition to guide projects to the right solution.

Project control relies on accurate, reliable, and timely information. Planning for the collection, formatting, and analysis of project data contributes to the successful implementation of a project.

Periodic project reviews on major projects are essential to determine the progress achieved at a given point in time as compared to the project plan. Reviews are also an opportunity to assess the value of the benefits of the projects to determine whether they should be continued. Special reviews may also be appropriate when either projects do not meet expectations or there is a need to review the potential benefits.

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SECTION II

Project Planning Techniques

Chapter

5

Practical Tools and New Developments in Project Selection

Christopher A. Chung and Abu Md Huda

Biographical Sketch . . .

Christopher A. Chung is an associate professor in the Department of Industrial Engineering at the University of Houston. His areas of interest are engineering management and management and operation training simulators. Dr. Chung is also the author of the *Simulation Modeling Handbook: A Practical Approach.* He has a bachelor's degree from Johns Hopkins University and a master's and doctoral degree from the University of Pittsburgh. Dr. Chung has management experience as the commanding officer of a U.S. Army bomb disposal unit and industrial experience as a manufacturing quality project engineer for Michelin Tire Corporation.

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Introduction

The selection of appropriate projects is critical to the execution of organizational strategies. Because of this strategic importance and the significant resources that may be dedicated to a project, project managers should ensure that all potential projects should undergo a formal evaluation process. This evaluation process should identify promising projects while rejecting those that are inferior with respect to the organization's mis-

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sion, objectives, goals, and strategies. This chapter presents a number of practical tools and examples to assist users in this process.

Projects are a primary means of executing organizational strategies. For this reason, project-management practitioners should have a working knowledge of practical project-selection techniques. This knowledge should include how to identify individual project-selection factors, choose among a variety of project-selection models, and implement the chosen model.

The objective of this chapter is to provide project-management practitioners with this working knowledge. This chapter will first show how to generate a list of project-selection factors that support the organization's mission, objectives, goals, and strategies. It will then discuss the advantages and disadvantages of a range of both nonnumeric and numeric project selection models. Next, it will illustrate, with the use of extensive examples, how to use each of these project-selection models. Lastly, the chapter will discuss advances in information technology to assist the project manager in more effectively executing the project-selection process.

Determining Project-Selection Factors

The first step in the project-selection process is to identify a set of factors against which the project manager must evaluate potential projects. These factors will differ according to each organization's mission, objective, goals, and strategies. Though selection factors are unique to each organization, the following list of factors may serve as a preliminary starting point:[1]

Alignment with core business
Top management support
Positive impact on various stakeholders
Stage of technology development
Adequate organizational technological knowledge
Existing facility and equipment
Availability of raw materials
Potential market for output
Probability of adequate share of potential market
Able to reach market in a timely manner
Adequate return on investment
Adequate payback period

While these project-selection factors may serve as a starting point, project-management practitioners should direct significant effort towards identifying an organization-specific set of factors. Though many methods are available to identify these factors, we recommend the simple but effective technique of brainstorming.

BRAINSTORMING

Brainstorming is the process of generating new ideas by a group of people in an organization. In a brainstorming session, five to twelve qualified people gather together to discuss alternative ways of handling a situation or solving a problem. The idea is to generate a spontaneous expression of new ideas regardless of evaluation. The process requires that there should be no criticism or evaluation of any suggestion during the initial phases of the session. There should be no limit on the number of ideas generated, and participants may suggest new ideas based on other participants' ideas. A brainstorming session generally consists of the following three-step procedure.

Step 1: Problem statement. The process of brainstorming starts with the statement and a small introduction of the problem. For the purposes of this chapter, the problem would be the identification of project-selection factors for a particular organization.

Step 2: Brainstorm. In this stage, participants are asked to submit their own suggestions for the selection factors. Participants offer suggestions in a sequential manner. All the suggestions are recorded on an overhead or chart. Being able to viewing the growing list of selection factors may help the participants generate new ideas for selection factors. Ideas are recorded until all participants pass. There can then be free discussion and clarification of the recorded ideas. Once this discussion is completed, the nominal group technique can be used to retain the most important ideas for project selection factors.

Step 3: Nominal group technique. In this stage, each participant is given a certain number of votes to cast in favor of the listed ideas. The votes in favor of each idea are totaled and a certain number of the most popular ideas are retained as project-selection factors.

Project-Selection Methods

The next step in the project-selection process is to choose one or more project-selection models. The choice of model is dependent on the amount of information and time available to the project-management practitioner. The two basic categories of project-selection models are nonnumeric and numeric methods.

Nonnumeric Methods

Nonnumeric methods are generally used when there is only a limited amount of information available on each project or when the selection process must be completed quickly. These methods are characterized by the use of expert opinion, graphical, and ''go/no go'' means to select projects. Nonnumeric methods include comparative benefit, decision tree, and profile models.

COMPARATIVE BENEFIT MODEL

Project-management practitioners can use the comparative benefit model when a number of dissimilar projects are under consideration. This allows a ranking to be obtained even though the projects may not be able to be evaluated against each and every individual project-selection factors. One variation of the comparative benefit model utilizes the Q-sort technique.

Q-sort

Q-sorting is used in rank-ordering projects in the process of project selection.[2] The process can be carried out by an individual or by a committee of people. It involves the evaluators sorting a deck of cards containing the project titles from the most preferred to the least preferred projects. The sorting is based on an overall subjective evaluation of the projects based on a set of predefined guidelines. These guidelines may include one or more of the organization's project-selection factors.

The steps in Q-sorting are as follows:

1. Each participant is given a set of cards, bearing the name or title of a project.
2. The participant is asked to sort the cards into two categories, one of high priority and the other of low priority, according to an overall knowledge of the selection guidelines. There is no requirement that there be an equal number of cards in each category.
3. Both the high- and low-priority cards are resorted to identify medium-priority projects. These projects are extracted and placed in a new pile. There should now be high-, medium-, and low-priority piles.
4. The high-level pile is then sorted into two groups, one group of high-level projects and a second group of very high-level projects. Similarly, the low-level pile is sorted to form a new low-level group of projects and a very low-level group of projects.
5. There should now be very high, high, medium, low, and very low piles of projects. The selections should now be further surveyed by the individuals to adjust any card that seems to be out of place.

After the completion of the Q-sorting, the individual decisions are tallied for presentation to the entire committee. This tally shows the degree of agreement within the group. The group then discusses the result to modify it or reach a general consensus. The projects in the very high category, for example, would be further considered for funding.

DECISION TREE MODEL

The decision tree model uses a series of branches to determine which projects best meet the needs of the organization.[3] In simple decision tree models, the project is evaluated on a go/no go basis at each branch, according to the requirements of the selection factors. Projects that meet the requirements proceed to the next branch. Projects that fail any requirements are considered as having zero value to the organization and are removed from further consideration.

EXAMPLE. For the decision tree method and all other subsequent techniques, we will utilize two projects, A and B, as examples to illustrate the application of various project-selection models. The following paragraphs summarize these projects with respect to the starting point project-selection factors previously identified.

Project A will produce a project that is aligned with the core business of the organization. The project has the support of top management and is favorably viewed by the organization's stockholders. However, it is early in the stage of technology development and the organization does not have a great deal of specific technological knowledge about the manufacturing process. As would be expected, the organization also does not currently possess facilities to manufacture the product. If the organization decides to go ahead with the project, raw materials are readily available. The organization believes that there is a potential market and that they can reach the market in a timely manner, as well as gain a share of the market. Unfortunately, the investment in the manufacturing process is not likely to provide an initial adequate return on investment. Similarly, it may take a longer than acceptable payback period.

Project B will produce a product that is not specifically associated with other products that the organization has manufactured in the past. The project is well received by top management, but the organization's stockholders are concerned about entering a market that is already close to saturation. Because the organization has not previously been in this business, little organizational technological knowhow is present. However, the technology required to manufacture the product is well developed and the organization can easily modify existing facilities and equipment to manufacture the product with readily available raw materials. The market already exists and the organization can rapidly enter the market, but there is some question as to the probability of gaining a significant market share. Because little research and development is necessary, the organization is confident that there would be an adequate return on investment and a reasonable payback period.

Application of the decision tree model to project A would be as follows. At the first branch, project A would be evaluated for its alignment with the organization's core business. Since this requirement is met, it would then be evaluated for top management support. Because there is top management support, project A would next be evaluated for its impact on various stakeholders, including the organization's stockholders. Project stakeholders view the project favorably, so the evaluation process proceeds. At this point, project A has successfully negotiated the first three project-selection factor branches. However, it is discarded at the fourth factor, because the technology is in an early stage of development. Project B is discarded at the start of the decision tree process because it is poorly aligned with the organization's core business. Thus, it would appear that neither project A nor B supports the needs of the organization.

An advantage of the decision tree model is its ability to depict the evaluation process graphically. Project managers/teams can quickly identify the limitations of individual projects. Unfortunately, the decision tree model possesses a number of disadvantages. One is that the project either meets or does not meet the project-selection factor requirements. Thus, the project manager/team is forced to make go/no go decisions. A second disadvantage is that only those projects that meet all of the needs will successfully negotiate the decision tree model. This may cause projects that are strong in many respects and weak in only in one or two respects to be discarded. Particularly rigorous decision trees may not yield any suitable projects.

PROFILE MODEL

The primary use of the profile model is in situations where an organization has limited information about the potential contribution of each project. The profile model may utilize the set of organizational project-selection factors developed above. For each factor, the project evaluators make a binary decision, that is, either yes or no, as to whether the project meets the requirements of a given selection factor. After evaluating all of the factors, the project manager totals the number of factors which the project fulfills. The project manager/team can then select either all projects that meet a minimum number of the requirements or a certain number of the projects that meet the most requirements.

EXAMPLE: An examination of projects A and B with respect to the preliminary project-selection factors would yield the following results.

	Meets Requirements	
Selection Factor	Project A	Project B
Alignment with core business	Yes	No
Top management support	Yes	Yes
Positive impact on various stakeholders	Yes	No
Stage of technology development	No	Yes
Organizational technological knowledge	No	No
Existing facility and equipment	No	Yes
Availability of raw materials	Yes	Yes
Potential market for output	Yes	Yes
Probability of share of potential market	Yes	No
Able to reach market in a timely manner	Yes	Yes
Adequate return on investment	No	Yes
Adequate payback period	No	Yes
Total requirements met	7	8

According to the profile model, project A meets seven requirements while project B meets eight requirements. It would appear that project B is a slightly better choice for the organization to pursue than project A.

While the profile model is simple and easy to use, it suffers from a number of limitations. The most serious of these is that the project manager/team must decide that the project either meets or does not meet each of the selection requirements. There is no mechanism to account for varying degrees to which a project meets the selection requirements. A second limitation is that this model assumes that each selection requirement is of equal importance to the organization. Thus, a selection factor that may actually have significantly less value to the organization will have the same mathematical impact on the final rating as a more critical selection factor.

Numeric Methods

Numeric methods are normally used when more information is available about the potential projects and a sufficient amount of time is available to conduct a more rigorous evaluation. Most of these models may be easily implemented using microcomputer spreadsheet software such as Microsoft Excel. There are two general categories of numeric methods: *scoring* and *accounting* models.

SCORING MODELS

Scoring models are more complex versions of the basic profile model. Whereas the basic profile model required a simple yes/no response to each selection factor, scoring models require a numeric assessment of the degree to which the project contributes to the factor. Scoring models include unweighted and weighted factor models.

Unweighted Factor Model

The unweighted factor model consists of assigning a numeric score for each selection factor for each project. This model assumes that each selection factor is of equal importance. Typically, each project is rated as very high, high, medium, low, or very low with respect to each selection factor. A numeric value is associated with each rating. A project rated very high for a particular factor would receive a value of five. Conversely, a project rated very low may receive a value of one. After the numeric score for each selection factor is assessed, the values for all of the selection factors are totaled. The total score for each project is compared to other competing projects. The projects with the highest scores are presumed to offer a better fit with the strategic and tactical needs of the organization.

EXAMPLE: With additional information, a reevaluation of projects A and B with the unweighted factor model could yield the following results:

	Rating	
Selection Factor	Project A	Project B
Alignment with core business	4	4
Top management support	4	4
Positive impact on various stakeholders	5	2
Stage of technology development	1	4
Organizational technological knowledge	2	2
Existing facility and equipment	1	3
Availability of raw materials	5	5
Potential market for output	5	5
Probability of share of potential market	5	1
Able to reach market in a timely manner	5	3
Adequate return on investment	2	3
Adequate payback period	2	5
Total unweighted score	41	41

Using the unweighted factor model, both project A and project B receive a rating of 41 points. While project B was rated higher using the profile model, the increased sensitivity of the unweighted factor model indicates that the projects are approximately equal in opportunity for the organization.

As with the profile model, the unweighted factor model is limited by its inability to take into account selection factors that are more important to the organization.

Weighted Factor Model

The limitations of the unweighted factor model are taken into account in the weighted factor model. In this model, a weight associated with each project selection factor is added. This allows selection factors deemed more important to the organization to have greater influence on the final scoring of individual projects. One difficulty inherent in the weighted factor model is in determining the individual weights for each of the factors. One way to determine the individual weights involves the use of the Dephi method.

DELPHI METHOD FOR DETERMINING WEIGHTS. The Delphi method utilizes a panel of members to make subjective judgments on the relative importance of each project-selection factor.[4] Judgments are collected in an anonymous manner so that the participants are free from undue influence or inhibition in expressing their opinion. The responses are aggregated in a statistical format by an administrator and are fed back to the panel. The panel individually deliberates judgment based on the feedback. After a number of iterations, a final judgment is made and documented. The implementation of the Delphi method to determine project-selection factors can be summarized by:

Step 1: Group-forming. The administrator forms a group of experienced individuals to participate in the Delphi process.

Step 2: Opinion-gathering and feedback. Each individual rates the relative importance of each of the selection factors on a 0 to 10 scale. This data is collected and statistically summarized. The statistical summary is then distributed to the participants to enable them to compare their individual responses with the anonymous views of the others.

Step 3: Iterative balloting. Members of the panel revise their opinions of the relative importance of the selection factors based on the statistical analysis.

Step 4: Consensus. The iterative process may include anonymous written explanation of the correctness or incorrectness of any response. The process continues until a certain percentage (for example, 70 percent) of the members has reached consensus. Otherwise the final statistical analysis is displayed with a note that consensus could not be reached. This statistical analysis results in the raw weights for each of the project selection factors.

NORMALIZATION. After the determination of the relative importance of the selection factors by the Delphi method, it is necessary to normalize the factors. The values for all of the factors are totaled and then the relative importance of each factor is divided by the total. This yields a weight between 0 and 1 for each project-selection factor.

Selection Factor	Raw Weight	Normalized Weight
Alignment with core business	8	8/95 = 0.084
Top management support	10	10/95 = 0.105
Positive impact on various stakeholders	10	10/95 = 0.105
Stage of technology development	6	6/95 = 0.063
Organizational technological knowledge	7	7/95 = 0.074
Existing facility and equipment	4	4/95 = 0.042
Availability of raw materials	9	9/95 = 0.095
Potential market for output	10	10/95 = 0.105
Probability of share of potential market	10	10/95 = 0.105
Able to reach market in a timely manner	8	8/95 = 0.084
Adequate return on investment	8	8/95 = 0.084
Adequate payback period	5	5/95 = 0.053
Total weights	95	

EXAMPLE. The score for each project is calculated in a similar manner as the unweighted model. the value for each selection factor is multiplied by the project-selection factor weight.

Selection Factor	Weighted Project Scores: Project A	Project B
Alignment with core business	4 × 0.084 = 0.336	4 × 0.084 = 0.336
Top management support	4 × 0.105 = 0.420	4 × 0.105 = 0.420
Positive impact on various stakeholders	5 × 0.105 = 0.525	2 × 0.105 = 0.210
Stage of technology development	1 × 0.063 = 0.063	4 × 0.063 = 0.252
Organizational technological knowledge	2 × 0.074 = 0.148	2 × 0.074 = 0.148
Existing facility and equipment	1 × 0.042 = 0.042	3 × 0.042 = 0.126
Availability of raw materials	5 × 0.095 = 0.475	5 × 0.095 = 0.475
Potential market for output	5 × 0.105 = 0.525	5 × 0.105 = 0.525
Probability of share of potential market	5 × 0.105 = 0.525	1 × 0.105 = 0.105
Able to reach market in a timely manner	5 × 0.084 = 0.420	3 × 0.084 = 0.252
Adequate return on investment	2 × 0.084 = 0.168	3 × 0.084 = 0.252
Adequate payback period	2 × 0.053 = 0.105	5 × 0.053 = 0.265
Total weighted score	3.753	3.366

With the weighted factor model, project A shows clear superiority over project B, even though project A was rated lower than project B with the unweighted factor model. The additional effect of the weighting for each selection factor is directly responsible for this differentiation.

ACCOUNTING MODELS

Accounting models can be used by project managers/teams either in isolation or in conjunction with some of the previously discussed models. When used in isolation, models fail to take into account the impact of any other factors that are not specifically financially related. In contrast, when utilized in conjunction with the weighted factor model, a systems approach results where accounting issues are considered, but not used to dominate the evaluation. Since this publication emphasizes practical approaches, we will limit our discussion to the simple accounting models of payback period and return on investment.

Payback Period

This method is used to determine the length of time required for a project's accumulated cash flow to equal the amount of capital that was originally invested in the project. In the most simple case, if we assume that the net cash flow will be equal year to year, the number of years to pay back the project investment is:

Payback period in years = Total project investment/Net annual cash flow

Generally speaking, a payback period of one year or less is considered excellent, while most organizations will require a payback period of less than three years.

EXAMPLE. Project A has a total investment of \$200,000. Operating expenses including direct labor and maintenance are anticipated to be \$30,000 per year. Expected revenues as a result of the project will be \$75,000 per year. The net cash flow is \$75,000 − \$30,000 = \$45,000. The payback period is \$200,000/\$45,000 = 4.44 years.

Project B has a total investment of \$100,000. Operating expenses including direct labor and maintenance are anticipated to be \$20,000 per year. Expected revenues as a result of the project will be \$83,000 per year. The net cash flow is \$83,000 − \$20,000 = \$63,000. The payback period is \$100,000/\$63,000 = 1.59 years. Thus, in isolation, it would appear from the payback period analysis that project B would be more advantageous to the organization.

Return on Investment

Many organizations require that investment in a project meet a minimum rate of return. Typical minimum rates of return are between 20 and 50 percent. Rates of return may be calculated with the following equation:

Total project investment × (A/P, Rate of return, Service life) = Net annual cash flow Where (A/P, Rate of return, Service life) can be found in an engineering economy table of interest factors.

EXAMPLE. If the expected service life for project A were eight years, we would have the following equation:

$$200{,}000 \times (A/P,\ \text{Rate of return},\ 8\ \text{years}) = 45{,}000$$
$$(A/P,\ \text{Rate of return},\ 10) = 0.225$$

Using an engineering economy table of interest factors, 0.225 corresponds to a rate of return of approximately 15 percent.

If the expected service life for project B were three years, we would have the following equation:

$$100{,}000 \times (A/P,\ \text{Rate of return},\ 3\ \text{years}) = 63{,}000$$
$$(A/P,\ \text{Rate of return},\ 3) = 0.63$$

Using an engineering economy table of interest factors, 0.63 corresponds to a rate of return of approximately 40 percent. Thus, if the minimum return on investment the company were 30 percent, project B with a rate of return of 40% would be far more attractive than project A with a rate of return of 15 percent.

New Developments in Project-Selection Techniques

Recent advances in information technology enable the project manager to execute the project-selection process more effectively than every before. Today, project managers have access not only to the Internet, but frequently to organizational intranets. A project manager may typically use the Internet to benchmark project-selection factors with those of other competitors through public access databases or information brokers. The success of the Internet has convinced many larger organizations with dedicated information technology personnel to develop secure internal Internet or intranet systems. These intranet information systems can give project managers access to previous internal projects or project-selection processes that might otherwise have been inaccessible. This is particularly important as the records of many past projects may only exist on paper or be accessible through some legacy database system.

Information technology also allows the project manager to conduct electronic brainstorming sessions for identifying organizational specific project-selection factors. Advantages of electronic brainstorming over conventional brainstorming for this process include the ability to include more individuals in the discussion and to allow the participation of individuals who cannot attend the sessions due to distance or schedule limitations. It also allows for an electronically recorded history of the discussions. The primary disadvantage is the unsynchronized nature of implementing electronic brainstorming. Unless everyone in the session is simultaneously participating, the discussion does not occur in real time. Thus, it may be necessary to allow for several days before the session can be concluded. Electronic brainstorming can be implemented by either an e-mail discussion list or an electronic bulletin board.

An e-mail discussion list is the easier of the two to implement. With this method, the project manager sets up an e-mail address list that includes the email addresses of all of the individuals with potential interest in the project. These individuals are commonly known as stakeholders. As each individual stakeholder thinks of a new idea, the concept is entered in an e-mail replay to the list and is automatically redistributed to all of the members of the e-mail list.

A small irritation that has been identified with e-mail list brainstorming sessions is when the participants set their e-mail package to notify them automatically of incoming e-mail. If there is a high degree of volume on the list, the constant notification of e-mail messages can become disturbing. Many otherwise useful individuals are likely to request to be removed from the list rather than be continuously disturbed by the series of e-mail messages.

A final issue associated with e-mail brainstorming is the manner in which many individuals may communicate. There is some evidence that individuals will communicate more formally than in person, but less formally than with written correspondence. This means that it may be necessary periodically to sanitize or censure the e-mail list prior to remailing to all of the recipients.

The electronic bulletin board approach to brainstorming eliminates the continuous e-mail message notification problem. Here, the project manager sets up a web-based bulletin board to control the brainstorming discussion. Individuals must take the initiative to regularly check the bulletin board for new developments. The potential success of this approach may at first seem questionable. However, many user group bulletin boards typically experience high levels of activity. If the project manager's brainstorming group is as interested in the project as the average individual is in interest group bulleting boards, the necessary level of activity is ensured.

Summary

The objective of this chapter was to provide project-management practitioners with a working knowledge of practical project-selection techniques. This chapter included specific instruction on how to generate a list of appropriate project selection factors, the advantages and disadvantages of a variety of nonnumeric and numeric project-selection models, and how to implement each of these models.

Appropriate project-selection factors can be identified using the preliminary list and modified through brainstorming sessions. The project manager can utilize advances in information technology to help perform these sessions. The choice of project-selection model depends on the amount of information available on individual potential projects and the amount of time available for the evaluation. Some project-management practitioners may find it beneficial to use the simpler nonnumeric models to screen out the most promising projects and then use the more complex numeric models to assist in the final decisions.

ENDNOTES

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Chapter

6

A Comprehensive Model of Project Management

John R. Adams and
Miguel E. Caldentey

Biographical Sketch . . .

John R. Adams, a past President and Chair of the Project Management Institute (PMI), is a Professor of Project Management at Western Carolina University, part of the University of North Carolina Public University System. He founded and directed that institution's Master of Project Management Degree program from 1984 until his retirement in 2002. He has extensive experience as a practicing project manager, notably on several major military weapon systems development programs, and has consulted extensively in the field. He is a champion of the project-management profession and a frequent contributor to its literature.

Miguel E. Caldentey, a resident of Caracas, Venezuela, completed his system engineering degree and worked for several years with Anderson Consulting Company in its Caracas offices, participating in reengineering and system installation projects. He completed his M.B.A. degree and Project Management Certificate at Western Carolina University in 1998, where he also served as a teaching and research assistant in the College of Business. He has recently resumed his career as a Senior Project Manager with Anderson Consulting in Venezuela.

Introduction

Although many expert project managers have developed different models for managing projects, no one model has been accepted as the standard for describing the processes a project must go through to move an idea from a concept to a finished product. Each model variation has strengths and weaknesses. The traditional model that is most widely accepted within the project-management profession is termed the project life cycle (see Figure 6–1). This is a useful model for explaining what must be accomplished to complete a project, but it is not realistic in describing how that work should be accomplished.

The Project Management Institute's *Guide to the Project Management Body of Knowledge* (PMBOK) has attempted to develop a model of the process a project must go through from conception to completion. The model leaves much to be desired in explaining the progress of managing a project through its life cycle because it completely fails to recognize the need to use knowledge acquired during the project's execution to modify decisions made earlier.

This chapter presents a model that builds on both the traditional life-cycle concept and the work presented in the PMBOK to produce a more comprehensive model of project management. Unlike the other two models, the model presented in this chapter uses feedback of newly developed information gathered during later phases of the life cycle to change the project's plans and modify decisions that are made early in the project life cycle.

Toward a Realistic Model

A model is a simplification of reality, constructed for the purpose of explaining, illustrating, and emphasizing some of the main characteristics of that reality. If a model tried to incorporate all of the real world's complexity, it would be as complex and difficult to understand as the real world. For this reason, a model should be designed to highlight the most important attributes of the real-world situation being modeled, the attributes that, when understood, provide an overall explanation of what occurs in the actual situation examined. In this case, the situation to be examined is the generic process of managing a project. It is a complex process, one that appears on the surface to vary significantly in detail from one organization to another, yet one that also demonstrates high levels of consistency regardless of the project being considered. The challenge here is to model the commonalities that cut across projects and organizations while recognizing and allowing for the fact that the details of implementing this process will vary greatly from project to project and from organization or organization. One of the most universal of all characteristics associated with the execution of projects is the need to almost continuously modify the project plan to reflect the conditions encountered when the work of the project is actually being performed.

Traditional Project Life Cycle

Most models of the project-management process are based on the concept of the project life cycle in which the project is broken into phases based upon the type of work being performed in that phase and the type of skills needed to perform the work. One example of a typical project life cycle is shown in Figure 6–1. In this model, the project's life cycle is divided into four phases with clearly defined deliverables for goals marking the transition form one phase to another. The project life cycle is traditionally explained as follows:

Phase I: Conceptual. Management above the level of the project manager conceives of a project, evaluates it with respect to other possible projects, and commits to proceeding with this project. This commitment is generally associated with the appointment of the project manager, which marks both the deliverable of this phase and entry into the planning phase of the project.

Phase II: Planning. This phase involves the development of the detailed project plan and the project's managerial team. Formal acceptance and approval of the plan by the project's sponsor or owner marks the transition to Phase III and the initiation of physical work to accomplish the project.

Phase III: Execution. This phase may involve subcontractors, construction workers, programmers, medical personnel, or other skilled personnel necessary for accomplishing the work of the particular project. The actual work of producing the product being produced by the project is accomplished in this phase.

Phase IV: Completion. The transition to the completion phase traditionally occurs when the product being produced by the project is ready for testing or some form of demonstration to confirm that the product is complete and ready to be accepted by the sponsor or owner. The project ends with the formal acceptance of the product by the sponsor or owner of the product, or with the project's early termination if it is determined that the project should be abandoned.

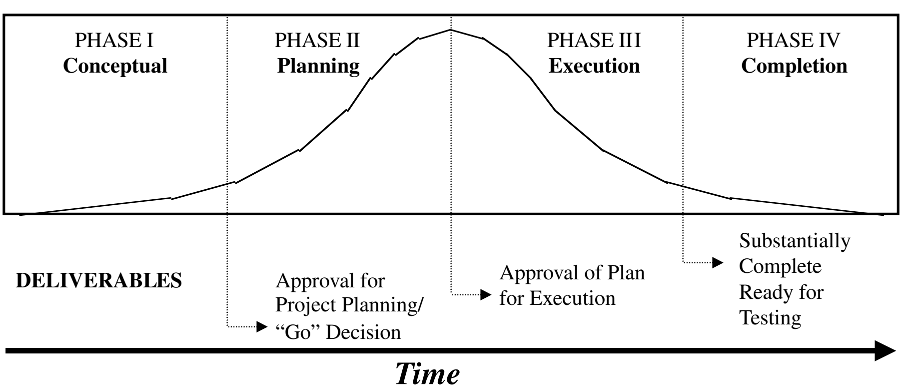

Figure 6–1 A Typical Project-Life-Cycle Model

Deliverables

The phases of the project life cycle typically refer to the product being produced by the project, rather than the process of managing the project. The model of project management presented by the PMBOK attempts to relate the project's phases to the *processes* being implemented to accomplish that work. According to the PMBOK:

> Each project phase is marked by completion of one or more *deliverables*. A deliverable is a tangible, verifiable work product such as a feasibility study, a detail [*sic*] design, or a working prototype. The deliverables, and hence the phases, are part of a generally sequential logic designed to insure proper definition of the product of the project.[1]

The term *project* could be substituted for the term *project phase* in the first line of this quotation and the statement would be just as valid. Thus the project itself could be considered a ''phase'' in a larger, ongoing work effort of the organization—such as developing or implementing a strategic plan. In fact, this quoted statement applies equally well to a project, a phase of a project, a subproject, a task within a project, an activity, or a work package. The only difference would be the scope of the work being discussed. Projects at any level are thus made up of smaller projects. Any work ''processes'' that are incorporated within a model of project management must therefore also be scalable based upon the scope of the project being considered.

Processes

The PMBOK attempts to relate the processes involved in managing a project to the phases of the project life cycle. A process is defined as ''a series of actions bringing about a result,''[2] a concept that can also be interpreted at several different levels of detail within the project context (as noted above). This general concept is used in the PMBOK to classify a variety of management processes into different process groups depending on the nature of the action that is being accomplished. The PMBOK defines initiating, planning, executing, controlling, and closing as the five ''process groups'' associated with project management.[3]

In the real world, project managers will grant the value of identifying project phases, defining the activities that should occur in each phase, and identifying management review points for making a transition from one phase to another. This is a useful technique for describing to others what needs to be accomplished when, and by what groups, in order to complete the project. However, no project manager would propose that the project is actually conducted in this manner, and a model of the project-management process needs to explain how the project is actually conducted. The problem with the project life cycle is its implication that a project progresses in a continual flow through its life cycle. For example, the project life cycle implies that planning is completed, reviewed, and approved in detail during the planning phase of the project, and the project is then implemented according to that approved plan during the execution phase. Real-world experience clearly demonstrates that information obtained during the execution phase of the project is consistently and regularly fed back and used to revise the project plan based upon actual occurrences in the field over which the project manager may or may not exercise control. The same issue exists with other phases. That is, feedback of occurrences in the field that result in improved knowledge of what the project will actually require or accomplish is regularly used to modify the decisions made earlier in the life cycle. Because a comprehensive model of project management must deal with the *process* of managing a project, the model must provide for the information feedback needed to modify the schedule, the budget, the work flow, and even the basic project objectives, when necessary. The feedback reflects what actually happens when managing projects in the field.

EXAMPLE: The B-52 Follow-On Bomber. Several years ago, the U.S. Air Force was working on an approved and funded project to develop a replacement aircraft for the B-52 bomber. The B-52 was the most recent of a long line of aircraft that included the famous B-17 Flying Fortress; the B-24 Liberator and the B-29 Super Fortress of World War II fame; the B-36 Stratofortress developed immediately after World War II; and the first jet-powered long-range bomber, the B-47. These aircraft were specifically designed to carry large bomb loads over long distances and drop them on enemy targets from very high altitudes. For accurate bombing, they had to fly straight and level for a period of time immediately before dropping the weapons so that the bombardier could take accurate aim on the targets. The aircraft were essentially large, slow, multi-engined cargo carriers with very little maneuverability and limited defensive capability. For the new aircraft, the original project specifications called for implementing new technology to create a new weapon system of similar design but capable of carrying larger bomb loads at higher speeds over longer distances. The new aircraft would need to operate at higher altitudes with an increased capability for survival in a combat environment.

Several years into the project, studies and analyses of potential enemies and their future defensive capabilities demonstrated clearly that ground- and air-launched guided missiles and radar-detection equipment were being deployed that would soon make it impossible for a large, relatively slow, high-altitude bomber to survive long enough to reach its target, much less return from enemy airspace. It was clear that an entirely new approach to long-distance bombing was required and that the basic project objectives would have to be modified if a useful, effective, and survivable weapon system was to be developed.

The existing project objectives, of course, had been approved and funded by the Congress of the United States. Any significant modification to the basic weapon-system design philosophy would have a significant impact on the approved schedule, budget, design specifications, and capabilities of the new weapon system. Neither the project manager nor any other military person had the authority to make such changes without the specific approval of both the U.S. Congress and the military Commander-in-Chief, the President of the United States.

The project manager prepared documentation making the argument for a significantly different weapon-system design. The documentation included the impact such changes would have on the schedule and budget for the project. The project manager took the proposal through the military chain of command to the Secretary of Defense, and finally to a joint session of the House and Senate Armed Services Committees. The Committees voted to endorse the proposed revision to the weapon system philosophy. The committee members encouraged Congress to approve the proposed adjustments to the project's schedule, budget, and specifications. The Committees also encouraged Congress to authorize new research projects aimed at developing the specialized electronic equipment needed by the new bomber system. Congress and the President approved the proposed changes, and the project plan was totally revised to reflect the new requirements. The final result of the project was a weapon system designed to penetrate enemy defenses by flying well below the potential enemies' radar detection system, using a terrain-following airborne radar developed specifically for this aircraft.

During the execution phase of the project, the project manager discovered that it was necessary to change basic decisions that had been made and approved during the conceptual phase of the project. From the modeling point of view, information developed during the project was provided as feedback to the sponsor and owners of the project so that appropriate decisions could be made. The result was a complete redesign of the project plan that had been developed and approved during the planning phase of the project, at a time when conditions under which the aircraft would need to operate were not accurately known.

This admittedly rather extreme example is intended to show that feedback across a project's phases is an absolutely essential part of the processes used to manage projects. This feedback process is used regularly in large and small projects to make both major and minor adjustments to the previously defined project plan. An acceptable model of project management must therefore provide for the feedback of information about events that occur during the life cycle of the project, and thus accommodate to the conditions of the real world in which the project is being conducted.

Core Processes and Facilitating Processes

The PMBOK introduces a classification scheme for defining processes that occur in managing projects in more detail than the process groups. These processes are called *core processes* and *facilitating processes.* The PMBOK defines core processes as those that ''have clear dependencies that require them to be performed in essentially the same order on most projects.''[4] Facilitating processes are those that are ''more dependent on the nature of the project.'' That is, they ''are performed intermittently and as needed during''[5] the project.

The core processes include those activities that must be accomplished uniquely for each project as the detailed project plan is developed. The core processes include developing the specific work-breakdown structure (WBS), the logic flow and schedule of activities to be conducted, and the budget that will be used to manage and control the project. Also called *project-management knowledge areas,* these core processes cover:

- The scope of the work to be accomplished
- The time available to complete the project
- The money or resources senior management is willing to commit to the project
- The integration of the above three factors (scope, time, and money) as necessary to complete the project

The facilitating processes include those activities that are frequently provided as a service to the project on an as-needed basis depending on the specific characteristics of the product being developed. In organizations that lack some aspect of the support required for completing the project, or in stand-alone projects, facilitating processes must be developed or provided by the project itself. For example, projects that subcontract much or all of the work involved may require a high level of procurement management services and skills for the entire project's duration. Other projects may need procurement skills only for a limited number of large-scale purchases of material or equipment. Facilitating processes typically include human-resources management, risk management, communication management, and quality management.

Project-Management Process Model

The following project-management process model is specifically designed to incorporate the five process groups defined in the PMBOK (i.e., initiating, planning, executing, controlling, and closing). The model also demonstrates the complex interactions that occur among these process groups as the project progresses. The basic model is shown in Figure 6–2. Notice that the facilitating processes as defined in the PMBOK are shown outside the flow of the core processes, indicating that they can be integrated into the project's work flow as needed based on the particular characteristics of the project. The core processes—those that must be conducted in approximately the same sequence on any project—are shown as providing the feedback necessary to modify the project's plan, and even the project's objectives, during the conduct of the project. The model can be interpreted at any level

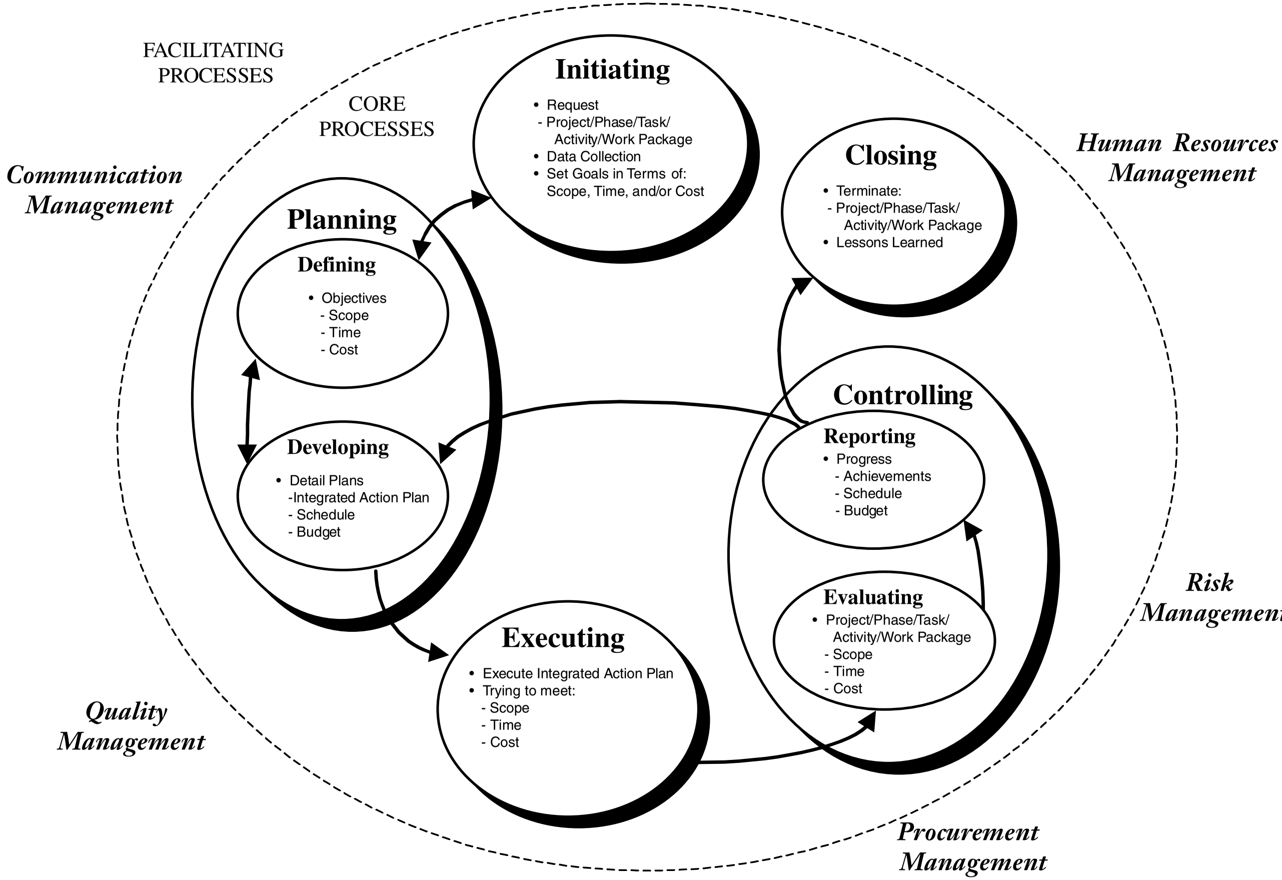

Figure 6–2 Five Process Groups Project-Management Model

of detail appropriate to the project, including the phase, task, activity, and work-package levels of detail, but for the sake of clarity the discussion begins at the project level. The typical phases of a project's life cycle referred to in Figure 6–1 can be directly associated with four of the five process groups shown in this model.

Initiating-Process Group

Work on a project begins with the initiating-process group. Senior management defines the basic requirements and requests that a project be initiated. Senior management consists of the people to whom the project manager looks for guidance and direction concerning the project's objectives. Senior management could include, depending on the project, managers above the project manager in an organization, the sponsors of the project, the future owners of the product resulting from the project, or any combination of these. The goals of the project are defined in terms of:

- The scope of the work to be accomplished
- The time available to complete the work
- The money or resources senior management is willing to commit to the project

These are three of the four project-management knowledge areas defined by the PMBOK as contributing to core processes, and they are typically known as the ''triple constraints.'' (The fourth project-management knowledge area, integration, is discussed later.) Before moving to the next phase, called the planning process group (or planning phase), a project manager is appointed and a project objective is established.

Planning-Process Group

Planning takes place at two different levels within the planning-process group. First, the project manager interacts with senior management to define the project objective in more detail; to specify the priorities among the scope, time, and budget aspects of the project; and to determine the appropriate levels of decision-making authority within the project. In particular, the project manager must develop at least a general understanding of:

- What decisions are within his or her prerogative
- When senior management wishes to be involved in making decisions relevant to conducting the project

Second, the project team then develops an integrated project plan, to include the project's action plan or work flow, the schedule, the budget, and the interactions among them. This is where the fourth core process defined in the PMBOK and drawn from the ''project integration management'' knowledge area is brought into the model. More specifically, the project-management process requires that planning, executing, and controlling be accomplished as an integration of the project scope, time, and cost-management knowledge areas. The feedback arrows in the model indicate that the project manager gets senior-management approval for the integrated project plan before the project proceeds to the executing phase.

Executing-Process Group

The executing-process group involves implementing the planned activities according to the approved schedule and budget. This is where the work of the project is actually performed and where both resources and time are consumed. One must recognize that, no matter how carefully and well it is developed, the project plan is actually based on a complex structure of estimates or guesses concerning durations and costs. No project manger will assume that all these guesses will prove to be correct. Instead, the project manager must implement a series of checks and balances designed to:

- Identify when the project is deviating from the approved plan
- Provide the information needed to take action concerning any significant deviation(s) from the plan

This series of checks and balances is defined collectively in the PMBOK as the controlling-process group.

Controlling-Process Group

The controlling-process group, unlike the other four process groups, does not have an equivalent phase in the traditional project life-cycle model shown in Figure 6–1. Rather, the control process is the area that is missing from the project-management life-cycle model. The controlling process provides the feedback that allows (and requires) that the project plan be revised. Failure to include this concept in the typical project life-cycle model is what makes the life cycle inappropriate as a model of the project-management process.

Periodically, project personnel must evaluate and document progress in terms of:

- The time that has been consumed
- The money that has been spent
- The work that has actually been accomplished

On small projects, this may be a very informal process. On large projects, however, it tends to become a very formal process consuming considerable time and effort. The current project status must be compared with the current project plan to determine how the accomplishments have varied from what was planned. Progress must be reported in terms of specific activities, and the status of each activity must be documented in terms of the time consumed, the money committed, and the actual work accomplished. When a given activity is completed, the work associated with that activity proceeds to the closing process group so the activity can be administratively terminated. In all other cases, variances from the plan should be used as a basis for revising the project plan to provide the best opportunity possible under the existing conditions for accomplishing the overall objectives of the project.

The closed loop from the planning process group through the executing process group and the controlling process group back to the planning process group is the key to demonstrating how feedback is used in managing projects to revise both the integrated project plan and the basic objectives of the project, when necessary.

Projects are completed activity by activity. Schedules and resources may need to be revised any time an activity's actual accomplishments vary from what was planned. Controlling processes identify these variances and report them so that the necessary adjustments can be made in the project plan. As an example, if an activity is accomplished late, other activities may have to be delayed and resources may have to be reallocated to minimize the impact of the delayed activity on the project as a whole.

If the impact is small, or if the impact can be managed by a minor adjustment in schedule, budget, or resource allocations, then the adjustments to the plan can usually be accomplished within whatever project specifications are current at the time. If the impact is large, however, or if a significant opportunity develops that had not been considered when originally defining the project's scope, the project manager may need to prepare documentation and make proposals that could modify the overall objectives of the project—that is, the time, budget, and/or scope of work assigned to the project (for example, see the B-52 Follow-On Bomber example above). In such a case, the project manager must consult with senior management to determine the appropriate course of action that would best serve those for whom the project is being conducted. This latter situation is reflected by the double-headed arrows leading back from planning to the initiating process group.

Closing-Process Group

The project is completed when the objectives (as revised during the project to include the possibility of simply terminating the project completely) have been met. In the closing-process group, termination processes such as closing out contracts, paying contractors, reassigning responsibilities for the project's product and personnel, and documenting lessons learned are completed.

A Hierarchy of Projects

It is important to note that projects are made up of projects that are in turn made up of projects. The model depicted in Figure 6–2 is equally applicable to a project, a phase of a project, a task within a phase, an activity within a task, a work package, or any other subdivision of work within a project that has a specified *deliverable*. The only difference would be the scope of the work being performed, or, in other words, the scope of the project being discussed. The model is therefore applicable at all levels of detail associated with a program or project. It basically emphasizes the repetitive nature of the process groups at all levels of detail within the project and documents the continuous interactions among them as the project progresses over time toward completion. Figure 6–3 demonstrates that the model can be applied at any level of detail within the project.

At the highest level, the project must follow the behavior explained by the model shown in Figure 6–2. At this level, as the project is examined from the perspective of the project manager, four of the process groups can be considered phases of the project, integrated together by the processes incorporated within the control-process group. All activities of the project must be initiated, planned, executed, controlled, and closed, with all the required interaction taking place among these processes.

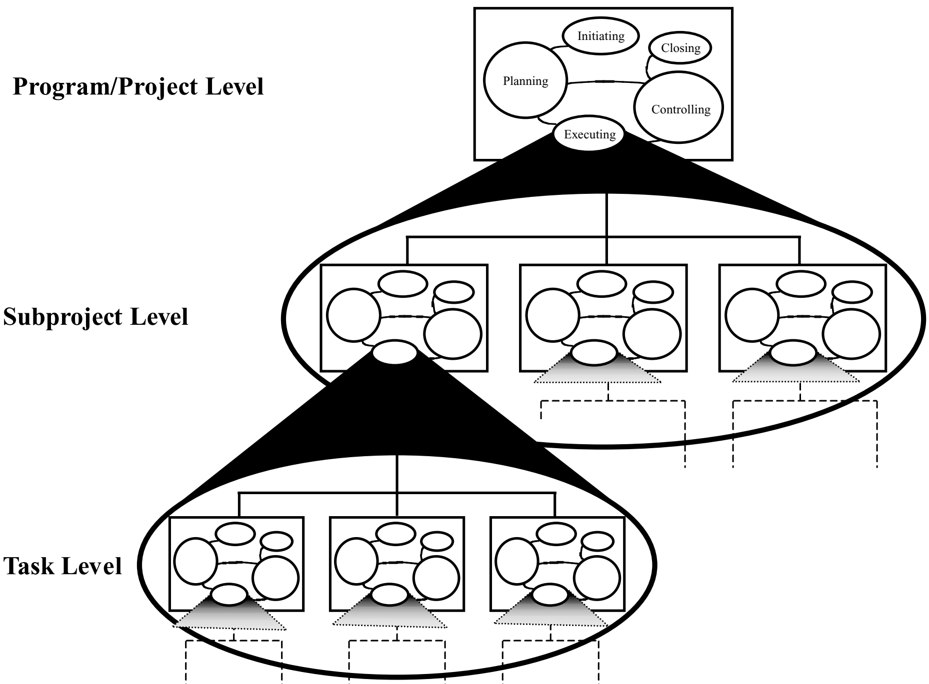

Figure 6–3 Model Applied at Different Levels of the WBS

However, subprojects may be initiated that must also be implemented through a project-management process. Examining the subproject from the perspective of the subproject manger, the full model should be implemented through the initiating, planning, executing, controlling, and closing-process group of the subproject. From the perspective of the overall project manager, however, the subproject is being conducted as part of the execution phase of the overall project. Figure 6–3 is intended to demonstrate this concept, showing that, although subprojects or tasks may require the full project-management process, they are all part of the subordinate activities for the manager overseeing the total project effort.

Core vs. Facilitating Processes

Core processes are related to the basic elements that must be managed in almost every project, including scope, time, and cost and the coordination among these elements. The model presented in Figure 6–2 and described above concentrates on these elements. Within the project-management process, a clearly defined set of tools exist that have been developed specifically for supporting these core processes, including the work-breakdown structure, network logic diagramming, earned value analysis, and various cost estimating techniques. These tools are generally applied to the project in a process that follows a fairly well-defined sequence of activities. For example, the work-breakdown structure is used to break the project down into the activities that will be used to plan and manage the project's progress, while network logic diagramming is used to sequence these activities into a logical flow of work. Clearly the logic flow cannot be developed until the activities have been defined, so the work-breakdown structure is implemented before the corresponding logic diagram can be developed. These tools are used to develop and implement the specific, unique plan that is designed for a particular project. Most of the computer software tools developed specifically to assist in managing projects provides features that aid in managing these elements.

On the other hand, *facilitating processes* are applied to projects at different points in the project's life cycle, at different levels of detailed analysis, and in different orders of application depending on the nature of the project and the product being developed. For example, projects that subcontract much or all of the work involved may require a high level of procurement management services and skills for the entire duration of the project, while other projects being accomplished entirely within the sponsoring organization might require procurement skills only to deal with a limited number of large scale purchases of materials or equipment.

Figure 6–4 is intended to show that the ongoing activities in the supporting organization may provide some or all of the facilitating processes support needed by the project. The amount of support provided depends on the relevance of the processes to the particular project and the capabil-

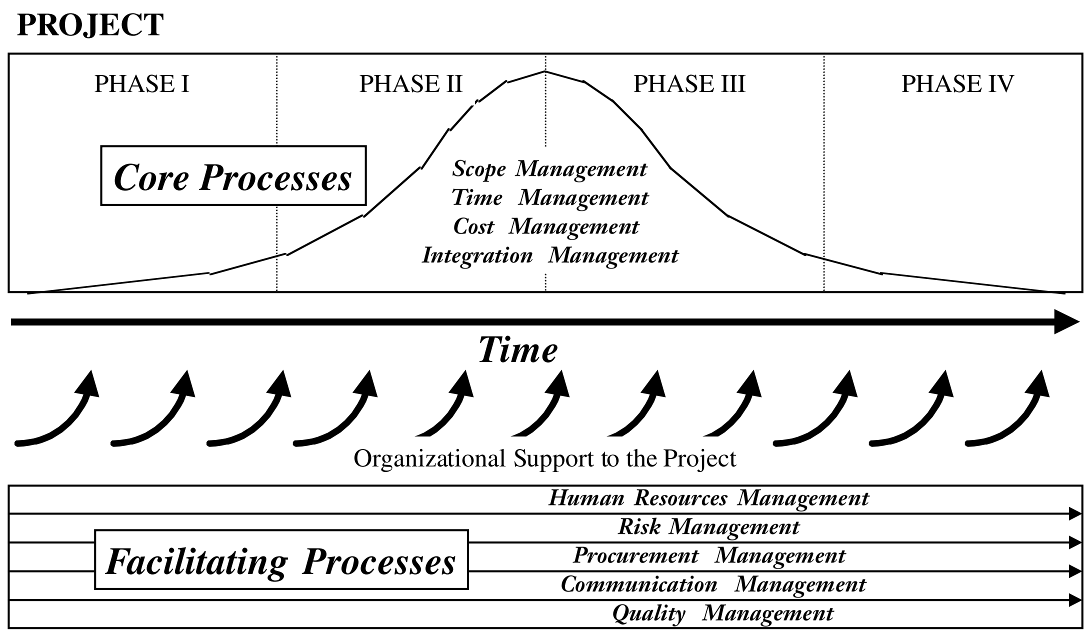

Figure 6–4 Core/Facilitating Processes Relationship

ities of supporting organizations to provide the needed services. In projects that are conducted completely within a large, functional organization, the organization may provide most or all of the facilitating processes. It is more likely in stand-alone projects, however, that the project will have to develop its own management for the facilitating processes. These facilitating processes are:

- ***Human resource management.*** The effective use of people in the project, including team building, conflict management, leading, delegating, motivating, performance appraisal, and other such activities associated with managing the human resource
- ***Communication management.*** The administration of effective communications within the project and with those outside the project who have a stake in or should support the project
- ***Quality management.*** The use of quality control (statistical sampling, Pareto diagrams), quality assurance, and the total quality concept to assure the required level of quality is incorporated into the project.
- ***Risk management.*** The use of risk identification, risk quantification, risk response development, and risk response control in order to analyze, prepare for, and respond appropriately to project risk
- ***Procurement management.*** The use of appropriate contracting and procurement methods and techniques to administer the project work that will be performed by agencies outside the organization sponsoring the project

Managing Facilitating Processes

The model in Figure 6–2 explains the project-management process from the standpoint of core processes and describes the relationships among the five process groups defined in the PMBOK relative to this process. The facilitating processes are shown as auxiliary to the core processes, and it is implied that facilitating process support can be obtained from outside the project. It has also been stated, however, that projects may have to provide their own facilitating processes. In the case where the facilitating processes support cannot be provided from outside the project, the same relationships should be developed among the process groups for the facilitating process as exists for the core processes. Procurement management is used as an example below:

- ***Initiating.*** In this process group, the general contracting strategy is determined, including whether the project is to be conducted primarily in-house, by contract, or somewhere in between. If it is to be a mixed project with some work conducted inside and some outside the project, the individual who will determine what work is to be contracted out should be identified as part of this process group.

- ***Planning.*** In this process group, there are two main subprocesses:
  - ***Defining.*** Here clear objectives should be defined that guide the decisions regarding whether to procure, what to procure, when to procure, and who is responsible for the procurement decisions.
  - ***Developing.*** Here the detailed procurement plan is developed and integrated into an overall project plan.
- ***Executing.*** In this process group, the contracts are developed, solicitation is performed, and the contracts are awarded and executed on a schedule designed to support the integrated project plan.
- ***Controlling.*** In this process group, there are two main subprocess groups:
  - ***Evaluating.*** Here the contracted work is tracked to determine what work has actually been performed at any specific point in time.
  - ***Reporting.*** Here the contracted work actually completed is compared to what was scheduled to be completed in the current project plan, and any significant variances are documented. These variances are reported to the project team so that any needed adjustments can be made to the integrated project plan.
- ***Closing.*** In this process group, completed contractual work is paid for and the contract is closed out.

Conclusion

Project management is a growing profession that is rapidly gaining recognition from major business and government organizations, but it has yet to define an accepted, comprehensive model that effectively describes the processes a project must go through in order to transition an idea from a concept to a finished product. This lack is an important issue to a growing profession, for it indicates that the basic processes driving the accomplishment of work within the profession are not yet well understood. This has implications for our ability to teach prospective new members of the profession what they need to know to survive in project management. If we cannot prepare new members to function well in our profession, then the profession cannot survive and grow in the long run. The model that is most widely accepted within the project-management profession today is termed the project life cycle. This is a useful model for explaining what must be accomplished to complete a project, but no project manager will propose that the life-cycle model adequately describes the process by which projects are accomplished. The Project Management Body of Knowledge (PMBOK) attempts to incorporate processes into the discussion of project phases, but fails to recognize the need to use knowledge acquired during the project to modify decisions made in earlier phases. The model presented in this chapter builds on both the life-cycle concept and the work presented in the PMBOK to produce a more comprehensive model of project management.

Specifically, the concept of using feedback of newly developed information to change the project's plans and modify decisions that had been made earlier in the project life cycle is added to the earlier work. This significantly improves the ability of the model to explain how project managers improve and adapt their project plans to the conditions that are encountered as the project progresses.

One purpose of this model is to provide a conceptual base for further developing the PMBOK and our understanding of how projects are accomplished. It is hoped that others will use the work presented here to better understand the way projects are managed today. This should also help expand the Project Management Body of Knowledge and provide a basis for developing improved methods for managing the projects of the future.

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Chapter 7

Another Look at Life Cycles

Thomas C. Belanger and Jim Highsmith

Biographical Sketch . . .

Thomas C. Belanger is the President of the Sterling Planning Group in Sterling, Massachusetts, the Director of the Center for Business and Industry at Worcester State College, and Director of Training and Sponsorship for the Central Massachusetts Chapter of PMI. He is the author of *How to Plan Any Project*, 2nd Edition, SPG, 1995; *Successful Project Management*, AMACOM, 1995; *The Complete Planning Guide for Microsoft Project*, Butterworth-Heinemann, 1997; and more than 50 articles on management and project management.

Mr. Belanger has worked with management at all levels to create, adapt, and introduce project-management methodology in several Fortune 500 companies. He has also worked with a Town Fair Committee to create life-cycle phases, deliverables, and activities for planning and running a country fair.

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Mr. Highsmith is a recognized leader in the agile software development and project management movement. He was a co-author of the Agile Manifesto and is a founder and board member of the AgileAlliance. Jim has 25-plus years experience as a consultant, software developer, manager, and writer, and has published dozens of articles in major industry publications.

 Field Guide to Project Management, Second Edition. Edited by David I. Cleland

Introduction

This chapter will revisit the concepts of life-cycle processes and models for software development and other types of product-development projects. By using a structured approach, IT, software, and other organizations that work on projects with outcomes that are largely known can benefit from the experiences of their predecessors. Standardized life cycles, because they provide order and help provide completeness to plans, can help improve predictability for those who work on what may have been haphazard development projects. The life-cycle processes as described by IEEE (IEEE Std 1074-1997) provide an excellent starting point for organizations that must create or revise their project-management methodology, deliverables, and activities. Since the 1970s, models such as the waterfall, evolutionary, incremental development, RAD, and others have been tried in an attempt to make software development more predictable. Though they have achieved spotty success, they have moved us forward.

But how do these processes apply to the world of ever-evolving and changing requirements and specifications or new, relatively untried technologies? A new family of methodologies, under the banner of Agile Software Development, has evolved at the convergence of software development and project management and promises project management that focuses on innovation and creating customer value. Individual methodologies under this agile umbrella include extreme programming, Scrum, adaptive software development, and feature-driven development.

In most software- and systems-development projects, the requirements and specifications are an honest attempt to clarify what the developers should build. Often these projects, such as a migration project, upgrade project, or a project to make enhancements to an existing system, have a particular desired outcome. Often they solve a specific business problem, such as improving accuracy in sales orders. But even with a specific desired outcome and clear requirements and specifications, change will almost inevitably occur as a project unfolds, with larger projects generally experiencing more changes than small ones.

Whether you are planning and managing a migration project or the development of a new application that solves a problem, the result you plan to create will affect the type of work process best suited to that result. Frequent interruptions in these work processes while new requirements are added can have serious business consequences, such as lost customers. Therefore, for any of these projects, you will save time and minimize turmoil if you have a methodology that includes defined life-cycle processes. In the 21st century, most organizations have them, and increasingly they actually use them. Using appropriate life-cycle processes does not guarantee success, but not using one comes close to guaranteeing failure.

Regardless of the life-cycle model and processes used, involve the users, subject-matter experts, sponsors, and other stakeholders from the beginning. Get the requirements right, then confirm them frequently. Users and sponsors should know, within a reasonable range of dates, when they will have specific functionality available to them, and the impact on their business. What is the impact on those who will use the new or enhanced system? What is the availability of people with the right combination of skills to actually do the coding necessary for the enhancements? Do they have a successful history of working together?

A business requirement document (BRD), and a conduct BRD walkthrough that includes business analysts, subject matter experts, users, developers, and others as appropriate. The BRD must be written in language that is easily understood by all stakeholders, stating clearly what the users will get from the project. Get sign-off. Will the requirements and specifications change? Will the scope creep? You can bet on it. That is why it is so important to have an orderly, collaborative change process that includes updates to time, schedule, and cost estimates. Once the business requirements are signed off, analyze alternatives and formulate an approach. Next, prepare a functional specification or software requirements specification.

Software-development life cycles (SDLCs), or product life cycles, are present in almost every organization. The Department of Defense (DoD) and its contractors use them; construction management companies use them. These life cycles are composed of phases, such as concept, requirements, design, construction, and implementation. Sometimes the structure and guidelines are appreciated, while at other times they are cursed because they often require elaborate documentation and seemingly endless revisions.

Software Life-Cycle Processes

The Institute of Electrical and Electronic Engineers (IEEE) has published a Standard for Developing Software Life Cycle Processes. The Standard contains activity groups that are equivalent to phases or stages in most software life cycles. For software development, IEEE's Life Cycle Processes[2] add specific deliverables and activities, a structure that can easily be adapted if you need to create or revise your SDLC. It can be applied to most life-cycle models. The five activity groups are:

- Project management
- Predevelopment
- Development
- Postdevelopment
- Integral

The five activity groups with their respective activities are:

A.1 Project Management Activity Groups
- ***A.1.1*** Project Initiation Activities
- ***A.1.2*** Project Planning Activities
- ***A.1.3*** Project Monitoring and Control Activities

A.2 Pre-Development Activity Groups

A.2.1 Concept Exploration Activities
A.2.2 System Allocation Activities
A.2.3 Software Importation Activities
A.3 Development Activity Groups
A.3.1 Requirements Activities
A.3.2 Design Activities
A.3.3 Implementation Activities
A.4 Post-Development Activity Groups
A.4.1 Installation Activities
A.4.2 Operation and Support Activities
A.4.3 Maintenance Activities
A.5 Integral Activity Groups
A.5.1 Evaluation Activities
A.5.2 Software Configuration Management Activities
A.5.3 Documentation Development Activities
A.5.4 Training Activities

Various life-cycle models have used these or similar phases and activities. Project managers who want to choose an appropriate life-cycle model should consider the following:[3]

- Requirements volatility
- The "shape" of requirements volatility (e.g., discrete leaps, based on brand-new threats; or gradual changes as with a need to do things faster)
- The longevity of the application
- The availability of resources to develop or effect changes (it may be easier to get resources up front than to devote significant resources for enhancements)

In the sections below, three common life-cycle models—waterfall, evolutionary prototype, and rapid application development (RAD)—will be discussed. The Agile model will then be explained.

WATERFALL

Almost everyone is familiar with the waterfall life-cycle model. As the name implies, this model is characterized by sequential phases. This life-cycle model is the oldest and has been applied to projects in nearly every industry. In system and software development, the software theoretically evolves in an orderly fashion from concept to design to development and implementation. The Gantt chart bars representing the software development phases descend from left to right, as shown below. The phases would generally succeed one another with little overlap.

Because planning for an entire project is attempted while work is beginning, there is a heavy reliance upon the precision of the requirements and specifications documents. According to Boehm:[4]

> For some classes of software, such as compilers or secure operating systems, this is the most effective way to proceed. But it does not work

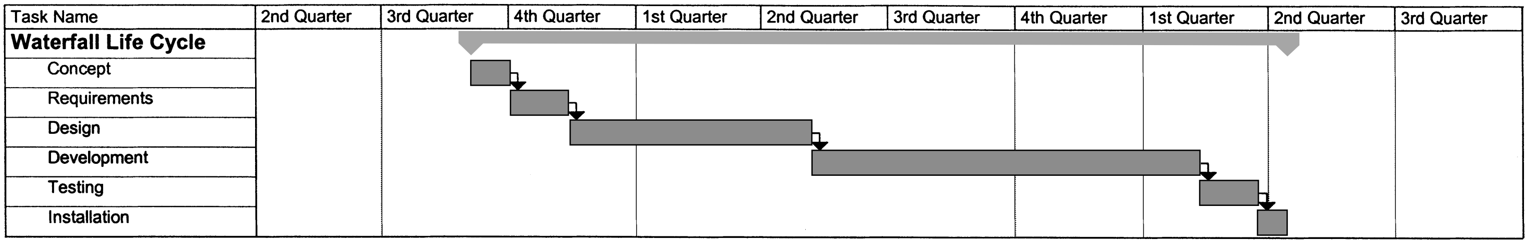

Figure 7–1 Waterfall Life Cycle

well for many classes of software, particularly interactive end-user applications. Document-driven standards have pushed many projects to write elaborate specifications of poorly-understood user interfaces and decision-support functions, followed by the design and development of large quantities of unusable code.

Using the waterfall model, phases or stages, once complete, are generally not revisited. This often translates to a ''throw it over the wall'' way of thinking. When this happens, one group believes it has finished prematurely. Many have found through experience that this life-cycle model is not appropriate for most software development.

EVOLUTIONARY

To use the evolutionary prototyping model, Analysts gather known requirements and then Developers design and build the desired functionality. This model can work though only some of the requirements are known, because the customer or sponsor is kept informed about ongoing progress and accepts the concept of getting software that will evolve and become more robust over some period of time. Often there is a wide range of possible duration for the project.

With a limited number of the known requirements met in the form of a prototype, the users begin working with the new software to try it out. When the users provide feedback about their experience in using the system, the requirements and specifications are augmented, further design and coding occurs, and the next prototype evolves. New dialog boxes and new functionality are added with each new prototype and, importantly, with the customer's full knowledge and concurrence.

The evolution of a system can take a number of approaches. The first prototype may be chosen because the functionality provided meets the most urgent need, or you could choose to start with the easiest functionality (although this approach is not usually recommended).

RAPID APPLICATION DEVELOPMENT (RAD)

RAD is a user-centered and team-based life cycle that allows for functionality to be installed quickly, in smaller chunks. Users are involved in system design and in providing feedback on a regular basis. RAD is often used in conjunction with joint application development (JAD), which is a collaborative effort that combines the knowledge of users, analysts, and developers. RAD is most often associated with small development teams of between four and six people that simplify communications and reduce the number of meetings needed, and short, three- to six-month project durations.

RAD, which extends the set of practices used with evolutionary prototyping, combines five productivity-enhancing techniques to develop applications:[5]

- Rapid prototyping
- Integrated development tools

- SWAT (Specialists with Advanced Tools) teams
- Interactive JAD
- Timeboxing

Taken together, these techniques help prevent scope creep by tightly coordinating the efforts of all stakeholders. Each works to support rapid application development (RAD).

The RAD life-cycle model is designed to allow for incremental development.[6] Rather than planning all of the details necessary for a two-year project, RAD breaks the project into small, sequential three-month ''timeboxes,'' during which a group of related functions or objects can be designed, developed, and installed. Then another group of functions or objects follow the same sequence. This allows for the inevitable changes and related learning as the system evolves.

Effort and cost estimating for RAD is done one increment at a time. If it is determined that a certain function cannot be completed within a certain increment, it is moved to the next increment.

Many variations of RAD are being used at different organizations. Most apply rapid prototyping and evolutionary techniques. Some forgo functional specifications for detailed requirements, but most reduce documentation time drastically, including rewrites.

RAD is complementary with object-oriented development because object-oriented development is considered to be more flexible and adaptable than earlier development technologies (and therefore fits with the frequent changes encountered in RAD development). It aims at producing an object. Objects, or classes, which are more stable than a business process, have attributes and behaviors related to real-world things such as accounts and customers. They are things, which makes their decomposition and resource assignments match up well with a work-breakdwn structure. Some examples of objects/classes are:

- An account record
- A paycheck
- A timecard

Each object is unique. When related objects, classes, or use cases are tested together, they can be grouped into packages. For example, tax-related objects or classes could be grouped together as a package. Ordering-related objects from a company website can be referred to as a package that can be designed, developed, and tested.

Though RAD does allow for iterations, another, more flexible approach is needed.

The Final Outcome Is Not Known

There are two distinct types of oil drilling—production and exploration. In the first, the known location and characteristics of the oil field drive engineers to figure out cost-effective means to extract the oil. A production drilling project has a well-known outcome and a project plan that focuses on efficiency and cost control. Exploration drilling is entirely different. For all the sophisticated geophysical analysis of seismic data, on average a company spends $100 million and has a 10 percent chance of striking a production-quality oil field. Exploration drilling is an exercise in risk management.

New product development, new business initiatives, and seemingly well-understood projects with new twists (the Big Dig in Boston, for example) are examples of *exploratory* projects for which the outcome may not be completely defined until the end of the project. A product vision, or goal, drives the project, and, while schedule and cost boundaries may be established (drillers often establish a depth at which they will abandon an exploratory well), the specifics of the project evolve over its life as customers and the project team interact and learn about the problem space. In this environment, a different type of life cycle is needed in which planning, requirements gathering, design, and building all evolve in parallel over time.

Agile Life-Cycle Model

Although the term *Agile life-cycle model* is used for consistency with other sections of this chapter, agile project management and development encompasses more than life cycle. ''Agile'' reflects the recognition that many projects have characteristics of new product development (NPD)—requirements volatility, utilization of new technologies, intense time pressure, and high-quality demands. Responding to these demands requires more than a new life cycle, it requires an adaptive, collaborative approach to project management and development—an agile social architecture to accompany an agile life cycle.

In the 1990s, a half-dozen software development methodologies evolved under names like extreme programming, adaptive software development, scrum, and feature-driven development. In February 2001, the leaders in each of these methodologies met and created an umbrella term that covered all these approaches to developing software under conditions of high uncertainty—they are now referred to as agile software development methodologies. Similar approaches in manufacturing, industrial product development, and construction arose under labels such as agile manufacturing, the Lean Aerospace Initiative, and lean construction.

When Exploration Is the Problem, Innovation Is the Solution

Symyx boasts that their process enables scientists to discover and optimize new materials at 100 times the speed and 1 percent of the cost of traditional research. Drug companies, which once pored over designing compounds, now generate millions of compounds and then test them using ultrasophisticated, ultra-speedy mass spectrometers. Toyota employs set-based design in its automobile design process—maintaining multiple design options on components until late in the development process. Boeing designed the 777 in silicon (using sophisticated simulation programs) before building physical components.

From materials research to drugs to airplanes, companies are relentlessly driving the cost of change out of their new product-development processes. Why? In order to increase experimentation, to increase the diversity of paths explored, to foster innovation. These "exploration" projects severely challenge traditional production-oriented project-management practices that attempt to optimize, predict paths, and conform to detail plans. A new model—labeled agile project management—focuses on quick starts, iterative exploration, delivering customer value, low-cost iterations, frequent feedback, and intense collaboration. Agile project management excels on projects with high exploration factors, those projects in which new, risky technologies are incorporated, requirements are volatile and evolve, time-to-market is critical, and high quality must be maintained.

The uncertainty and risk of exploration projects make it difficult to impossible to utilize a serial project life cycle in which planning and requirements gathering can be completed in the beginning of the project. As new technology—from new high-tensile materials to Internet-based information technology, genomics and life science technology—advances, companies try to predict when and how to incorporate these new technologies into new products and business processes. The newer the technology—the more bleeding edge—the greater the risk and uncertainty (and of course the higher the potential reward because of these risks) of incorporating it into a project plan. Similarly, the detail requirements of new products and business initiatives are often fuzzy. Product teams are often long on vision but short on specifics. The key point here is that the details are not only unknown, they are usually unknowable in the beginning. Only through building the product itself—often using models, simulations, and prototypes—does this information unfold.

In order to succeed in this highly volatile and usually time-pressured environment, project teams must be creative and innovative, in both a technical dimension and an organizational dimension. The way they work together needs to encourage innovation and at the same time deliver results reliably to some vision within a set of boundary conditions.

Prerequisites for an Agile Approach

There are two prerequisites for project teams who want to use an agile approach—problem type and project community culture. While agile practices can be used with nearly any type of project, they provide potentially greater payback with projects classified as exploration projects—those that are either NPD projects or have characteristics of NPD projects. And agile projects, since they are exploratory in nature, require a substantially different mindset (culture) than that required for production type projects.

Two characteristics indicate if a problem, or project, type is suitable for an agile approach—exploration and low-cost iteration. The first issue is whether or not the project involves a level of exploration, in terms of either technology or requirements. When there is uncertainty about the specific requirements for a product or the applicability of new technologies (will they work, how long will it take us to make it work, etc.), then an exploratory approach—try something, test the results, adjust—works best. Secondly, an iterative approach only works in situations in which the cost of iteration (the cost of change) can be kept low. Software is the most malleable medium, and under the right circumstances the cost of software changes can be kept low (within a given platform architecture). One of the reasons so many industrial products are being designed using simulations and models is that the cost of iteration—trying and testing—can be kept low.

Production and exploration cultures are different. Production approaches and cultures, value planning, stability, repeatability (input-driven), and conforming to plans. Exploration approaches and cultures, value experimentation, adaptation, reliability (results-driven), and conforming to value (often at the expense of conforming to plans). Each of these approaches and cultures has validity for the appropriate project types, but it is difficult to pursue a production problem with an exploration culture and vice versa.

A third prerequisite, related to the wider culture of the organization (not just the project team), is that the product-management and/or customer group (depending on whether the product is for internal or external customers) must be willing to work closely with the development team on an on-going basis. In traditional, serial life-cycle development, the product managers/customers can often get away with contributing to requirements at the beginning of the project and then interacting very little thereafter (this is the theory, but it really doesn't work very well). Agile development with its short iterations requires active participation by the customers throughout the project.

The Agile Manifesto (for Software Development)

The agile movement, at least in software development, was launched in the spring of 2001 with the publication of the *Manifesto for Agile Software Development*. This manifesto declares that:[7]

> We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:
>
> **Individuals and interactions** over processes and tools
> **Working software over** comprehensive documentation
> **Customer collaboration over** contract negotiation

Responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more.

These value statements have a form—the first segment indicates a preference, while the latter segment describes an item that is something of lesser importance. The first statement does not say that processes and tools are unimportant, but stresses that the interaction of talented individuals is the primary creator of value. Every individual is unique, therefore processes should be melded to individuals and teams, not the other way around.

Similarly, while documentation—at least in moderation—can be useful, the primary focus must remain on the final product—working software (or working industrial products or their simulations). Working products are real; they demonstrate value to the customer in ways that no other development artifacts (documentation, for example) can.

Contract negotiation, whether an internal project charter or a legal contract, is necessary, but it is insufficient. Contracts and charters provide frameworks within which the parties can work, but only ongoing collaboration between developers and customers can produce viable results. Finally, while plans are useful, they can also blind a team to change. In exploratory projects, planning is important, but adapting to customer, technology, and management changes during the project is even more important.

Agile Iterative Life-Cycle Model

There are many variations of iterative life cycles—iterative, incremental, evolutionary, spiral, and others. The iterative style that could be labeled an agile life-cycle model has several characteristics—quick starting; short, feature-based iterations; frequent feedback; and quality focused. In addition, in agile projects the entire team—customers and those who are delivering results, not just the project manager and group leaders—is involved in planning and other project-management activities.

QUICK STARTING

''Two beers and a napkin,'' replied one agile proponent to the question of how quickly to begin a project. As the degree of exploration increases, the extent of useful up-front planning decreases rapidly.

This raises one of the key issues in development (not just agile development)—balancing anticipation (up-front planning, architecture, requirements gathering, and design) versus adaptation (letting the plans, architectures, requirements, and design evolve over the iterations). When the market is highly volatile and uncertain and iteration costs are low, engineers need to rely more heavily on their ability to adapt than on their ability to plan. The rhythm becomes,—plan a little, build a little, revise a little, plan a little more. . . . In most cases, quick starting means a few weeks (rather than months) of requirements gathering and feature identification, architectural design, iterative project planning, and other typical project initiation work. The length of the quick start will depend on the type of project and its size, but the emphasis for high-exploration-factor projects will always be on the ''quick.''

SHORT, FEATURE-BASED ITERATIONS

Once underway, agile projects proceed in short, time-boxed iterations. For software projects, these time-boxes are several weeks in length (usually two to six weeks), while for other products they may be longer. But while many people view iterative development as incorporating short time-boxes, they often miss the second critical piece, that the product of these iterations are working product features—partially completed products or models containing those features.

When outcomes are known, the team can measure progress against those known outcomes. However, when outcomes are unknown, the feedback loop between the project team and its customers must be short and the information exchange must be in a shared medium. Regardless of the product, from software to electronic instruments, technical documents—even most requirements documents—do not represent shared medium. ''Shared'' means that the artifacts under discussion between customer and developer are well understood by both parties. Engineering blueprints may be shared space between two engineers, but not between engineers and customers. Features are shared medium—they are artifacts that have value to the customer and can be directly used by that customer. By reviewing features, customers can give immediate feedback to project team members about the product. In software development, features are working software, not documents. Working features are tangible, real evidence of progress that customers can relate to their business goals.

Another key aspect of these short, timeboxed, feature-based iterations is that they force the project team, the customers, and executive management into facing difficult trade-off decisions throughout the project because features are tangible. Features work or they don't. If the team plans to deliver fifteen working features in an iteration, they either work or they don't. If the results fall short, then all parties need to face the reality that the project will probably not progress as planned. Realistic evaluation of progress and quick response are characteristic of agile projects, and many managers and teams find this realism unsettling. Iterative development can also become incremental development when those reviewed partial results are actually deployed for the customer.

FREQUENT FEEDBACK

When exploring through iteration, a critical piece of keeping projects on track is frequent feedback in four areas: product, technology, project status, and team performance. First, the features delivered for each iteration are reviewed by customers or product marketing, and change requests (using an informal process) are fed into the next iteration planning process. Second, the technical team evaluates the technical quality of the product (design, conformance to architectural plans, defect levels). Maintaining technical quality is an important tenet of agile development because keeping the cost of change down (by maintaining consistent high quality) is so critical to effective exploration. Third, status reporting remains important for any project. And fourth, particularly in agile projects, which tend to be high-stress, it is important that the team evaluate its performance—both process and behavior—and make adjustments on a regular basis.

Whereas production-oriented project management focuses on conformance to plan, periodic review, and then corrective action, agile project teams, assuming that the plan will be incorrect much of the time, refer to adjustments as ''adaptive action,'' arising from constant analysis of plans, actual results, and current expectations.

TECHNICAL QUALITY

One way in which agile development can be differentiated from other evolutionary approaches is the emphasis on technical quality in order to minimize the cost of change and therefore experimentation. Exploration requires iteration and experimentation, which in turn require low iteration cost in order to be viable. Low iteration costs are achieved by technical practices such as constant, ruthless testing, continuous integration of features, simple design (designing for what is known rather than anticipating what is unknown), and systematic redesign (to maintain design quality).

Agile Social Architecture

A life-cycle model does not, by itself, deliver reliable innovation. Innovation and creativity can not be planned, but they can be reliably delivered given the right environment. Harvard Business School professor Rob Austin and co-author Lee Devin characterize the difference between exploration and production work as *artful making* versus *industrial making*. '''Artful', because it derives from the theory and practice of collaborative art and requires an artist-like attitude from managers and team members. 'Making', because it requires that you conceive of your work as altering or combining materials into a form, for a purpose.''[8] Production projects may be best served by industrial making, but exploration projects are certainly best served by artful making. There are three key social architecture aspects of agile project communities that contribute to this artful making: collaboration, self-organization, and self-discipline.

COLLABORATION

Agile project management is collaborative project management. Collaboration differs from communication. Communication involves sending messages or documents between individuals. Collaboration involves joint participation in creating a product or document, or participating in some decision-making process.

Innovation arises from diversity and interaction—from involving a range of people with complementary skills and experience in intense interaction and debate. One reason for the increased emphasis on cross-functional teams arises from this need to interact, in real time, to create innovative products.

Agile teams employ a range of collaboration practices that include, but are not limited to, jointly planning iterations, holding daily team integration meetings, holding customer focus group sessions at the end of each iteration, using peer-to-peer development practices such as pair programming, and holding brief mini-project retrospectives at the end of each iteration or milestone.

SELF-ORGANIZING, SELF-DISCIPLINED TEAMS

Self-organizing teams are those in which the project manager establishes goals, articulates boundaries, reviews results, and participates in key project decisions while project team members manage their own work (for example, tasks are not assigned by the project manager but signed up for by team members), are accountable for results, and figure out how to deliver the results within a general framework agreed to and adapted by the team. Leaders articulate goals; team members determine how to achieve those goals.

Self-organizing teams are democratic and egalitarian (empowered in a sense), but the satisfaction of working in this kind of environment comes at a price—self-discipline. Many project teams operate on authoritarian discipline—the boss is in charge. Talented, skilled technical savvy individuals—the kinds of people required to create new products—balk at working in these environments. However, people who want to work in a less authoritarian environment have to discipline themselves by fully participating in team discussions and debate, working within the framework the team has decided upon, accepting accountability for results they have agreed to deliver, and respecting other team members for their contributions. Self-organizing and self-discipline go together to create an innovative, adaptive culture that has the best chance of delivering on extreme projects.

The Agile Edge

Companies, from those that create software products to those that create medical electronics, have embraced agile project management and software development to gain a competitive edge by increasing their ability to deliver innovation reliably. Agile development focuses on processes and practices that are particularly effective in high-change, uncertain environments driven by intense time-to-market pressures. Agile development also embodies a particular social architecture, one characterized by both self-organization and self-discipline, a social architecture well suited to deliver on these extreme projects.

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Chapter

8

Putting Together a Work-Breakdown Structure

Paul Warner and Paul Cassar

Biographical Sketch . . .

Paul Warner is a Senior Business Manager of IT/IS in Operations at Rolls-Royce Corporation in Indianapolis. He has a B.S. (1987) and M.S. (1995) in Industrial Engineering from the University of Pittsburgh, along with an M.B.A. (1991) from Indiana University. Mr. Warner has a broad background in information technology and systems, industrial engineering, manufacturing technology and development, and Enterprise Resource Planning. He joined Rolls-Royce in 1987 (then Allison Gas Turbine of General Motors). From 1993–1998, Mr. Warner was on academic leave as a research/teaching assistant at the University of Pittsburgh. During that time, he also managed the University's Manufacturing Assistance Center (1996–1998).

Paul Cassar joined Rolls-Royce Allison in November 1998 as Executive Vice President—Finance from Rolls-Royce North America (RRNA), located in Reston, VA. Mr. Cassar earned an Honors Bachelor of Commerce degree in Accounting and Finance from McMaster University (1971), graduating Summa Cum Laude. His financial career began with Clarkson Gordon & Company, located in Ontario, Canada, in 1972 and continued with companies such as Reid Dominion Packaging Limited, International Harvester, and NEI Canada Limited. While with International Harvester, Paul carried out several overseas assignments that included time in France and the United Kingdom. At NEI Canada (1985–1990), Paul held financial positions culminating in President in 1988. In 2001, Paul assumed his current position as VP Business Process Improvement for RRNA. In this role Paul is tasked to increase the pace of deployment of company-wide processes across RRNA, and integrally with this to improve IT planning to ensure better visibility and control of cost. Information technology is also part of Paul's accountability.

A senior manager once began a talk on measuring performance with an analogy from his rugby days. Every time he walked out onto the field before a match, he knew exactly what the goal was and his purpose on the team. When he left the field, he knew *exactly* (''sure as hell'' was his actual phrase) whether he had met the goal or not and how he had contributed to the outcome.

Every day is a journey toward achievement of corporate objectives, each company's World Cup. Projects, the building blocks of corporations, can be considered matches that get them their Cup. Management wants all projects won. The way the team knows what each project goal is, how they contribute to it, and whether or not they obtain victory at its end is through the project's work-breakdown structure (WBS).

WBS Defined

What is the project WBS? According to the PMI Standards Committee 1996 the WBS is a

> product-oriented *family tree* of project components that organizes and defines the total scope of the project. Each descending level represents an increasingly detailed definition of a project component. Project components may be products or services.[1]

Based on the rugby analogy, this is what the team members need. *Product-oriented* sets a definable, tangible deliverable, a purpose, and the overall the goal of the project. *Family tree*, *project components*, and *descending levels of detail* indicate that a WBS has a hierarchy that ties the various efforts through manageable summary points to the overall goal. *Total scope*, *products*, and *services* mean that defined within the WBS will be what needs to be done for the entire project, its budget, and how it will be achieved.

A project win consists of the achievement of three objectives: technical requirements, schedule, and budget (see Figure 8–1). There is something to achieve, create, modify, decommission, and/or transition to (technical requirements), a waiting customer (schedule), and a finite amount of resources available (budget). The WBS is a visual model that breaks down the ultimate project objectives into manageable, understandable, and winnable work units. It defines the entire project scope in a manner that ensures that all components are included and that their relations to each other are identified. A WBS provides a systematic way for the team to consider all the required components and steps in the beginning of a project and is the reference by which the team will know *exactly* whether they have won or not at the project's conclusion.

In general, the WBS provides the means for:

- Summarizing all the deliverables, resources, and activities of the project
- Relating the work elements to each other and the total project

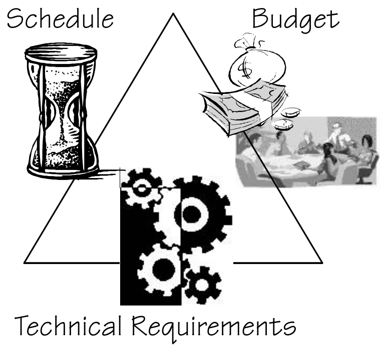

Figure 8–1 Project Objectives

- Building the project team by cross-referencing the lowest-level work elements to the organizational resource responsible for their completion
- Addressing all contracted resources required for the project
- Estimating costs, simulating project scenarios, and conducting risk analysis
- Providing information to define, budget, schedule, perform, and control work packages
- Providing a point where metrics can be developed and measured

WHY A WBS

To appreciate the real value of the WBS, it is beneficial to understand that running a project is different from running the day-to-day operational activities of an organization. While both involve schedules to meet, limited budgets, resource planning, and difficult decisions, the team needs to consider the differences when planning, organizing, executing, managing, and controlling projects. Day-to-day operational activities deal with familiar, repetitive work, supported by work methods and job definitions that have been defined and refined over a relatively long period of time. Historical performance data and experienced individuals exist to guide managers' decisions. The team members performing the functional activities are usually familiar with each other and most likely have a common skill among them, such a design engineering department, manufacturing cell, human resource office, or graphic arts group.

Projects are an ad hoc effort, dealing with something new to the organization. Projects rely heavily on estimates made from limited data and are executed in an environment of higher risk. They have a beginning and an end. Project teams come together for a purpose, achieve it, then get disbanded and absorbed back into the company. Team participants will represent a broad cross-section of the organization, bringing with them different views, working practices, and communication barriers. Depending on the age of the technology introduced, the skill base within the organization may be light, thus outside consultants and contract labor may be used. Adding even more to the team diversity, projects can reach across a broad area, covering multiple plants in multiple countries. Finally, line managers are often rewarded to achieve the near-term payoffs of day-to-day activities rather than the far-reaching benefits of a project, and thus affecting the availability of potential team members.

Given the uncertainty in the end deliverables, the limited supporting data, and the communication challenges of diverse resources, the team needs a common, shared understanding of what is required and how it will get done. The WBS is a roadmap that brings together all the deliverable end items and the major tasks essential for the conception, design, creation, test, and operation project phases, along with the disposal of the end items. When controlled properly, the WBS also helps the project team deal with change. As the project accumulates effort, new knowledge will be gained, altering the assumptions upon which early estimates and directions were set. Through the WBS, team members track and evaluate effort against tasks from one common information source and make any necessary, controlled adjustments to changing conditions, instantly visible to all concerned.

WBS Functions

The WBS serves four major functions for a project:

- Conversion of project requirements into manageable tasks
- Translation of tasks into specific, committed work packages
- Communication of objectives to all stakeholders
- Foundation for project planning, scheduling, and control

CONVERT REQUIREMENTS INTO MANAGEABLE TASKS

The project manager and developers creating the WBS must start with a clear understanding and definitive statement of the overall project objective. They first break down this objective into major project components. Each component is then divided into key summary activities, then down the WBS in a hierarchical manner to the lowest level of reportable activity (see Figure 8–2).

Inevitably, the question is asked ''How deep does a WBS go?'' When developing a WBS, the project team faces two competing targets: comprehensiveness and manageability. The team clearly does not want to overlook any major requirement. However, if the WBS is too detailed, the visual model becomes overbearing and thus loses its communication effectiveness (see Figure 8–3).

The WBS level should be set at a level where budget can appropriately be allocated and managed throughout the life of the project. Taking an example from a software upgrade project, one component was the hardware

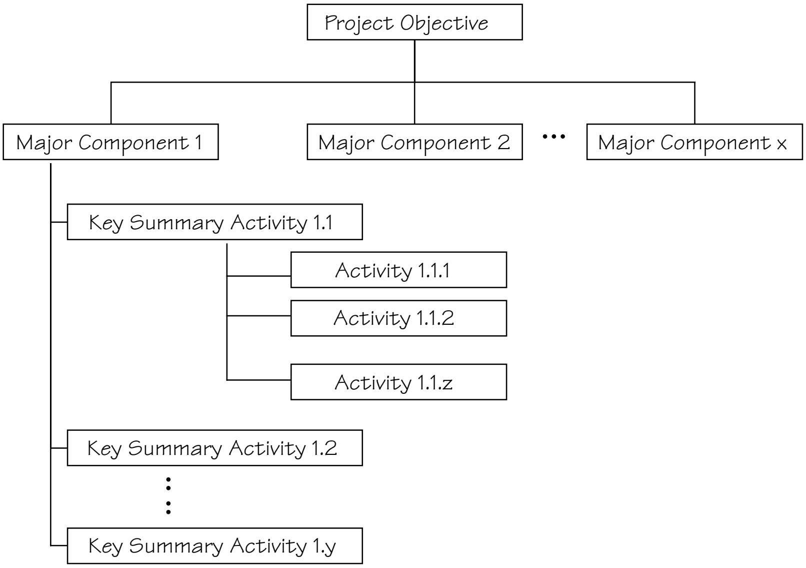

Figure 8–2 Generic Project Breakdown

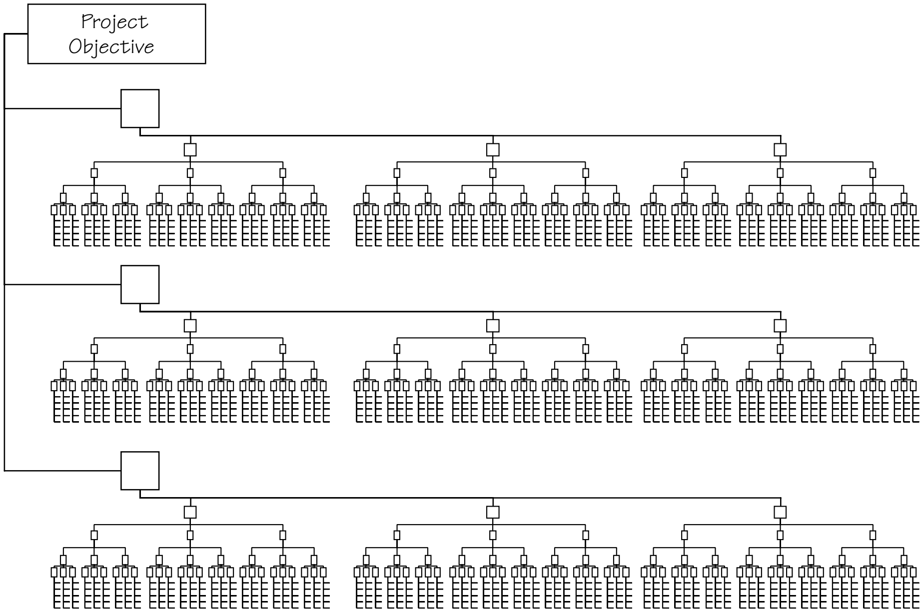

Figure 8–3 A Very Deep WBS Example

upgrade, of which there are many steps. Team members not involved in this activity, such as the training crew or end users, did not need to see every minor detail of this requirement. To ensure both manageability and comprehensiveness, the team can reasonably document many of the low-level tasks without listing them directly on the WBS. A statement-of-work (SOW) document describes the actual effort to be performed on a project step. SOWs combined with the specifications form the basis for a contractual agreement on the project. They describe what is going to be accomplished, a description of the tasks, the end products delivered from the work, plus any references to specifications or standards. Thus, the lowest level WBS activity description still communicates the required task succinctly to the team (e.g., install new server), while the SOW clearly identifies the specifics to be done for those performing them.

TRANSLATE TASKS TO SPECIFIC, COMMITTED WORK PACKAGES

Work packages are a combination of the WBS steps at the lowest level and the assigned responsible person. While a number of people may actually be involved in a given project step, it is critical that only one person be assigned responsibility, the work package manager. This eliminates confusion (i.e., one person assuming another was responsible) and potential missed assignments.

Work packages should have clear, measurable results with defined start and end dates. They should be sized to minimize work in progress over a number of control reviews. Otherwise, they become difficult to assess and lose the ability to feedback control information to the project team. For example, if a work package is estimated to take three months to complete (e.g., train end users) and review cycles are biweekly, an assessment of percent complete and ahead or behind schedule at each cycle reveals little to the team. Smaller, more measurable work packages (e.g., secure rooms, complete training material, produce manuals, prepare trainers, deliver training, etc.) help the team better assess project progress.

The effort of the work package can be described, related to the overall project objectives, tied to any specifications required, estimated, scheduled, and budgeted. This is how the project players know how they contribute coming into a project and how well they did leaving it.

Within the process of developing the WBS, the team determines how best to divide the project into major groups, groups into tasks, and tasks into subtasks. When an acceptable level of detail is obtained, the tasks and subtasks are matched against the organizational structure. The project manager can see what is required and what skills are needed. This assists in the communication with the line managers of the resources to gain their commitment to release people to the project. The timing of the resource availability impacts the overall project schedule and task priorities.

COMMUNICATE PROJECT OBJECTIVES AND PERFORMANCE TO PROJECT STAKEHOLDERS

The WBS is the information link to project stakeholders. Project stakeholders are essentially anyone with a stake in the outcome of the project (e.g., the end customer, the overall program manager, the project steering committee, the team resource owners, contractors, team members). Each project stakeholder should have access to the status of the project anytime throughout its life.

The WBS is the foundation for the project control systems. Because it is designed with increasing levels of detail and mapped to a higher project component and objective, work can be easily summarized to the level of control desired by the stakeholder. Control systems, such as scheduling, cost and performance measurement, and resource tracking, all have their roots from the WBS. They are the key to warning of stakeholders of any imminent problems early enough so that the team can make decisions and adjustments to solve them or, better yet, avoid them altogether. It is important that stakeholders know how data is inputted into the project WBS. This defines the data that drives the project measurement and control systems. Covered in the WBS should be the project-account systems (e.g., accounts receivable, accounts payable), work booking tools to be used, and project performance reporting rules and methods.

FORM FOUNDATION FOR PLANNING AND SCHEDULES

The WBS is the basis from which the team plans and schedules the project. Through the WBS visual model, the team understands the relationship and precedence of tasks, their duration and cost, the people involved, and when they will be available. A project manager may be overwhelmed by the size and scope of a project objective. However, the process of creating a WBS is basically the same regardless of is scope. If a team properly exercises the methodologies of project management, the magnitude of the cost of a project should be of no concern to any of the team members. The WBS provides a systematic approach to define all the work packages along with their interrelationships from the scope of the project. Through this process, a team can break down a large project into smaller, controllable, and more comfortable work packages.

WBS Components

To be an effective communication tool, the WBS must have a common language understood by all project members and stakeholders. How the team codes the WBS is instrumental to ensuring that all parties understand the entire scope of the project and their role within it. There are three basic elements of the WBS:

- Reporting
- Structuring
- Coding

REPORTING

The first thing to remember is that people need information to manage a project. It is important that the WBS designers have an understanding of what the team and stakeholders will need to know to control a project. When designing the WBS, all levels of reporting should be reviewed, ranging from senior management summaries through to the person inputting project data. Designers must ensure that both the WBS and the reports generated from it clearly convey what is required, what work has been done toward it, and what actions are expected by the report user. Different stakeholders of the project will need to know varying degrees of project details depending on their level of responsibility, authority, and accountability. A project engineer may want to book hours against a job order for a project component; a project group leader may want to know the total hours billed against that job order by week; and a project manager may want to know the total costs summed-to-date of the component to compare against an estimate. These varying levels of details will impact the structuring and coding of the WBS.

Reporting flexibility and speed are also important considerations. Reports from the WBS must be easy to produce without requiring complicated computer programs or manual collection of data. The more complexity that is put into the structure and code of the WBS, the more difficult it will be to retrieve information from it. A simple design code conducive to basic query summations promotes speed and flexibility in reporting.

STRUCTURING

Since the WBS is the device by which all project information is gathered and dispersed, its structure design is an important component of an effective working project. WBS designers must carefully structure the WBS considering both the data-collection need of the project and the reporting needs. It is important that each level serve a purpose and render meaning to its users, while, of course, balancing manageability with comprehensiveness as previously discussed. The lowest levels provide the information to plan, manage, and control the project. Each higher level becomes a summary point of all the activities of the levels directly beneath it. However, to maintain manageability, designers must not include too many levels into the WBS. Four to six levels are sufficient for most large projects.

CODING

Regardless of position or background, a well-designed WBS code is easily understood by any project member. By using systematic procedures early, the team can reduce or eliminate assumptions regarding the coding that cost the project later, and maintain integrity in the use of the WBS throughout the project.

The WBS code is related to the structure design, for each level of the structure adds a segment to the code. The code from each work element is the combination of the number of letter coded work levels preceding it plus its own identifier. For example, in a software-upgrade project, *Level 1* can represent the *project components* (e.g., 1.0 Program Management, 2.0 Infrastructure, 3.0 Software Upgrades, 4.0 Change Management, et al.), *Level 2* can represent *key summary activities* under each component (e.g., 4.1 Communications, 4.2 Process Behavior Training, 4.3 Senior management training, 4.4 End user transactional training, et al.), *Level 3* can represent the work package level (e.g., 4.4.1 Train super users, 4.4.2 Develop training material, 4.4.3 Secure training rooms, 4.4.3 Deliver end-user training).

By including the preceding levels related to the work elements, the coding system enables the summary of the costs and activities of lower-level work packages along the correct path of higher-level work elements in the WBS. The hierarchical numbering scheme produces a unique code to label and identify work packages. This helps establish the WBS as the device used by the project control systems. Utilizing the WBS code for entering and summarizing all project data and information enables the team to compare progress to a baseline. Example: Project element 4.4 (End-user transactional training) was overrun due to the unavailability of training rooms. To prevent slippage, the unbudgeted cost of leased computers was booked against work package 4.4.3 (Secure training rooms).

WBS in Action

Enterprise Resource Planning (ERP) software applications have become more comprehensive and far-reaching across the organization. Previous stand-alone systems, such as sales, engineering, logistics, purchasing, manufacturing, finance, and human resources, now share data within the same system or via electronic bridges in real time. Real time means that any data change can have an instantaneous impact on the company (especially bad data—e.g., wrong lot size). This system integration changed the whole philosophy of software upgrades, raising the scope and risks. No matter the size of the software or magnitude of change, if another part of the enterprise is affected in real time, the area becomes a major player in the upgrade project.

In a recent software upgrade event, sound project-management practices were utilized, including a firm WBS. The entire site was touched. While the task looked daunting, the results were highly favorable: on-time, under budget, and the technical parameters met upon go-live.

GETTING THE TEAM TOGETHER

Because the WBS ultimately determines who is to be included on the team, the designers are usually a group of people experienced in project management who are knowledgeable about the project end items and the availability of resources required to achieve them. This upgrade project started with the ERP director, the site business improvement director, the lead manager of the IT provider, and ERP managers from the major parts of the business: customer units, purchasing, operations, and finance.

BUILDING THE WBS

When putting together a WBS, the designers first looked at the project as a whole, e.g., software version, fit into the corporate vision, major components. It is recommended that the team review a previous project WBS to spur ideas and learn from past experiences. Initially the designers may venture into areas beyond their expertise. However, at this stage, they need not immediately bog themselves down with all the details. The group should begin with a simple structure, outlining the project with two to three levels. For an ERP upgrade, major components include project management (the work involved in managing the project), system infrastructure (server size, network, clients), software upgrades, change management (preparing the organization for the upgrade), process analysis, any customization requirements, validation and testing, and post-implementation activities. Initially, the structure should be clear, with the code open to further refinement after the structure has been finalized by the team (see Figure 8–4).

The team then continues with a more detailed, level-by-level breakdown, clarifying the project's scope, until the proper practical level of work packages is reached. Identify for each work package:

- Technical specifications—what exactly needs to get done
- Resources required and commitment acceptance from the resource owner of resource availability
- Authority and responsibility for its completion
- Estimates of time and financial budget
- Milestone events and schedule dates

The designers should solicit input from team members and stakeholders who will be using it to adjust the code and structure. Always make sure that each lower element of work is associated with only one higher-level element. This maintains the accountability of project elements up the hierarchy through to the project objectives. It is also a good idea that once the structure and code are prepared, the designers generate a few sample reports using the WBS and distribute them to various team members and stakeholders for review.

After the final design of the structure, code, and reports, the WBS is presented by the designer and explained to the team and stakeholders, including the dictionary of each WBS element.

USING A WBS

Since the WBS can be used to gather and disperse information, instruct the team to input project data (e.g., completion date, hours booked, etc.) for each element under its WBS code. Periodically total this information up the

Software Upgrade

1. Project Management
    - 1.1.1. Planning
    - 1.1.2. Monitoring
    - 1.1.3. Controlling
    - 1.1.4. Administration
2. Infrastructure
    - 2.1.1. Server Capacity
    - 2.1.2. Network Capacity
    - 2.1.3. PC Capacity
3. Software Upgrades
    - 3.1.1. Cutover Data Loaders
    - 3.1.2. Knowledge Base
    - 3.1.3. Operating Systems
    - 3.1.4. Bridges to other systems
    - 3.1.5. GUI
    - 3.1.6. Development Box
    - 3.1.7. Quality Assurance Box
    - 3.1.8. Production Box
4. Change Management
    - 4.1.1. Communications
    - 4.1.2. Process Behavior Change
    - 4.1.3. Senior Management Training
    - 4.1.4. End User Transactional Training
5. Process Analysis
    - 5.1.1. Analysis of Current Production System
    - 5.1.2. Analyze New Version to Current Busi ness Processes
    - 5.1.3. Refine Process Definition and Documentation
6. Customization
    - 6.1.1. Develop and Design
    - 6.1.2. Configure System
    - 6.1.3. Test
    - 6.1.4. Transport
7. Validation
    - 7.1.1. Testing Logistics
    - 7.1.2. Unit Testing
    - 7.1.3. Interbusiness Testing
    - 7.1.4. Integration Testing
    - 7.1.5. Rework and Retest
8. Post Upgrade Support
    - 8.1.1. Provide Production Support
    - 8.1.2. Postimplementation Review (PIR)
    - 8.1.3. Summarize and Review Lessons Learned

Figure 8–4 High Level WBS for a Software Upgrade

levels of WBS and compare actual performance to budget and schedule. Use the information to address problems and initiate corrective actions and adjust work packages, budgets, and schedules accordingly. In a previous example, leased computers charged against an upgrade project could have been used in a variety of places for a number of reasons. By assigning it to a specific WBS code, the reason for the cost was more easily identified.

CONTROLLING A WBS

Executing a project requires adherence to project-management principles. It is important that the team use a change-control process. Once past the project-definition phase, the WBS is frozen at a point in time and changed in an organized, orderly, systematic manner. While flexibility is an obvious requirement in dynamic environments, maintenance of the WBS integrity is critical. Identify budget and schedule impact of changes and require signatures for changes, additions, and deletions to the WBS document. For some team members, the change-control process may seem militant and bureaucratic. Make sure to stress early in the project that this policy is critical and that it is the most effective way to maintain the WBS as a valid communication tool for all team members and stakeholders.

Conclusion

The WBS is a highly valuable management tool in delivering project success. It is a disciplined, systematic methodology to organize project work and ensure that all required work packages and the required resources are identified. The WBS adds clarity by providing a visual communication tool for all project stakeholders that details deliverables along with the processes by which they will be attained. It allows a diverse team to break down the complex project components into committed, measurable, and manageable work packages. The WBS enables the team to begin planning, estimating, budgeting, scheduling, executing, and controlling the work required to meet the project deliverable. A WBS provides a systematic way for the team to understand the goal and their purpose as they walk onto the project field and lets them know *exactly* whether they have won or not when the project is done.

ENDNOTES

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Chapter

9

Tools to Achieve On-Time Performance

J. Davidson Frame

Biographical Sketch. . .

J. Davidson Frame is Academic Dean of the University of Management and Technology. Prior to joining the UMT faculty, he was Professor of Management Science at George Washington University, where he served as Department Chair of the Management Science Department and established GW's project-management program. From 1990–1996, Frame served as the Director of Certification at the Project Management Institute (PMI). In 1997–1998 he served as PMI's Director of Educational Services. In 2000–2002, he sat on PMI's international Board of Directors. Frame has published more than 30 scholarly articles and eight books.

This chapter examines basic issues of project scheduling. First, it reviews the process of estimating the duration of project activities. If realistic estimates can serve as the basis of project planning and implementation, the likelihood of conducting a project successfully grows dramatically. Then the chapter examines six dominant techniques of project scheduling: Gantt charts, milestone charts, precedence diagramming, critical chain scheduling, time-boxed scheduling, and earned-value management.

The Impact of the New Business Environment on Project Scheduling

Effective project professionals must possess a wide array of skills. The broad range of desired skills is reflected in the Project Management Institute's *Guide to the Project Management Body of Knowledge* (PMBOK), which identifies nine specific areas of competency in project management: (1) scope management, (2) time management, (3) cost management, (4) human resource management, (5) risk management, (6) quality management, (7) procurement management, (8) communication management, and (9) integration management. A quick review of this list suggests that effective project professionals should be good generalists: in addition to understanding the technical aspects of their work, they should be good at business, at administration, at contracting, and at dealing with people.

Having said this, it should be recognized that what most distinguishes effective project professionals from professionals working in other areas is their focus on the management of time. Project professionals are expected to be experts in the art and science of scheduling project efforts. They should be good at estimating how long it takes to carry out specific activities, at identifying when key milestones can be achieved, at developing alternative scheduling scenarios, at tracking schedule progress, and at offering guidance on how schedules can be accelerated.

The effective management of time has always been recognized to be important to individuals and organizations. After all, time is a non-renewable resource—once it passes, it can never be reconstructed. People are concerned that they utilize their time effectively and try to avoid wasting time. In today's brutally competitive environment, effective time management is more important than ever. Our customers have come to expect us to deliver goods and services as quickly as possible. If we cannot satisfy them in this respect, then they will shift their business to our competitors.

Recognition that we must supply our customers with goods and services quickly has created serious problems for many project teams. It has led to a situation where unrealistic promises are being made as to when goods and services can be delivered. If these promises are not kept, then customer disaffection arises. In a scramble to meet the unrealistic promise dates, good project procedures may be ignored, shortcuts may be taken, and decision-making may be colored more by panic than by good sense.

Ongoing research I am conducting suggests that among the well-known triple constraints of time, budget, and specifications, working within the time constraint is where project teams are having their greatest difficulty. For example, in one recent survey of 438 project professionals working in 42 organizations, I found that while 55 percent stated they were facing budget problems and 29 percent stated they were having trouble meeting the specifications, 69 percent reported facing schedule slippage. Clearly, schedule-related problems are the key problems encountered by this group of respondents—and I suspect that their experiences are shared by most project teams today. It is clear to me that these schedule difficulties are directly tied to the making of unrealistic promises as to when goods and services will be delivered. As an old joke goes, nine women working concurrently cannot make a baby in one month.

Estimating Durations of Activities

Effective project scheduling rests heavily on developing accurate estimates of the duration of individual activities. The ability to create accurate estimates depends largely on the estimating organization's prior experience in doing the activities. If the project team is carrying out a set of activities for the first time, then it is likely that the estimates will be rough. For example, researchers carrying out a project to identify the causes of a newly discovered disease are treading new ground and have only the vaguest sense of how long it will take them to do the job. On the other hand, if a team has carried out a set of activities many times before, then their estimates can be quite precise: a team that has installed a certain type of telephone switch for hundreds of customers has detailed knowledge of how long it takes to carry out each task.

Increasingly, organizations recognize the role of experience in enabling them to make accurate estimates of time, cost, and resource requirements for their projects. Consequently, they are beginning to implement procedures to capture their experiences systematically by having staff maintain accurate records of their activities. Thus, software testers keep track of how long it takes to test certain software modules, and equipment installers track the duration of standard hook-ups. This type of data can provide future project workers with guidelines on the duration of individual activities.

DISTINGUISHING BETWEEN WORKING TIME AND ELAPSED TIME

In developing project schedules, it is important to recognize that the passage of time can be viewed from different perspectives. For example, there is a fundamental difference in computing the time spent by a painter in painting a chair and the time it takes for the paint to dry on the chair. If, while the painter is painting the chair, she is interrupted with a phone call, then work on the chair temporarily stops. Similarly, during the time the painter takes a lunch break, work on the chair stops. This concept of time is called *working time*. For workers who work eight hours a day for five days a week, their working time effort is 40 hours per week.

In contrast, phone interruptions have no bearing on whether or not paint dries on the chair. The paint *will* dry no matter what. This concept of time is called *elapsed time*. Elapsed-time activities are common in projects that entail physical activities, such as construction and facilities-management projects. On such projects, freshly poured concrete must be given time to cure, paint time to dry, and glue time to set. Even intangible projects in the software arena may encounter elapsed time situations: for example, mainframe computers operate 24 hours a day, seven days a week. They do not take lunch breaks or shut down on holidays. Thus, a software testing job may be sitting in a queue until 2:30 on a Sunday morning, at which time it is finally enabled to execute.

Failure to recognize the difference between working time and elapsed time activities may lead to incorrect schedule estimates. To see this, consider the following simple example: Marvin finishes painting a chair at 5:00 on a Friday afternoon. Immediately upon finishing the chair, he goes home and has a relaxing weekend with his family until he returns to work at 8:00 on Monday morning. This is a clear illustration of working time. Marvin works during the week, then takes a break over the weekend, during which time no work is done.

Meanwhile, the paint on the chair begins drying at 5:00 p.m. on Friday. If it takes two days for paint to dry, then the paint-drying effort will be completed at 5:00 p.m. Sunday. This illustrates an elapsed time effort. Even while Marvin is relaxing on Saturday and Sunday, the paint on the chair is drying. Note that if in entering data into a computerized schedule the project scheduler treats the paint-drying activity as a working time effort, the computer will calculate that the paint will begin drying at 8:00 Monday morning and will be completely dry by 5:00 p.m. Tuesday—an incorrect conclusion.

USE OF THE PERT BETA DISTRIBUTION TO ESTIMATE DURATIONS

One thing that experience teaches seasoned estimators is that whatever duration they estimate for a task, their estimate will not be 100 percent correct. An estimator might predict that a particular task will take two days to undertake. When carried out, the task might actually take 2.2 days. Had project conditions been a little different, it might have taken 1.9 days. The point is that the exact duration of a task will almost certainly vary from the estimated duration.

Often, the variability of estimates assumes what is called a *PERT Beta distribution*. An example of a PERT Beta distribution is pictured in Figure 9–1. Let us assume that this particular distribution shows us how many hours it can take for the paint on freshly painted chairs to dry. The distribution suggests that the quickest time for paint to dry is three hours. The slowest is seven hours. Most frequently, paint dries on chairs in four hours. A number of factors contribute to the variability of paint drying times: humidity, ambient temperature, and thickness of the paint are three significant factors. As these factors vary from job to job, so will the time it takes for the paint to dry.

The PERT Beta distribution mirrors what frequently happens on projects: the very best time in which a job can be done (three hours in our example)

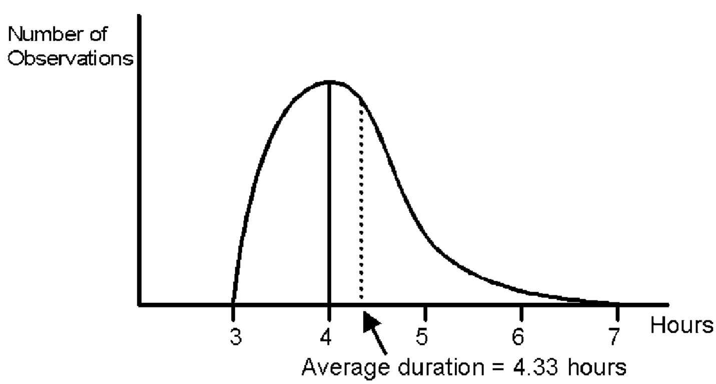


Figure 9–1 Pert Beta Distribution

is not that much better than what happens most typically (four hours). However, when things go wrong, durations can really stretch out (up to seven hours in our example). It should be noted that what happens most frequently is not a good estimator of how long it takes for a task to be carried out. A good estimator is the *average* time spent on a task. If the pessimistic estimate of duration is substantial, then the average time spent on a task will be larger than what happens most frequently because the worst-case situations cause the average value to grow in size.

Calculating the average value of a PERT Beta distribution is nontrivial, since this distribution is fairly complex mathematically. However, statisticians have developed a simple formula that enables us to estimate the average with a fair degree of accuracy:

$$\text{Average duration} = (a + 4b + c)/6$$

where a = optimistic duration, b = most typical duration, and c = pessimistic duration. In the paint-drying example, average duration is $(4 + 4 \times 4 + 7)/6$, or 4.33 hours. This means that if we were to track the drying times of, say, a thousand painted chairs, we would find that they took an average of 4.33 hours to dry.

Even here, we know that it will not take exactly 4.33 hours for the paint to dry. The actual result will be something greater or less than this. The level of accuracy of our estimate can be roughly identified by using the following formula (in statistics, this level of accuracy is called *standard deviation*):

$$\text{PERT Beta standard deviation} = (c - a)/6$$

where c = pessimistic duration and a = optimistic duration. In our numerical example, standard deviation is $(7 - 3)/6$, or 0.67 hours. Thus in reporting our estimate for how much time it takes for paint to dry on chairs, we would make the following statement:

''We are quite confident that it will take 4.33 hours, plus or minus two-thirds of an hour for paint to dry on most chairs. That is, the paint can dry in as little as 3.67 hours or as long as 5.00 hours.''

Of course, the actual values can lie outside this range. On a particularly hot, dry day, the paint may dry very quickly—say, in 3.25 hours. Or on a cool, humid day it may dry slowly—say, in 6.1 hours. The key point here is that by computing the average and the standard deviation, we have a good sense of the range of time it will take for most cases.

Project planners who compute standard deviation for their duration estimates will have a better handle on their estimates than those who do not. To see this, consider estimates made for the amount of time it takes for an expert and a novice to carry out a particular system test during a system-integration exercise. Let us say that the expert has conducted this type of test many times over the past ten years. To her, this test has become a routine effort. She can perform it in an average of 12.0 hours. A computation of the standard deviation might show that the amount of variability for during the job is plus or minus 0.5 hours.

In contrast, the novice has just begun implementing this type of systems test. Like the expert, he can conduct the test in an average of 12.0 hours. But because of his inexperience, his performance is less consistent. He may sometimes shortcut proper procedures and actually get the job done more quickly than the expert. On the other hand, when he encounters problems, this will show him down and he will take longer to do the job. While his average time spent in conducting the test might be 12.0 hours, the corresponding standard deviation might be plus or minus 1.5 hours.

What this information tells us is that while both the expert and novice will spend the same average amount of time conducting the test, it is just as likely that the novice will do the job in 13.5 hours (12.0 + 1.5 hours) as that the expert will do it in 12.5 hours (12.0 = 0.5 hours). If the consequences of schedule slippage are serious (for example, they may trigger contract penalties), the lack of predictability of the novice's performance should be factored into the schedule estimate.

THE NEED FOR INDEPENDENT VERIFICATION

No amount of sophisticated statistical treatment will produce accurate estimates if the numbers that go into the formulas are off-target. Unfortunately, this is a fairly common occurrence today. For example, salespeople face substantial pressure to sell an organization's goods and services to clients because their incomes are often tied—through the use of sales commissions—to the volume of revenue they can generate. To make the sale, they may promise customers that projects can be carried out according to promise dates that are unrealistic. If the project team cannot make these promise dates, then customer disaffection is ensured.

In order to avoid this kind of problem, it is a good idea to have schedule promise dates independently verified. This verification can occur by using outside parties to cross-check promise dates (this is the preferred mode of operation of the U.S. Department of Defense) or by employing internal resources. The important point is that the promise dates should be reviewed from both a technical perspective (e.g., is it technically possible to do the work as quickly as promised?) as well as from a broad managerial perspective (e.g., do we have qualified resources available to carry out the work as planned?).

If the assessment of the independent verification is that the promise dates cannot be met, then the project should not be carried out unless the promise dates are renegotiated. This is a tough decision to make, because the organization may be unwilling to lose the business. However, if they move forward on the project, they will encounter customer disaffection. The organization may be seen to be incompetent and consequently may lose large amounts of future business.

MONTE CARLO SIMULATION

Project planners have recently begun employing Monte Carlo simulations to obtain better estimates of project schedules. This technique was developed in the 1940s, but it only gained widespread usage in the 1990s with the advent of user-friendly software that runs the simulations of personal computers. The technique allows planners to factor uncertainty into their estimates of schedules, budgets, and resource requirements.

The way Monte Carlo simulations work can be illustrated by means of an elementary example. Assume that we are working on a very simple project that has only three phases to it. The first phase involves designing a widget, the second entails building it, and the third involves testing it before turning it over to the customer. Our records show that on similar projects, the design effort most typically takes 4 days, the building effort 12 days and the testing effort 4 days. If we were simply to add these numbers together, we would deduce that this project should take 20 days to complete.

However, let us assume that we carry out a Monte Carlo simulation to estimate project duration and that we have the data shown in Table 9–1 to help us with our estimate. With Monte Carlo simulation, we instruct the computer to employ a random-number generator to allow our estimated values to fluctuate according to whatever distribution we specify (say a normal distribution or a PERT Beta distribution or a triangular distribution). Using a random-number generator, the computer may specify that the design effort takes 4.2 days, the building effort 10.9 days, and the testing effort 4.5 days. In total, 19.6 days will have been spent on the project. Then the computer has the random-number generator change the values for design, build, and test and computes the total duration a second time. This process is repeated many times. On each occasion, the computer keeps track of the total estimated time. What is happening here is that the computer is simulating the vagaries of carrying out a project under many different circumstances.

Table 9–2 shows the results of a Monte Carlo simulation when the random-number generator is instructed to employ a triangular distribution to generate values for the design, build, and test phases. It did this for 10,000 iterations. The results show that if this project were carried out many times, the average duration for doing the work would be 21.6 days, 1.6 days longer than our original estimate of 20 days. Furthermore, the Monte Carlo simulation can give us probabilities for different scenarios. For example, the simulation described here found that 25 percent of the time, one can expect the project duration to be 20.5 days or shorter, while 25 percent of the time, one can expect the duration to be 22.7 days or longer. Most significantly, the simulation suggests that it is highly unlikely that we could do the work

Table 9–1 Estimated Time to Carry out the Widget Project

Task	Best Case	Most Typical	Worst Case
Design	3 days	4 days	7 days
Build	10 days	12 days	16 days
Test	3 days	4 days	6 days

Table 9–2 Results of Monte Carlo Simulation, Using 10,000 Iterations

Average Duration	Standard Deviation	Minimum Duration	Maximum Duration	25% Likely That Duration Is Less Than:	25% Likely That Duration Is More Than:
21.6 days	1.6 days	16.9 days	27.5 days	20.5 days	22.7 days

in 20 or fewer days as initially estimated (the probability of this eventuality is only 17 percent).

At present, software exists that permits project planners to carry out Monte Carlo simulations on their computer-based precedence diagram schedule networks (the precedence diagram method methodology is discussed later in this chapter). The duration of each task in the precedence diagram is allowed to fluctuate according to whatever distribution the planner specifies. The computer can be instructed to go through hundreds of iterations, where durations are allowed to fluctuate randomly for all tasks. The simulation tracks the results of all these runs to identify a broad range of project outcomes. As a consequence, planners can create reasonably realistic scheduling models.

For a more detailed exposition of Monte Carlo simulation, see Frame.[1]

Scheduling Techniques

Presently, three basic scheduling techniques dominate project management practice: Gantt charts, milestone charts, and precedence diagram method networks. Each of these techniques will be discussed in turn.

GANTT CHARTS

The Gantt chart is the most commonly employed project-management scheduling tool. Its simplicity is its strength. Project staff, customers, and upper-level managers can interpret Gantt charts without training. Project workers can begin constructing them immediately. Overall schedule status can be determined at a glance.

Gantt charts come in a number of variants. The most common variant—the bar chart—is shown in Figure 9–2. This simple Gantt chart pictures a project to build a birdhouse. The project is being carried out by Susan and her young son, Randy. In this variant, bars are used to display the interval of time in which an activity is supposed to be carried out.

A little reflection shows that the most basic information that the Gantt chart contains is data on when tasks begin and when they end. Given this information, we can determine the length of the tasks. For example, the task ‘‘obtain kit’’ starts at 9:00 a.m. and ends at 10:00 a.m. Thus it consumes one hour of effort. Similarly, ‘‘Gather tools’’ starts at 10:00 am and finishes at 10:30 a.m., consuming one-half hour of effort.

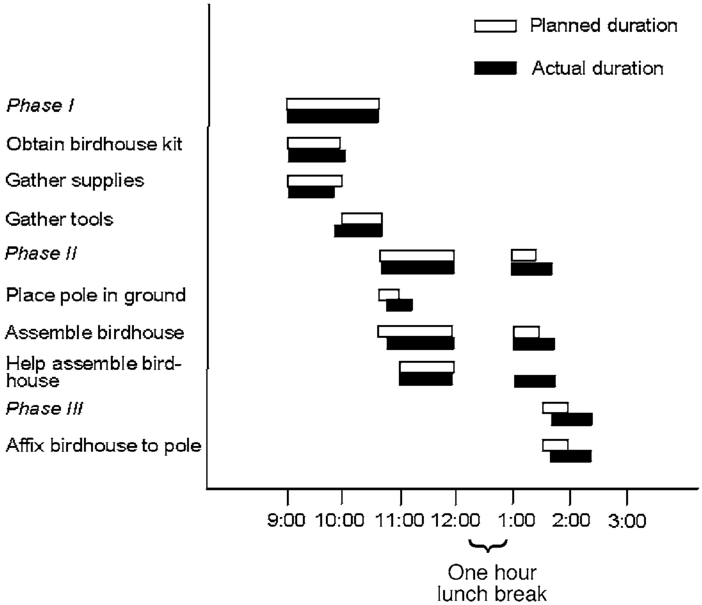


Figure 9–2 Gantt Chart

By inspecting the chart, we can also identify the proposed sequencing of activities. For example, while the task ''Assemble birdhouse'' is being carried out, first ''Emplace pole'' and then ''Help assemble'' are being implemented.

Gantt charts are the most effective way of portraying schedule status to customers, staff, and management. That's because they allow actual effort to be juxtaposed directly against scheduled effort. In figure 9–2, planned effort is pictured with empty boxes while actual effort is pictured with the solid black boxes. A review of the ''actuals'' data suggest that work was achieved according to the schedule for the first three tasks (phase I), but that slippage occurred in phase II. Specifically, ''Assemble house'' began a little late and ended late, and ''Help assemble'' began late and took longer to carry out than planned.

MILESTONE CHARTS

Gantt charts are a simple way to picture how tasks are scheduled to occur. Milestone charts, in contrast, focus on the desired *results* of activity. In a sense, they provide targets at which the project team aims its efforts. In addition, like the milestones travelers encounter along highways, they are markers indicating where individuals are in regard to their starting point as well as their destination.

Figure 9–3, a milestone chart, lays out the birdhouse project according to a number of key milestones. It should be noted that the milestones contained in the chart reflect anticipated results, not tasks per se.

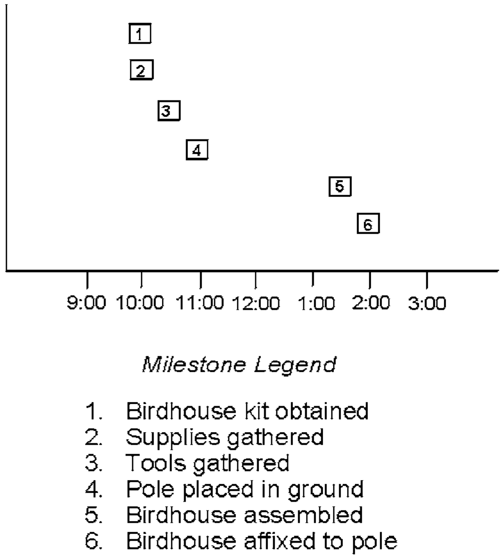


Figure 9–3 Milestone Chart

When milestone charts are employed with a measure of creativity, they can provide the project team with valuable insights. For example, they can be employed to enable the project team to estimate the amount of work they have carried out. To see this, consider a 2,500-person-hour project where the scheduler has carefully identified five milestones, each of which represents the planned accomplishment of an estimated 500 person-hours of work. Once the work associated with the first milestone has been accomplished, the project team can state that they have achieved 20 percent of their targeted effort. When the work associated with the second milestone has been accomplished, the team can state they have achieved 40 percent of their target effort. And so on.

Another creative use of milestone charts has schedulers including a broad array of items in the chart, beyond purely technical milestones. One highly successful project team working on a near-billion-dollar project attributed a large portion of their success to the use of such a milestone chart. For example, the chart highlighted political milestones (e.g., ''It is politically wise to finish phase I by 13 August so that the CEO can announce project progress at the stockholder meeting on 15 August''), budgetary milestones (e.g., ''To obtain project funding for the next fiscal year, we must have our budget request form submitted to the finance office by June 30''), and bureaucratic milestones (e.g., ''Our next quarterly progress report is due on October 15'').

Milestone charts are particularly useful in trying to obtain an overview of project efforts on large, complex projects. With such projects, Gantt charts and PERT/CPM charts can become so messy that they are difficult to interpret. Because milestone charts simply highlight basic results, they are easy to understand, even on large projects. Furthermore, when the achievement of actual results is pictured on the chart, they can be compared to the planned milestones, allowing the milestone chart to be employed for project-control purposes.

PRECEDENCE DIAGRAM METHOD NETWORKS

As flowcharting techniques gained popularity in the 1950s, engineers began experimenting with ways to employ them to schedule project efforts. Two initiatives were highly successful: PERT (program evaluation and review technique) and CPM (critical path method). PERT was developed for the scheduling of the Polaris missile submarine program, while CPM was developed independently by DuPont Corporation for use on its chemical engineering projects. As we have seen, Gantt charts lay out when different tasks will be implemented and milestone charts focus on the achievement of key results. In contrast, PERT/CPM networks show how the different tasks are connected to each other, enabling the project team to view the project as a system comprised of interrelated parts.

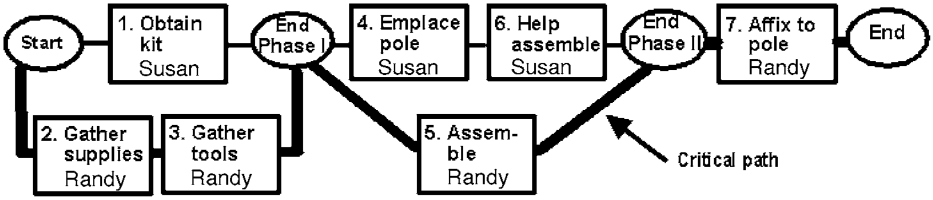
The PERT/CPM approaches gained a great deal of attention in the early 1980s with the development of user-friendly personal computer software that allowed project planners to conduct PERT/CPM analyses easily. (The first heavily used PC-based software product was called Harvard Project Manager.) Although there were pronounced differences distinguishing PERT and CPM networks in the 1950s, the current generation of scheduling software is basically an amalgam of key features associated with both techniques. It is neither pure PERT nor pure CPM.

Virtually all the new software approaches PERT/CPM by using what is called the precedence diagram method (PDM). With this approach, tasks are pictured as boxes and interdependencies as lines. This is the approach employed in this chapter. Back in the early days of PERT/CPM, the preferred approach was called the activity-on-arrow diagram approach. This methodology employed arrows to illustrate both tasks *and* precedence relationships. This approach is not treated here.

Functioning of PDM: The Basics

The basic functioning of PDM will be illustrated by means of the birdhouse example. A PDM chart for the birdhouse project is pictured in Figure 9–4. This chart contains two paths. As indicated in the figure, the tasks along one path are carried out by Susan while the tasks along the other path are carried out by Randy.

In phase I, Susan will drive to the hardware store to pick up a birdhouse kit. This will consume one hour. Meanwhile, Randy will gather supplies (one hour effort) and tools (one-half hour effort) from around the house. In all, Randy will devote 1.5 hours to phase I while Susan will devote 1.0 hours. Note that the duration of phase I will be defined by the longest path (Randy's). Thus, phase I will last 1.5 hours. In PDM, the longest path is given



Legend

1. Obtain kit, early = 9:00 a.m., late = 9:30 a.m.
   slack = 30 minutes, duration = 1 hour
2. Gather supplies, early = 9:00 a.m., late = 9:00 a.m.
   slack = 0, duration = 1 hour
3. Gather tools, early = 10:00 a.m., late = 10:00 a.m.
   slack = 0, duration = 30 minutes
4. Emplace pole, early = 10:30 a.m., late = 11:00 a.m.
   slack = 30 minutes, duration = 30 minutes
5. Assemble birdhouse, early = 10:30 a.m., late = 10:30 a.m.
   slack = 0, duration = 2 hours
6. Help assemble, early = 11:00 a.m., late = 11:30 a.m.
   slack = 30 minutes, duration = 1 hour
7. Affix to pole, early = 1:30 p.m., late = 1:30 p.m.
   slack = 0, duration = 30 minutes

Figure 9–4 Precedence Diagram

the name *critical path.* Susan's path is noncritical. In fact, because she is scheduled to carry out only one hour's worth of effort, she has a half hour of flexibility in implementing her task (this flexibility was called *float* in CPM scheduling and *slack* in PERT scheduling—today both terms are used interchangeably).

Because she has one-half hour of slack built into her schedule, Susan has a measure of flexibility in when she begins her task to obtain a birdhouse kit. She can begin it as soon as the project commences at 9:00 a.m. (this is called earliest start, or S_E), or she can begin it as late as 9:30 a.m. (this is called latest start, or S_L). Slack is $S_L - S_E$, or 9:30 − 9:00, or 30 minutes.

This same kind of reasoning can be extended to phases II and III. The thick lined path indicates the critical path for the whole project. This path enables the project team to calculate the estimated duration for the entire project, which is four hours (the sum of the durations for the tasks that lie on the critical path). If one hour is added to the project duration to take into account an hour lunch break at noon, then the end date for the work is 2:00 p.m.

The example offered here has been kept simple in order to explain some key characteristics of PDM logic. This same logic can be extended to cover highly complex, large projects.

Logical versus Resource-Driven Links

The trick to creating effective PDM network diagrams is to know how to link tasks together. Two aspects of linking tasks will be covered here: (1) recognizing the difference between logical links (sometimes called *hard logic*) and resource-driven links (sometimes called *soft logic*), and (2) understanding the use of start-finish, start-start, finish-finish, and finish-start links. In this section we deal with the first aspect, and in the next with the second.

The difference between logical and resource-driven links can be appreciated by referencing Figure 9–5. This simple PDM chart shows a number of tasks that George and Martha will carry out in order to prepare lunch for a picnic. George and Martha have decided to split the workload as equitably as possible. Thus while George is preparing sandwiches (ten minutes), Martha is preparing lemonade (four minutes) and gathering food for snacks (five minutes). Once the sandwiches, lemonade, and snacks are ready, they will be put into a picnic basket. The links connecting ''Prepare sandwiches'' and ''Prepare lemonade'' with ''Pack picnic basket'' and *logical links:* what the PDM chart suggests is that the picnic basket cannot be packed until the food is prepared.

Note, however, that the link connecting snacks to lemonade is a *resource-driven link.* There is no logical reason why ''Gather snacks'' *must* lie on the same path as ''Prepare lemonade,'' or why, for that matter, it should precede ''Prepare lemonade'' (it could just as easily have followed ''Prepare lemonade'' without affecting the quality of the lunch). In fact, if there were a third person to help with the project, he could have worked in parallel with George and Martha, preparing the lemonade while George worked on the sandwiches and Martha gathered the snacks, in which case the PDM chart would have three paths rather than just two.

The principal point here is that with logical links, schedulers do not have much flexibility in connecting tasks to each other. Logically, these tasks *must* be linked together in a prescribed order. On the other hand, with resource-driven links, there is a good measure of flexibility in connecting tasks. For

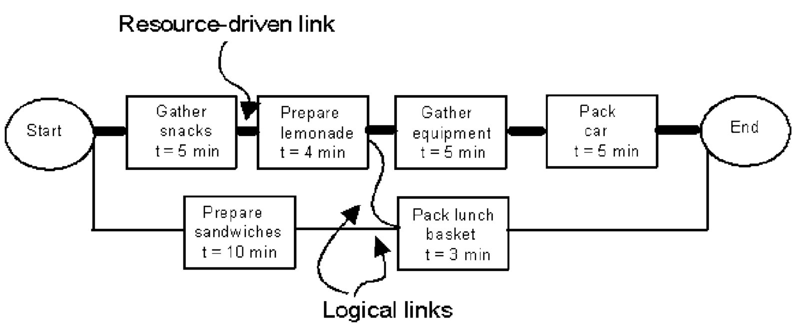


Figure 9–5 Logical and Resource-Driven Links

example, the more resources there are, the more possible it is to carry out tasks in parallel.

Different Types of Links

All the links described so far in the examples that have been offered are finish-start links. That is to say, the successor task cannot be started until the predecessor task is finished. Thus, in the picnic example, Martha will not begin gathering food for snacks until she has first completed preparation of the lemonade. Today's software makes it easy to build lags into the links, so it is possible to create a PDM chart that indicates that Martha should finish gathering snacks, wait one minute to catch her breath (a one-minute lag), and then begin preparing lemonade.

Another link that can be created is a start-start link. For example, painter A may begin applying a coat of quick-drying paint to the walls of a large house. Painter B is instructed to start applying a second coat of paint two hours after painter A begins his work. This is a start-start link with a two-hour lag.

A third link is the finish-finish link. Three writers might be instructed to finish writing their sections of a technical report by a specific date. Although they may have begun their work at different times, the key point is to finish together. This is a finish-finish link with zero lag.

The final link is a start-finish link. Assume that Mary's task is to edit a number of chapters of a long technical report. She instructs Ralph that he should complete (*finish*) work on his chapter two days after she begins (*start*) her editing chore so that she can work directly on editing his piece at that time. This is a start-finish link with a two-day lag.

The great majority of precedence links employed by project schedulers are finish-start links. The other types of links are available, however, to enable schedulers to portray their schedules more realistically under appropriate circumstances.

CHIEF VALUE OF PDM

A major value of PDM networks is that they serve as mathematical models of projects. For example, by creating a PDM chart, project planners can estimate the duration of the overall project and possess knowledge of the latest and earliest start times for individual tasks.

Beyond this, today's PDM-based project-management software provides planners with an integrated view of schedules, costs, and resource requirements. Consequently, project planners can conduct various ''what-if'' analyses to see the impact of different situations on schedules, budgets, and resource requirements. For example, they can create best-case, most-typical case, and worst-case resource scenarios to predict different scheduling outcomes that result from the different resource scenarios. Planners can raise and answer the following type of question: ''What will be the impact on the project's end date if only three of five installers are able to work on the installation of the equipment?''

GRAPHICAL INTEGRATED COST/SCHEDULE CONTROL

Control is the process of comparing planned activity against what is actually happening. By itself, looking at planned versus actual schedule performance is only marginally useful. Of more use is to engage in integrated cost and schedule control. To learn that a project is two weeks ahead of schedule may be small consolation if it turns out that it is also facing a 25 percent cost overrun. On the other hand, a two-week schedule slippage may be easier to take if it turns out that the project is experiencing a 25 percent cost savings.

Integrated cost/schedule control can be carried out easily by reviewing schedule and cost performance graphically. This is done in Figure 9–6, in which Gantt charts are employed to represent schedule performance and cumulative cost curves (also called S-curves) picture cost performance. Figure 9–6a shows a situation where the project is being carried out faster than planned. However, it is encountering a serious cost overrun. Figure 9–6b pictures a situation where the project is encountering schedule slippage and a cost overrun. Finally, Figure 9–6c illustrates a project that is being carried out on time and within budget.

CRITICAL CHAIN SCHEDULING

While PDM networks are more sophisticated than Gantt charts, a little reflection suggests that they are still quite primitive. To create a PDM network, you need only three pieces of information. First, you need to identify the tasks that are being executed. Second, you need to know the durations of these tasks. And finally, you need to know how these tasks are linked together. That's it!

What is missing here is explicit consideration of resource availability. In standard PDM scheduling, resource availability is handled indirectly when making estimates of task duration. If plenty of resources are available, task durations can be short. If they are not available, then task durations should be lengthened. But this is a haphazard approach to dealing with the role of resources in project scheduling, because the PDM approach does not explicitly accommodate resource availability. In view of the central importance of resource availability to project performance, it should be handled explicitly.

The critical chain technique does this. It not only looks at tasks, their estimated durations, and their dependencies, but it also takes into account resource availability. A simple illustration of how it works is presented in Figure 9–7. Figure 9–7a shows the precedence diagram for a four-task project. Tasks A and B comprise a path whose duration is nine days, while tasks C and D constitute a path with a ten-day duration. Because the critical path is the longest path, then the C–D path is the critical path.

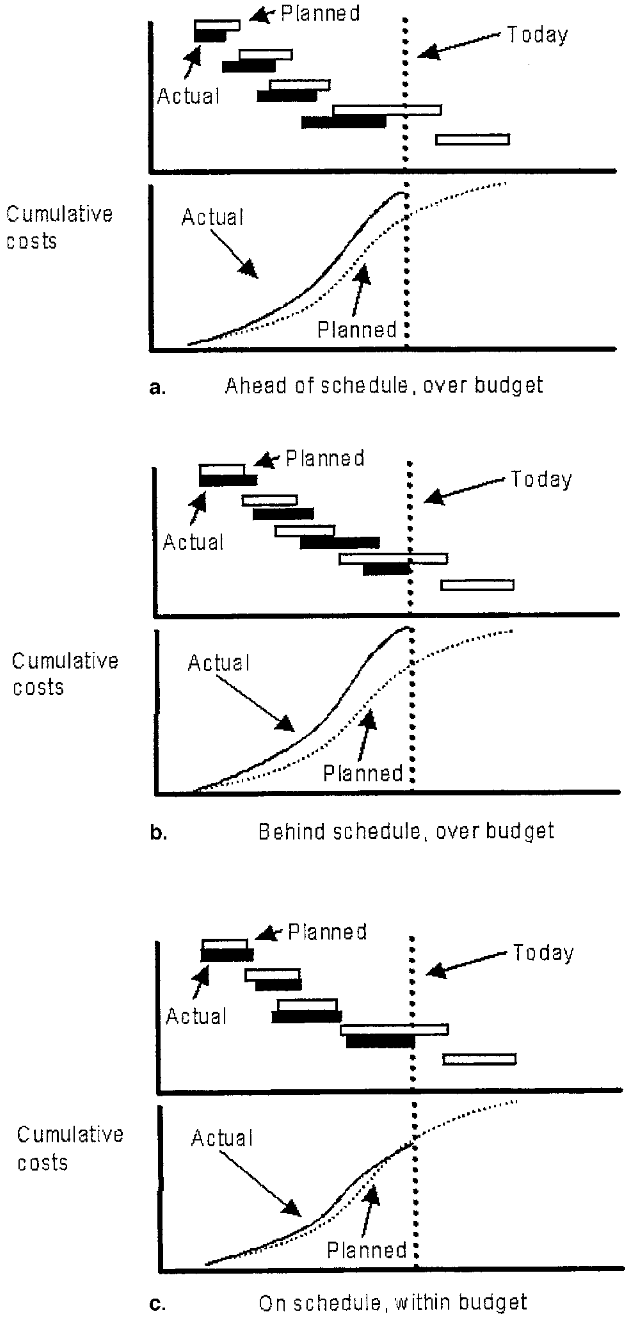


Figure 9–6 Integrated Cost/Schedule Control

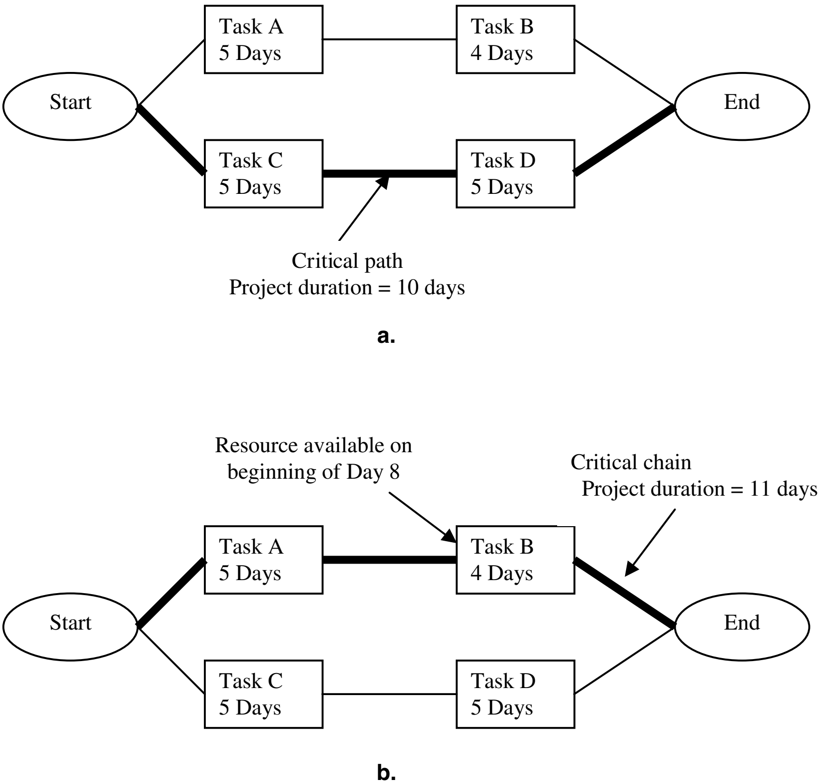


Figure 9–7 Critical Chain Scheduling

Let's say we have outside information that the worker who is scheduled to work on task B cannot show up for work until day 8. In theory, he can begin work on task B at the outset of day 6 (after task A's five day effort is complete). But in reality, other commitments keep him from beginning work on task B until the beginning of day 8. When this constraint is taken into account, it becomes clear that the project will take eleven days to complete, *not* ten days as suggested by the precedence diagram. A new critical path has emerged. In order to avoid confusion with the critical path generated by the precedence diagram, we give it a new name: the *critical chain.*

The critical chain technique was developed by Eliyahu Goldratt. It is an extension of work he carried out for the manufacturing environment, reported in his best-selling book (with Jeff Cox) *The Goal.*[2] In this book, Goldratt and Cox describes what they call the *theory of constraints* (TOC). TOC's basic principle is that when examining a process with a view to improving its performance, we should fix the bottlenecks. Too often, when trying to improve performance, we attempt to improve everything across the board, but this is a waste of resources because ultimately the performance of the process is governed by its weakest links—the bottlenecks.

In the late 1990s, Goldratt turned his attention to managing projects. He articulated his views in *Critical Chain*.[3] The rationale for the term *critical chain* is interesting. The word *critical* shows a connection to traditional PDM scheduling: the critical path is the path that defines the length of the project. The word *chain* captures the TOC principle: a chain is as strong as the weakest link. Thus, when examining a schedule, the critical chain is the path that takes into account bottlenecks in computing project duration. It may differ dramatically from the critical path and offers a more realistic perspective on project duration.

While the mechanics of putting together a critical chain schedule are interesting,[4] perhaps the technique's greatest insights are psychological. Two points in particular stand out: (1) when executing tasks, Parkinsons' law prevails; and (2) multitasking often covers a multitude of sins. Each of these points will be discussed briefly.

Role of Parkinson's Law in Executing Tasks

Anyone with experience in scheduling tasks has encountered the following phenomenon: If managers give workers two days to carry out a two-day effort, the workers may take, say, 2.2 days to do the job. If they give workers three days to carry out the same two-day effort, they may take 3.3 days. Given four days, they may take 4.4 days. The point is that no matter how much time the workers are given to do a job, they often take more time than required.

This phenomenon illustrates Parkinson's Law, which states that work expands to fill the time available to do a job. What often happens is that workers wait until the last minute to begin work on a task. Goldratt calls this the *student syndrome*. If they are given generous time frames, they feel little pressure to get on the job right away. When they finally begin the task, they discover that it will take more time to carry out than they anticipated. Hence, even though ample time was provided to do the job, they miss their deadlines.

The critical chain technique uses this phenomenon to provide guidance on how to build safety into duration estimates for tasks. The prevailing approach is to focus on a realistic estimate of task duration, and then add a little safety to the task duration to make sure enough time is offered to avoid schedule slippages. Let's say we are dealing with tasks X, Y, and Z, each of which is a three-day effort. In theory, if carried out sequentially, these three tasks should take nine days to complete in total. However, we are aware that there is opportunity for slippage, so we add an extra day of safety for each task. Thus, in making our duration estimates, we say that each task will take four days to execute. The total duration of the effort is now scheduled to be twelve days. Because we have added a substantial amount of safety to the task durations, we feel confident that we can do the job in the defined time frame. However, owing to Parkinson's Law, there is a strong likelihood that each tasks will take *more* than four days to carry out (let's say 4.5 days each). The total duration of the three-task effort is now 13.5 days.

To deal with this problem, the critical chain technique requires us to stick with realistic, unpadded duration estimates for each task. In our example, we allocate three days of duration for each of the three tasks. Total duration should be nine days. Because Parkinson's Law is still at work, there is a reasonable likelihood that there will be slippage in the schedule. Let's say that each task experiences a half day of slippage, so the total duration—with slippage—is 10.5 days. In creating a buffer to deal with slippage, some extra time should be added at the *end* of the sequence of activities. This buffer can be half of the total buffer you would use if you were adding safety on a task-by-task basis. In our example, we initially added one day of safety per task, which summed to three days of safety for three tasks. In following the guidance of the critical chain technique, we take half the three days of safety—i.e., 1.5 days—and use that as buffer for the entire three-task path.

Note that in our example, scheduling work in the traditional way, where safety is added to each task, resulted in a total duration of 13.5 days. By estimating task durations realistically and adding buffer at the end of the path, total duration is reduced to 10.5 days. Three days were saved simply by managing the buffer intelligently! Experience with real projects suggest that projects scheduled according to the buffer-management principle described here actually save substantial amounts of time.

Problems of Multitasking

In the critical chain perspective, multitasking means that project staff are asked to carry out a number of different tasks concurrently. This situation is captured in the following statement: "George, I would like you to spend most of the day testing the ABC software routine. That should be your top priority. But I would also like you to help Martha design an XYZ protocol and want you to prepare a briefing for the executive committee meeting at 4:00 p.m. this afternoon."

What George is experiencing is commonplace today. Nearly everyone complains that he or she is being asked to juggle several balls at the same time. To a certain extent, this multitasking may be justified, reflecting the messy character of today's business climate. Things don't seem to fit in neat compartments any more.

The critical chain perspective holds that this form of multitasking should be avoided if possible. It maintains that multitasking hides a multitude of sins and that it is the haven of incompetents. At first this viewpoint does not seem to make sense. Today we cherish the image of people who are able to do several things at one time. But a little reflection shows that there is merit to admonitions against most cases of multitasking.

Following are some of the problems of multitasking that the critical chain perspective highlights:

- Multitasking creates friction and can reduce efficiency significantly. As people shift from one task to another, they have to adjust themselves to the new conditions. A significant amount of effort may be dedicated to getting up to speed.

- Multitasking can hide quality problems until it is too late to handle them proactively. To see this, consider the following example. Tasks A and B are each two-day tasks. It takes a total of four days to complete both. One way to carry out A and B is to spend two days on A, then, when it is completed, to spend two days on B. Another approach—equivalent to what we call multitasking here—is to work on A during four mornings and B during four afternoons. Note that in theory, both approaches get the job done in four days. Note also that with the second option, both A and B are completed at the end of four days. Consequently, if there are quality problems with the deliverable being produced, they are not likely to surface until A and B are both complete. With the first approach, however, problems with A (if they exist) will likely surface at the end of day 2 (when A is finished) and can be handled at that time.
- Multitasking makes it difficult to diagnose sources of problems because when two or more tasks are carried out concurrently, it is tougher to see what's going on.
- Multitasking provides low-productivity workers with an excuse for their poor performance. If they are criticized for their lack of accomplishments, they can say: ''What do you expect? With all these assignments, I've got my hands full. You can't expect me to get everything done right, can you?''
- Most people are not good at multitasking. It is difficult enough doing one thing properly when you are able to concentrate on doing a good job. But when you need to do two or three things at one time, there is a good chance that you will not do a good job on any of them.

The criticism of multitasking offered by the critical chain approach provides us with food for thought. As mentioned above, today's messy business climate is unlikely to make multitasking go away. Even as you try to carve out time to carry out a chore without interruption, you will probably receive phone calls requiring you to spend time putting out fires here and there. In the real world of work, no one functions in a protected cocoon. Still, as you find yourself trying to do two or three things at one time, you should recognize that you will pay a price for your efforts at multitasking.

TIME-BOXED SCHEDULING

During the glory days of dot-com companies, people began talking about ''Internet time.'' What they were referring to was the imperative to do everything at the speed of light. Customer orders should be filled and shipped immediately. Customer inquiries should be answered right away. Airline reservations should be confirmed instantly. Packages should be shipped around the world overnight.

This obsession with working at breakneck speed became dominant in software development. Software-development teams that traditionally were given six months to develop a new product were now given only two months. Certainly, an aggressive attitude to scheduling work could lead to speedier deliveries of new products, but there are physical limits to what can be done. If management orders a team to do what is truly a six-month job in two months, then they are setting up the team for failure. It was this environment that led to the development of time-boxed scheduling.

Time-boxed scheduling is based on the premise that ''you can't have it all.'' Let's say your company is planning to roll out a new software product that will take six months to develop. You are just about to begin work on the product when your marketing department learns that a competitor will release a similar product in four months. In order to scoop the competitor, your team is told to produce your new product in two months. This seems like an impossible chore.

However, with time-boxed scheduling, you see a way to get a product out the door quickly. The team leader might respond to the request in the following way: ''I understand that it is crucially important that we get a product out before our competitor does. The fact is that the laws of nature will not allow us to produce a full-fledged product in two months. However, if we cut back on some of the features designed into our new product, we can produce a great product in two months that will meet 80 percent of customer needs. We will call it Version 1.0. Once it is released, we can turn our attention to adding the expunged features back into the product, which we will release four months later as Version 1.1.''

There is no magic trick here. Time-box scheduling simply acknowledges that if you need to produce things more quickly, then you have to cut back on the features you plan to offer. This is not as radical a pronouncement as it might seem, owing to something called the 80:20 Rule. The 80:20 Rule suggests that 20 percent of the features we deliver someone serves 80 percent of their needs. Thus, in order to get a product out the door at breakneck speed, we can radically cut back on what we develop and *still* have high levels of customer satisfaction. If producing a product quickly enables us to establish a market presence before our competitors, this may give us an edge that leads ultimately to market dominance.

Experience shows that the greatest challenge to implementing time-boxed scheduling is to get both business people and technical staff to *prioritize* their needs and requirements. When asked, ''What two or three features of the new product are most significant,'' a typical marketer will answer. ''They're all important.'' Of course, they are not all equally important. From the perspective of customers, a relatively small number of features are *must-haves,* while a larger number are *nice-to-have,* and an undetermined number are *not-really-needed*. In time-boxed scheduling, you work with customers to prioritize the features that the product will deliver. You then incorporate a relatively small number of high-impact *must-have* features into your Version 1.0 deliverable.

The *science* of time-boxed scheduling entails use of objective prioritization techniques to rank features. Included here are techniques such as analytical hierarchy process, the poor man's hierarchy, and scoring sheets.[5] When applied properly, the *must-haves* surface to the top of the list, while the *not-really-needed* drop to the bottom. Features included in Version 1.0 should be taken from the top of the list.

The *art* of time-boxed scheduling requires business analysts to have good facilitation and negotiation skills. They have to convince both business customers and technical team members that in order to achieve breakneck deadlines, you can't have it all. Initially, they will encounter resistance from the business and technical players, who see scaling back the scope of their new products as undesirable. But ultimately they must realize that if they want to be first to market, they may have to offer less than what they ideally want to offer.

INTEGRATED COST/SCHEDULE CONTROL WITH EARNED-VALUE MANAGEMENT

One of the most significant innovations in project-management methodology was the creation in the 1960s of the cost/schedule control system (C/SCS). This methodology is a cost accounting approach to reviewing schedule and budget performance simultaneously. It is effectively the numerical equivalent of graphical integrated cost/schedule control. At the heart of the methodology is an attempt to track performance of something called *earned value,* an important measure of work performance.

C/SCS was the child of the U.S. Department of Defense (DoD), which played the lead role in establishing and promulgating standards for its use. In the 1990s, a global movement arose to promote application of earned value principles to all projects—big and little, government and private sector—and by the end of the decade DoD transferred the guardian role of the earned value system to the private sector, where it is captured as a document referenced as ANSI/EIA 738. The appellation C/SCS was dropped and henceforth the methodology was known as *earned-value management* (EVM).

The earned-value measure provides information on how much work has actually been performed. Work performance is measured in monetary terms. For example, the computation of earned value for a project may show that $3500 worth of work has actually been accomplished. Cost variance becomes a matter of comparing how much money has been spent against how much work has been done. If actual expenditures are $3700, the project is experiencing a $200 cost overrun, since $3700 has been spent to do $3500 worth of work.

Schedule variance is computed by comparing how much work has been done against what was planned to have been accomplished. If $4000 of work was planned to have been achieved, but only $3500 worth of work was actually carried out, then the project is behind schedule, since less work was done than was planned. Note that schedule variance here is being measured to monetary terms, not in temporal terms.

The key to employing the EVM methodology is being able to compute earned value. Several ways to do this have been developed. Three will be discussed here: (1) using the 50–50 rule, (2) computing earned value based on historical experience, and (3) making best-guess estimates.

The 50–50 rule

The 50–50 rule is best explained by means of a simple example. Let us say that a particular project is composed of four tasks. In creating the work-breakdown structure (WBS) for the project, we devise each task to be roughly of equal size. Since with EVM we are employing a cost accounting approach, size is measured in monetary terms. Thus, in our example, each task is a $100 task. If budgetary data are not available, one can employ person-hours of effort (or person-days) as a substitute—e.g., each of my four tasks is scheduled to consume 80 person-hours of effort.

Our goal is to measure work performance. To do this, we assume that the moment a task begins, we have done half the value of planned work. Thus, when a $100 task begins, we say, for accounting purposes, that we have done $50 worth of work. Only when the task is actually finished do we say that we have done the remaining half of the work. When a $100 task is completed, we can then state that we have achieved our $100 planned effort.

Let us say that in our hypothetical example we have completed work on three of the tasks and have begun work on the fourth. Using the 50–50 rule, we estimate that we have accomplished $350 worth of work—our earned value. That is, by completing the three tasks, we have achieved $300 of planned effort, and by beginning the fourth task, we have achieved an additional $50 of planned effort.

It should be noted that the 50–50 rule provides the project team with an *estimate* of earned value, not the real figure. Project staff who are concerned that the estimate may be too optimistic can employ a more conservative approach to calculating earned value: the 0–100 rule. As its name implies, the value of work associated with a task is not recorded until after the task is complete. In the four task example, earned value is $300 when the 0–100 rule is employed.

Historical Experience

A more accurate way to calculate earned value is to base the estimate on historical experience. Let us say that we are trying to compute earned value to track roofing work on 20 houses. Historical experience may suggest that when a roof has been framed out, it is 20 percent complete. When plywood panels have been laid down on the framework, creating a ‘‘solid’’ roof, the roof is 40 percent complete. When tar paper has been placed over the plywood panels, the roof is 50 percent complete. When shingles have been laid on one side of the roof, it is 70 percent complete, while when they have been laid on both sides, the roof is 90 percent complete. Finally, after finish work has been carried out, the roof is 100 percent complete.

To compute earned value, a technician can be sent to the houses to tabulate progress. If she sees fifteen houses whose roofs have only been framed out, she notes that fifteen houses are at the 20 percent mark. If she also identifies three houses where plywood panels have been laid down on the framework, then she notes that three houses are at the 40 percent mark. She determines that two houses have tarpaper laid down on the plywood panels, indicating that they are at the 50 percent mark. By taking a weighted average of the progress of the twenty houses ($[15 \times 0.2 + 3 \times 0.4 + 2 \times 0.5]/20$), she determines that the roofing effort is 26 percent complete. If the planned cost of the roofing effort for all twenty houses is $200,000, then earned value is $52,000 (26 percent of $200,000).

Best Guesses

It may be that owing to a lack of project data, the only available way of calculating earned value is to make a best-guess estimate of how much work has been done. This probably reflects the practice of most organizations in their attempts to measure work performance. An expert may review progress on a module or project work and guess that the module is 70 percent complete.

The problem with this approach is that it tends to lead to optimistic assessments of project performance. When projects first start out, it often looks as if the project workers are making tremendous progress, so best-guess estimates of earned value may inflate the true figure. Thus, the team may report that the project is at the 90 percent mark quite early in the life cycle. However, as projects are being wrapped up, it seems to take forever to tie up loose ends. We even quip that the last 10 percent of a project often takes 50 percent of the work effort. Consequently, the project is reported to be 90 percent complete for each of the last several months of its existence. This phenomenon occurs so frequently that we have even given it a name: the 90 percent hang-up.

USING EVM TO REPORT PROJECT PROGRESS

Project progress can be tracked quite clearly when project staff employ the EMV methodology. Consider tracking schedule performance. This is done in two ways. First, schedule variance is computed by contrasting the work that has been done (earned value) with the work that was supposed to be done (measured as planned cost). In the EVM approach, earned value and planned costs are given special labels—earned value is called BCWP (budgeted cost of work performed) and planned cost is called BCWS (budgeted cost of work scheduled). Using these new labels, schedule variance is defined as:

$$SV = BCWP - BCWS$$

Thus, if BCWP is $350 and BCWS is $400, this indicates a schedule variance of −$50. That is, this effort has achieved $50 less work than it should have.

A related way to examine schedule performance is to create a *schedule performance index* (SPI), which is defined as:

$$SPI = BCWP/BCWS$$

What the SPI measures is how much work has been done (BCWP) as a fraction of how much was supposed to be done (BCWS). If BCWP is $350 and BCWS is $400, SPI is 0.875, which indicates that the project has achieved 87.5 percent of what it was supposed to achieve.

To track cost performance, earned value (BCWP) is compared to actual costs, which is called ACWP (actual cost of work performed). The data for ACWP come from the accounting department and reflect money spent on salaries, purchases of materials, purchases of services, and so on. Cost variance is defined as:

$$CV = BCWP - ACWP$$

If BCWP is $350 and ACWP is $450, cost variance is −$100. That is, for the work that has been achieved (BCWP), the project team spent $100 too much.

A related way to examine cost performance is to create a *cost performance index* (CPI), which is defined as:

$$CPI = BCWP/ACWP$$

What CPI measures is the efficiency with which project funds are being expended. If BCWP is $350 and ACWP is $450, then CPI is 0.778, which indicates that the project is achieving 77.8 cents of work output for every dollar spent. This project clearly will run out of funds if it continues to operate at this level of efficiency.

An important function of CPI is that it lets the project team estimate what the final cost of the project will be. This estimate of final cost is called *estimate at completion,* or EAC. It is computed using the following formula:

$$EAC = (\text{Total project budget})/CPI$$

If the total project budget is $1,000,000 and the CPI is 0.778, the EAC is $1,285,714. This means that if the project continues to generate 77.8 cents of work for every dollar spent, it will have a $285,714 budget shortfall unless major adjustments are made (e.g., work can be cut back, budgets can be increased).

Collectively, the EVM tools we have just examined provide project teams with the capacity to carry out solid analyses of cost and schedule performance. These analyses can be carried out at whatever level of detail the team chooses. They can focus on aggregate data for the project as a whole, or they can concentrate on reviewing performance at the task and phase levels.

Note that as EVM departs from military directives and takes on a more civilian flavor, its guardians are attempting to make it look more user-friendly. Consequently, the rather awkward acronyms BCWP, BCWS, and ACWP are gradually being replaced by new ones. BCWP is now called EV (for earned value), BCWS is now called PV (for planned value), and ACWP is now called AC (for actual cost). The new appellations have not yet been fully adopted, so we are likely to live in a world where the old and new terms coexist for a number of years.

Conclusion

The capacity to schedule projects effectively is one of the most significant competencies a project professional should master. This has always been true in project management, but today it is more important than ever, because in this brutally competitive world, *speed* of product development and service delivery provides organizations with an edge that enables them to beat their competitors. As we have seen, the pressure to deliver goods and service faster and faster has created a situation where organizations often promise delivery dates that are unrealistic. If scheduled delivery dates are not met, then this certainly leads to customer disaffection.

Consequently, effective schedule management requires that project professionals develop accurate estimates of how much time it will take to do the job, create schedules that offer project teams good guidance on how they should carry out their work, track performance in order to determine whether the project will achieve its performance targets, and adjust schedules to accommodate the new realities that arise as the project is being executed.

ENDNOTES

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2 Goldratt, E. M. and Cox, J. *The Goal: A Process of Ongoing Improvement,* 2nd Edition. Great Barrington, MA: North River Press, 1992

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Chapter

10

Keeping the Lid on Project Costs

Kim LaScola Needy and
Kimberly L. Sarnowski

Biographical Sketch . . .

Kim LaScola Needy is an Associate Professor of Industrial Engineering at the University of Pittsburgh. She received her B.S. and M.S. degrees in industrial engineering from the University of Pittsburgh, and her Ph.D. in industrial engineering from Wichita State University. She has obtained nine years of industrial experience at PPG Industries and The Boeing Company. Her research interests include engineering economic analysis, engineering management, and integrated resource management. Dr. Needy teaches a variety of courses at both the undergraduate and graduate level that fall predominantly within the area of engineering management. Dr. Needy is an active member in numerous professional societies, including ASEE, ASEM, APICS, IEEE, IIE, and SWE. She is a licensed professional engineer in Kansas.

Kimberly Sarnowski currently works for Management Science Associates in their Business Analysis division. She holds an M.S. degree in industrial engineering from the University of Pittsburgh with a focus in operations research. Before coming to Management Science Associates, she worked as a Research Scientist at Lycos, Inc., working to improve the search engine's internal algorithms. At Management Science Associates, her work includes marketing mix analysis, promotion effectiveness, pricing, brand switching, customer segmentation, and loyalty studies applied to the CPG, pharmaceutical, and media industries.

Field Guide to Project Management, Second Edition. Edited by David I. Cleland

Introduction

Changes in the marketplace—such as heightened global competition, rapid advances in technology leading to shorter project life cycles, and strong emphasis on quality and customer satisfaction—have evolved from an unstructured activity with loose cost guidelines to a highly structured activity with well-defined procedures for estimating, controlling, and collecting data on costs. Customers expect high quality and on-time delivery from all project bidders and often use the cost estimate in deciding between potential contractors.

IMPACT OF COST ON SCHEDULE AND TECHNICAL PERFORMANCE

Cost affects schedule and technical performance measures. Cost, schedule, and technical performance measures can be thought of as a triangle where changes to one measure necessitate changes to the other two. For example, expediting the project schedule while maintaining the level of technical performance will increase costs in the form of overtime pay and additional charges to expedite parts and materials. A common Japanese approach to managing the interactions among these measures is to use target costing.[1] In this approach, a target cost is set for a project, and technical performance parameters and the project schedule are adjusted to meet the target cost.

A project costing system should yield accurate and timely cost information at the required level of detail. It should allow the project manager to evaluate the trade-offs when making decisions on issues affecting schedule and performance. Striking a balance between these three competing measures requires teamwork. For example, Touran presents a probabilistic model that considers the random nature of change orders and their impact on the cost and schedule of a construction project.[2] The use of cross-functional teams with representatives from areas such as accounting, sales, service, and manufacturing is an effective means of promoting consensus in the event that all measures cannot simultaneously be met and of ensuring that one measure is not ‘‘optimized’’ at the expense of another.[3]

COST AND THE PROJECT LIFE CYCLE

Costs must be closely managed throughout the entire project life cycle. The project life cycle consists of a conceptual phase, a definition phase, a production/construction phase, an operational phase, and a divestment phase. The conceptual phase establishes the feasibility of the project, develops a basic budget and schedule, and leads to the formation of the project team. The project’s cost, schedule, technical performance objectives, and design are established in the definition phase. The production/construction phase entails procuring project materials, producing/constructing the desired system, and verifying its performance. The operational phase involves installing the resulting system in the environment for which it was developed. Lastly, the divestment phase involves training personnel and transferring materials and responsibility for the system to the end user.[4]

At the start of a project, it is difficult to estimate with certainty the final cost. As the project nears its end, many of the expenses have already been incurred, leaving a smaller portion of the total expense to estimate. A large portion of project costs is typically expended in the production/construction and operational phases of the project, but the definition phase sets project's cost, schedule, and technical performance standards as well as the resource requirements and work breakdown structure (WBS).

Decisions made in the definition phase of the life cycle affect project costs far more than any cost control measures adopted during the production/construction and operational phases. It has been reported that approximately 75–90 percent of project costs are determined during the definition phase of the project.[5] Design practices that can aid in the development of realistic cost, schedule, and technical performance measures include the use of computer aided design/computer aided engineering (CAD/CAE), design for ''X'', concurrent design, simplification, robust design, and designed experiments.[6] An emerging area, design for supply chain management,[7] attempts to drastically reduce manufacturing, logistic support, distribution, and sales costs.

COSTS KEEP CORPORATE STRATEGY IN SIGHT

An effective cost estimating and control system sets performance measures and requires the selection of a cost management system that complements the company's corporate culture and strategic objectives. Note that the set of relevant performance measures often changes in different phases of the project life cycle. A good cost management strategy should not merely be a way to track exactly where costs were expended; rather it should encourage employees to support the company's strategies and cost reduction efforts.

CHAPTER ORGANIZATION

The next section of this chapter will discuss ways to examine project costing, such as types of cost, their frequency of occurrence, and their opportunity to be controlled. We will then cover the components of a fully integrated cost management system: how to integrate a cost management system with an operational control system, reporting the right data to the right people, and other factors. After a discussion of future trends in costing management, the chapter will conclude with a brief summary.

The Many Ways to Examine Cost

Costs can be examined with respect to type (direct or indirect); frequency of occurrence (recurring or nonrecurring); opportunity to be adjusted (fixed or variable); and schedule (normal or expedited).

DIRECT VERSUS INDIRECT COSTS

As the name suggests, direct costs can be traced directly to the project that generated the cost. The most common examples of direct costs include labor and materials. For example, consider the construction of a bridge. All of the labor costs associated with the workers involved with the actual construction process can be traced directly to the project. Note that this would not necessarily include nondedicated resources such as project management and accounting personnel who may be concurrently overseeing multiple projects.

In the case of a manufacturing setting, workers may clock in to a particular production work order via a labor collection system. Labor can then be accumulated for the work order (which is generally associated with a particular product) by type and quantity. Direct labor rates can subsequently be applied to the labor hours to derive the total direct labor cost. Although fringe benefits can be built into the worker's direct labor rate, they are generally placed into an indirect cost category. Like direct labor costs, material costs are readily traced directly to a specific project. For example, purchase orders may be issued to procure the needed materials to complete the project. In a production environment, the bill of material (BOM) will identify the type and quantity of all materials needed to manufacture the product.

Typically, anything that cannot be classified as a direct cost gets placed into an indirect cost category. Indirect costs are generally placed into one of two categories: overhead, or selling and general administration. Examples of overhead costs include indirect materials, utilities, property taxes, insurance, depreciation on equipment, repairs, maintenance, and, in general, all costs associated with operations. Costs that fall into the category of selling and general administration include advertising, shipping, executive salaries, sales and secretarial support, sales travel, sales commissions, and the like.

The process of tracing indirect costs to specific projects is not straightforward. Most organizations choose instead to use some method of allocation. In the past, when the ratio of indirect to direct costs was very low and computer sophistication was crude, there was little concern with an allocation approach. In the wake of the computer age and as the ratio of indirect to direct costs rises sharply, more attention is being paid to how to trace indirect costs equitably to the projects responsible for driving the costs. If care is not taken, there is a potential to grossly misstate the true project costs. Activity based costing (discussed later in this chapter) has evolved to address this shortcoming.

RECURRING VERSUS NONRECURRING COSTS

Costs can also be examined with respect to their frequency of occurrence (recurring versus nonrecurring). Typically, nonrecurring costs occur at the beginning and end of the project life cycle, whereas the recurring costs occur in the middle of the project life cycle. Examples of nonrecurring costs include preliminary design, market assessment, capital investment, training, divestment, and so on. Recurring costs are those that occur most frequently in the production/construction and operational phases of the project. Examples of recurring costs include material, direct labor, distribution, transportation, packaging, and sales. To help ensure profitability, cost-reduction efforts should focus on both recurring and nonrecurring costs.

FIXED VERSUS VARIABLE COSTS

Costs can be classified as fixed or variable. Fixed costs do not vary with respect to usage. For example, the leasing cost for a piece of equipment will not vary with the rate of production. The cost will be fixed regardless of whether the piece of equipment is fully utilized or sits idle. Similarly, the hardware associated with the running of a computer system is fixed regardless of the number of transactions processed through the system.

In contrast, variable costs vary in direct proportion to the usage level. Variable costs will rise as the usage level rises and fall as the usage level falls. Material cost is an example of a variable cost. The material cost to manufacture 100 units will be 100 times as great as the material cost to produce just 1 unit.

The distinction between fixed and variable costs is not always clear. One could argue that in the short term most costs tend to be fixed and in the long term they are variable. For example, consider direct labor. In a theoretical sense (in the long term), direct labor can be considered to be variable because direct labor increases and decreases in proportion to the production volume. From a practical sense (in the short term), however, direct labor can be considered to be a fixed cost. Why? Assuming that an organization employs permanent, full-time workers who will be paid for eight hours per day, then the facility will incur a certain amount of direct labor cost regardless of the amount of work.

NORMAL VERSUS EXPEDITED COSTS

Normal costs include the costs to complete the project according to the planned schedule agreed upon by the parties at the onset of the project. Note that the planned schedule may be aggressive and include the use of overtime to meet the completion date. In this case, overtime expenditures are considered to be normal. Expedited costs refer to those costs that are unplanned. They are additional costs incurred as a result of accelerating the schedule or staying on schedule when the project has fallen behind. Examples of these types of costs include the cost associated with temporary workers, or subcontracting work to outside entities; and premium transportation costs for overnight shipment of products or overnight receipt of materials or supplies.

CLASSIFYING COSTS

Because of the particular characteristics unique to each project, the same cost will not always fall into the same category. Rather, classification of costs will be project specific. A good example of this would be direct labor. For a project using permanent full-time employees, direct labor is considered to be fixed, at least in the short term. But for a project that uses all temporary, part-time employees, direct labor is variable. In this case, workers are only paid (and direct labor cost is only incurred) for work actually completed.

Table 10–1 illustrates several examples of costs and classifications. For example, consider the building lease cost. The building lease cost is an indirect type of expense. For a company that concurrently develops multiple projects, it is difficult to trace precisely how each project will consume the resources associated with the building expense. Common approaches used to make this approximation would be to allocate the expense to the project based upon the amount of square footage occupied by the project. Although in theory this approach appears to have merit, in practice it is difficult to implement because the same space is often shared by resources that support multiple projects.

The building lease expense is considered to be recurring. This expense will be incurred each period, not simply at the start of the project or as the project draws to a conclusion. For this reason, this cost is easy to predict across the project life cycle. The building lease cost is also fixed; in other words, the charge will remain constant regardless of the rate of production. This assumes of course that the project has not exceeded the capacity constraints associated with the building. Building lease expense is also considered to be a normal cost with respect to schedule. To accelerate the schedule or to pull the project back onto schedule would generally not require additional building lease expenses.

Components of a Fully Integrated Cost Management System

A fully integrated cost management system must allow for the timely and accurate collection, accounting, and control of cost data. How this is achieved is dependent upon the particular company objectives. The system should support cost estimation and project selection functions in support of strategic decision-making.

Table 10–1 Cost Classifications

	Type		Frequency		Adjustment		Schedule	
Costs	Direct	Indirect	Recurring	Non-recurring	Fixed	Variable	Normal	Expedited
Direct Labor	X		X		X		X	
Building Lease		X	X		X		X	
Expedite Costs	X			X		X		X
Material	X		X			X	X	

WHAT IS COST MANAGEMENT?

Miller and Louk define cost management as taking

> financial report numbers down to a more finite level of accountability by product, organization, project, cost element, etc. and correlating meaningful non-financial data with it to provide relevance. It is the means of interpreting information between operating and general management of an organization.[8]

A cost management system includes data collection, cost accounting, and cost control. Figure 10–1 shows the relationship of these functions to one another and depicts how they form the building blocks of a cost management system. At the lowest stage, data collection involves collecting data on the appropriate cost measures. At the next-highest stage, cost accounting compiles and presents cost data in order to allow for cost control. Cost control involves determining, explaining, and correcting cost variances.

In order to be effective, a cost management system needs to support the strategic business objectives of the firm and provide accurate information at the right level of detail and in a timely manner. The cost management system should be independent of the accounting system used for reporting external financial measures and should explicitly evaluate the trade-offs between satisfying cost, schedule, and technical performance objectives. Lastly, it should motivate workers to focus on project priorities.

ELEMENTS OF AN EFFECTIVE COST MANAGEMENT SYSTEM

A common problem with cost management systems is that they do not provide the appropriate information to the right people. Managers typically need information that is aggregated in order to get a macro view of the overall costs associated with the project. Workers at the departmental level

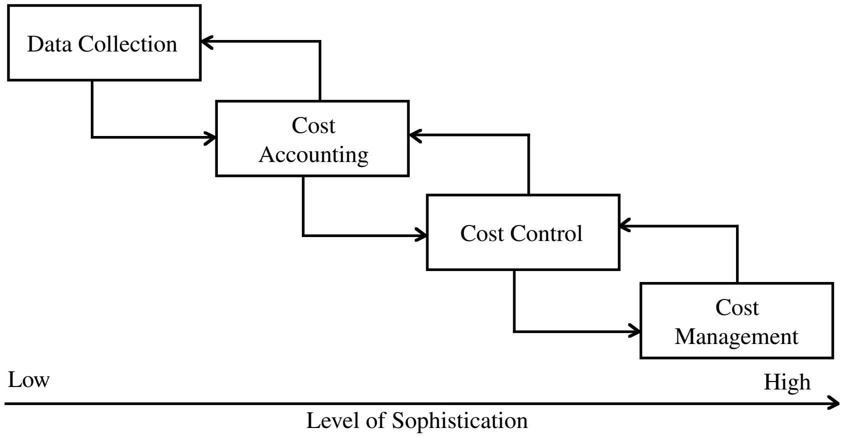

Figure 10–1 The Stages of Cost Management

Source: Miller and Louk, 1988, p. 542. Reprinted with permission of APICS, 1988 APICS International Conference Proceedings require more detailed cost information on performance measures which the workers understand and have control. Compiling only bottom-line financial information such as return on investment (ROI) and market share does not provide timely enough information for the proactive management of costs. In addition, departmental level workers cannot relate a measure such as ROI to their specific performance. By not presenting the necessary data to the right people at the appropriate level of detail, many cost control opportunities are simply overlooked.

In order to be effective, a cost management system should do the following:[9]

- ***A link to business strategic objectives.*** The cost management system should provide feedback on how well the business strategies are being executed and on whether these strategies are financially successful. In addition, the business strategy helps define which operational measures are most important (e.g., reliability of a system, on-time delivery, unit production cost of a product, etc.).
- ***Accurate information in a timely manner.*** This is perhaps the most important element of a successful cost management system. Relevant, accurate information is valuable only if it is generated in time for management systems to be proactive rather than reactive.
- ***Information at the correct level of aggregation.*** Managers need aggregated, macro-level data in order to make strategic decisions. Information on a host of extraneous performance measures becomes overwhelming and counterproductive. At the same time, workers at the departmental level need detailed information on their performance with respect to measures that relate specifically to their work so that they can see how their work contributes to the success or failure of the project. For example, providing a machine operator with data on ROI hardly serves as a motivational factor to reduce setup times and increase throughput.
- ***Data independent of the accounting system used for reporting external financial measures.*** Cost data should be relevant to decision-making rather than focused on external reporting measures. The data should be useful for effective operational control so that cost variances can be traced back to their cause.
- ***A focus on trade-offs between satisfying cost, schedule, and technical performance.*** If the cost management system emphasizes only costs, then workers will focus strictly on costs and downplay schedule and technical performance.
- ***Motivation for workers to focus on the right things.*** The cost management system should be used to promote teamwork within and between departments rather than competition.

WHERE DO THE DATA COME FROM?

Data for the cost management system can be collected from existing production and process control systems and from databases used for engineering design, sales, and marketing. The use of technology such as automated data collection (barcoding, radio frequency identification, magnetic stripe, etc.) has greatly facilitated the collection of a wide array of data. Data from existing production systems should be used whenever possible in order to avoid the inaccuracies and wasted time associated with redundant data entry into the costing system.

TECHNIQUES FOR COST ESTIMATING

A cost estimate is a forecast of expected costs based on a specified set of assumptions or conditions. The most common methods for cost estimating are expert opinion, analogy, regression, and bottom-up estimating.[10]

Although often considered a last resort, estimating costs via expert opinion is sometimes the only option available. Expert opinion should be based on fully documented assumptions. Estimates based on expert opinion are subject to bias. Generally, the quality of the estimates diminishes as the complexity of the task increases. In addition, the resulting estimate cannot be easily quantified in terms of uncertainty. Techniques such as Delphi can be used to quantify uncertainty when a group of experts is involved in decision-making.[11] Two other techniques that have recently been utilized to elicit expert opinion for estimating costs are analytical hierarchy process (AHP) and fuzzy logic. AHP is a useful tool for quantifying subjective individual opinion. Roztocki et al. describe the use of AHP to quantify the more difficult to estimate administrative costs for small businesses and the development of cost matrices.[12] Nachtmann and Needy have utilized fuzzy set theory to assist with cost estimation, specifically to handle estimation imprecision and uncertainty in activity based costing systems.[13]

Estimating cost through analogy involves analyzing the costs of a similar project (assuming that one exists) and then estimating the costs associated with the differences between the two projects. The technique typically relies on expert opinion and is therefore subject to the disadvantages discussed above.

Regression analysis to estimate costs is similar to the analogy approach.[14] Data on cost and variables associated with a similar project are collected. A predictive model is then built and used to predict costs for the current project.

Bottom-up estimating compiles detailed estimates of the costs of all the work packages in a project. It can provide extremely accurate cost estimates when detailed information is available; however, it is not always possible to obtain such information.

THE COST FACTOR IN PROJECT SELECTION

Cost is a key factor in evaluating the relative merits of multiple alternatives and selecting the best project. When comparing the costs associated with multiple projects, consider the time value of money. That is, certain nonrecurring costs may occur in the present, whereas others may not occur until some point in the future. Recurring costs will occur periodically over a specific time horizon. Therefore, all costs should be converted to the same point in time so that they can be compared equitably. It is customary to convert all costs to the present. This type of analysis is termed a *net present value analysis*.

Another adjustment may be required with respect to the project life cycle. Projects will typically have different life cycle lengths. Thus, it will also be necessary to compare the projects over the same time horizon. By considering the time value of money and by comparing the project over equal time horizons, the comparison of multiple alternatives will be more equitable. Techniques that focus on analyzing the trade-offs among alternatives include Simple Multi-Attribute Rating Technique (SMART), AHP, and decision trees.

SMART involves identifying a set of attributes that are important to a decision-making problem and weighting these attributes to reflect their relative importance.[15] Each alternative is then given a value that reflects how well it performs with respect to each attribute. The weighted average of these values shows the overall performance of each alternative.

Cost can be used as an attribute in SMART, or it can be kept separate and used to perform a cost/benefit analysis. Figure 10–2 shows an example of how SMART scores can be compared against cost to make decisions among alternatives. In this example, alternative 1 can be eliminated completely from consideration because alternative 2 provides a higher benefit score at a lower cost. Of the remaining alternatives, alternative 3 provides the lowest benefit but at a correspondingly low cost. Alternative 4 has the highest benefit score but also has by far the highest cost. The decision-makers would evaluate how much they are willing to pay for an increased benefit score in order to arrive at a decision between alternatives 2, 3, and 4.

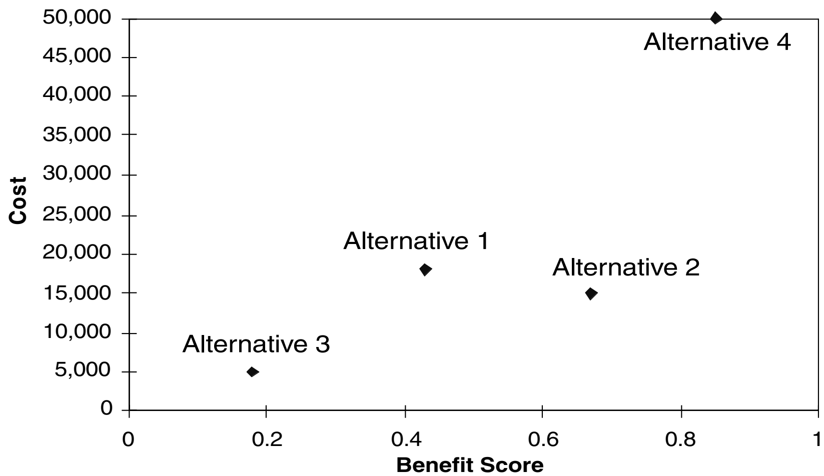

Figure 10–2 SMART Cost/Benefit Analysis Example

AHP is another multi-attribute decision-making tool.[16] In this method, weights of attributes are determined by developing a pairwise comparison matrix in which the relative importance of each attribute is evaluated with respect to all other attributes. As with SMART, cost can be included as an attribute, or a cost/benefit analysis can be performed.

Decision trees are useful for multistage problems in which the selection of a particular option or alternative at one stage can lead to other decisions to be made at later stages.[17] Suppose that a company needs to develop a design for the product that meets both cost requirements and specific reliability standards. The company has two alternatives: (1) use its own experience to develop such a design, or (2) subcontract the design work to a design engineering firm. Although the probability of a successful design being developed in the second alternative increases, the expected cost of developing the design also increases. A third option is simply not to produce the new product. Figure 10–3 shows a decision tree for this problem.

Trends in Cost Management

The heightened level of importance and awareness of cost management throughout the entire project life cycle has helped to foster the development of new tools and methodologies that are gaining widespread use in industry. These include design for manufacturability and assembly (DFMA), activity based costing, and design for supply chain management.

DESIGN FOR MANUFACTURABILITY AND ASSEMBLY

Design for manufacturability and assembly (DFMA) is an analysis technique used in a production setting. It is aimed at reducing the cost of a product (while maintaining the same functions and features) through simplification of its design. Although the actual cost to manufacture a product will be

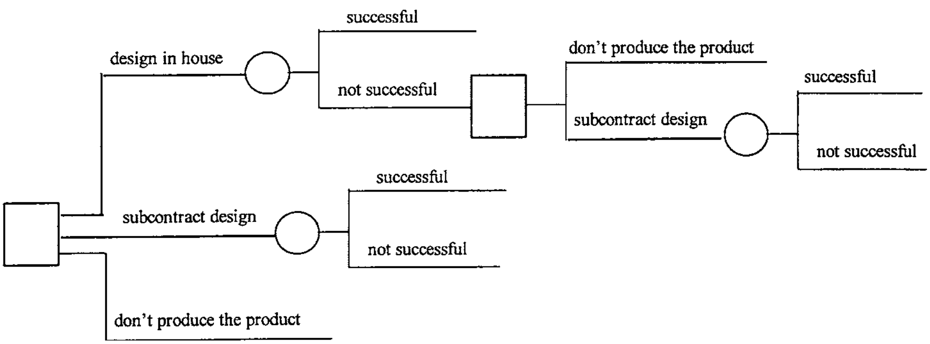

Figure 10–3 A Typical Decision Tree Structure

driven by the material, labor, and overhead costs, studies have shown that as much as 90 percent of the product's cost is determined in the preproduction phases of the project life cycle.[18] This represents the largest opportunity for cost and productivity improvement.

DFMA is accomplished through part simplification, usage of common parts, and part reduction. For example, fewer parts will result in lower direct material costs, fewer purchase orders placed, less component inventory held, and fewer operations performed. Assembly time will also be reduced, allowing companies to carry less finished goods inventory. This can lead to a faster response time to customers and a reduction in labor. Success stories describing the improvements resulting from implementing DFMA are impressive. U.S. manufacturers applying DFMA principles reduced product development time by 30–70 percent.[19]

ACTIVITY BASED COSTING

Indirect costs have been on the rise for U.S. manufacturers. These manufacturers are concerned that the existing traditional cost accounting systems used for costing are inadequate, particularly when the indirect cost must be traced to multiple products, systems, or projects.[20]

Activity based costing (ABC) has emerged as an approach to deal with the shortcomings associated with traditional cost accounting methods, namely, their handling of the allocation of indirect costs (primarily focusing on overhead allocation). Johnson and Kaplan describe the demise of the arbitrary methods utilized in traditional cost accounting methods for the allocation of indirect costs using volume based measures such as direct labor.[21] They argue that this method has lost relevance in the wake of an increasing indirect cost base. ABC addresses this deficiency by tracing indirect cost components directly to the source. It assumes that activities consume resources and projects consume activities. Activities that drive costs and are associated with the project can thereby be identified and traced directly to the project.

DESIGN FOR SUPPLY CHAIN MANAGEMENT

Design accomplished through mutual collaboration between supply chain partners is a key towards cost improvement. Specifically, it has been reported that the average discrete manufacturer realizes a 12 percent reduction in time-to-value, a 20 percent reduction in development costs, and a 7 percent reduction in manufacturing costs by collaborating with the supply chain early in the design process.[22] When the supply chain is elevated to the level of design and development, quality, time to market, and ultimately cost improvements can be achieved across the supply chain.[23]

Summary

Cost is a critical element within project management and must be given as much attention as schedule and technical performance. Contractors and other project-based firms can incur stiff penalties for cost overruns. This chapter has described the growing importance of cost, outlined ways in which costs can be examined or reduced, described components of a fully integrated cost management system, and described some of the important trends in the field.

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Chapter 11

Calculating Costs and Keeping Records for Project Contracts

James J. O'Brien

Biographical Sketch . . .

James J. O'Brien was Vice Chairman of O'Brien-Kreitzberg Inc., a national professional construction and project management firm, until it became a URS Corp. subsidiary. He continues as a consultant to URS Corp. He has a degree in civil engineering from Cornell University, and is a registered professional engineer in four states. He is a fellow of the American Society of Civil Engineers and has served as President of the New Jersey State Section. He is also a Fellow, Construction Management Association of America. He has served as Chairman of the Board of Project Management Institute, is certified as a project management professional, and is a PMI Fellow.

Many managers consider pricing an art. Estimates for contract bids must be well-thought-out decisions based on the best available information. Pricing should begin before proposal development. Project managers need to understand customer requirements, make estimates of cost targets, and establish a cost baseline. Effective cost estimates early-on permit management the opportunity to redirect or terminate the project before submitting a proposal or expending excess resources on an unsuccessful project.

Request for Proposal

The organization seeking proposals may provide requests for proposals (RFPs) to anyone responding to its announcement or advertisement about an upcoming project. A more usual approach is to use a two-step process. First, the customer uses a statement of qualifications (SOQ) to create a list

Field Guide to Project Management, Second Edition. Edited by David I. Cleland

of firms the customer believes are qualified to respond. Second, the customer sends RFPs to this relatively small list. Typically, SOQs are easier to review and evaluate than the more detailed proposals. The two-step process saves both time and effort.

In addition to RFPs and SOQs, a government agency may invite letters of interest (LOI). The government agency may also ask the bidding companies to submit a form SF 254, which provides general information about the company. In addition, the responding company may be required to submit form SF 255, which asks the company to address its capabilities in regard to a specific project. (Figures 11–1 and 11–2 show samples of forms SF 254 and SF255.)

The RFP usually contains the following:

- A description of the services sought
- Guidelines for performing the work
- Format for and outline of the proposal
- Factors that will be used to evaluate the proposals and weights for different factors
- A sample of the contract form to be entered into
- Notice of any proposal meeting and the due date of the proposal

The cost part of a proposal is usually prepared in a prescribed format (see Figure 11–3). That format shows the following:

- Labor hours and rates by individual or category
- Multiplier for overhead
- Direct expenses (per allowable items), such as the cost of air or rail travel, living expenses, car rental, tolls, parking, and gas
- Fee or profit (often limited to a maximum of 10 percent)

The outline prescribed for the proposal usually calls for the proposer to provide the following in the technical part of the proposal:

- Qualifications for performing the work
- Demonstration of an understanding of the work
- Description of the plan or approach to the project
- Description of the team that would be assigned, including a staffing plan
- Description of the specific experience of team members, including resumés

How Customers Select a Bidder

Customers review and score technical proposals. A short list of three to five companies are usually invited to introduce their key team members, present their approaches, and answer questions. Customers have several options to select who gets on the short list. One is to identify which teams are qualified

STANDARD FORM (SF)

254

Architect-Engineer and Related Services Questionnaire

1. Firm Name/Business Address

O'Brien-Kreitzberg & Associates, Inc. ACASS# 014208
1515 Broadway FEIN# 94-3213883
New York, NY 10036

1a. Submittal is for Parent Company Branch of Subsidiary Office

2. Year Present Firm Established: 1972

3. Date Prepared: February 5, 1996

4. Specify type of ownership *and* check below, if applicable
Corporation

- A. Small Business
- B. Small Disadvantaged Business
- C. Woman-owned Business

5. Name of Parent Company, if any:
Dames and Moore, Inc.

5a. Former Parent Company Name(s), if any, and Year(s) Established:
O'Brien-Kreitzberg & Associates, Inc., 1972
James J. O'Brien, P.E., 1968

6. Names of not more than Two Principals to Contact: Title/Telephone
1) P. Clay Baldwin / Senior Vice President / (212) 921-9898
2) D. Clarke Pile / Senior Vice President / (212) 921-9898

7. Present Offices: City/State/Telephone/No. Personnel Each Office

7a. Total Personnel 693

Atlanta, GA	(404) 524-5505	20	Koln, Germany	011 (4922) 152-7082	3	Phoenix, Az	(602)861-7426	3
Baton Rouge, LA	(504) 358-4240	4	Kuala Lumpur, Mala.	011 (603) 232-7416	1	Pittsburgh, PA	(412) 394-6888	20
Boston, MA	(617) 357-9800	48	London, UK	011 (44 171) 331-8900	3	Portland, OR	(503) 239-2210	15
Buffalo, NY	(716) 634-9482	9	Los Angeles, CA	(818) 907-6666	108	Sacramento, CA	(916) 383-8025	4
Chicago, IL	(312) 263-0959	10	**New York, NY**	**(212) 921-9898**	**146**	San Diego, CA	(619) 514-7550	8
Cleveland, OH	(216) 425-3193	3	North Sydney, Austl.	011 (612) 955-7772	1	San Francisco, CA	(415) 777-0188	107
Dallas, TX	(214) 720-4445	21	Oakland, CA	(510) 839-5491	38	San Jose, CA	(408) 451-1120	20
Denver, CO	(303) 534-7202	14	Oklahoma City, OK	(405) 525-1066	1	Seattle, WA	(206) 628-0883	16
Honolulu, HI	(808) 593-9039	3	Orlando, FL	(407) 481-8933	5	Toronto, Canada	(416) 393-3511	3
Houston, TX	(713) 688-7880	3	Pennsauken, NJ	(609) 665-2000	56			

8. Personnel by Discipline: *(List each person only once, by primary function.)*

181	Administrative	80	Cost/Scheduling Engineers	5	Industrial Engineers	7	QA/QC Managers
26	Architects	6	Draftsmen/Graphic Designers	15	Mechanical Engineers	3	Sanitary Engineers
13	Attorneys/Claims Analysts	2	Ecologists	2	Mining/Tunnel Engineers	3	Soils Engineers
4	Chemical Engineers	13	Economists/Financial Analysts	17	MIS Analysts/Computer Tech.	4	Structural Engineers
57	Civil Engineers	12	Electrical Engineers	0	Oceanographers	16	Transportation Engineers
59	Construction Inspectors	16	Engineering Technicians	3	Planners: Urban/Regional	4	Value Engineers
68	Construction Managers	17	Estimators	23	Program Managers		
33	Contract Administrators	1	Geologists	3	Public Information Managers		

9. Summary of Professional Services Fees Received: (Insert index number)

Last 5 Years (most recent year first)	1995	1994	1993	1992	1991
Direct Federal contract work, including overseas	6	6	6	6	6
All other domestic work	8	8	8	8	8
All other foreign work*	6	6	6	6	—

*Firms interested in foreign work, but without such experience, check here: o

Ranges of Professional Services Fees
INDEX

1	Less than $100,000
2	$100,000 to $250,000
3	$250,000 to $500,000
4	$500,000 to $1 million
5	$1 million to $2 million
6	$2 million to $5 million
7	$5million to $10 million
8	$10 million or greater

Figure 11–1

10. Profile of Firm's Project Experience, Last 5 Years

Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in Thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)
1) 021	163	172,950	11)			21)		
2) 112	16	12,850	12)			22)		
3) 201	65	25,700	13)			23)		
4) 202	323	29,550	14)			24)		
5) 203	21	4,000	15)			25)		
6) 204	9	17,950	16)			26)		
7)			17)			27)		
8)			18)			28)		
9)			19)			29)		
10)			20)			30)		

11. Project Examples, Last 5 Years

Profile Code	P,C, JV or IE	Project Name and Location	Owner Name and Address	Cost of Work (in thousands)	Completion (Actual or Estimated)
029 019 021 201	P	Hudson Valley Community College Troy, New York	Director Physical Plant Hudson Valley Community College 80 Vandenburg Ave. Troy, NY 12180	$14,000	1995
029 019 021 201	P	The West Campus Project Pottstown, Pennsylvania	Chief Business Officer Montgomery County Community College 340 DeKalb Pike Blue Bell, PA 19422	$14,000	1996
015 023 027 089	P	Dining Hall Rrenovation and ADA Upgrades East Stroudsberg, PA	East Stroudsburg University Assistant Director Facilities Management 200 Prospect Street East Stroudsburg, PA 18301	$8,000	1995
019 043 029 089 021	P	Columbia University Summer Construction Program New York, NY	Departmant of Design and Construction Columbia University B-230, Central Mail Room New York, NY 10027	$50,000	1995
029 023 089 021 112 039 201 106 060	JV	Cleveland State University 17th-18th Street Block Campus Extension Cleveland, Ohio	Cleveland State University Euclid at 24th Street Cleveland, OH 44115	$70,000	1996
029 021 019 106 058 201	P	Ulster Community College Expansion and Rehabilitation Project Stone Ridge, New York	Ulster County Community College Cottlekill Road Stone Ridge, New York 12484	$9,800	1993
027 047 095 050 201 089 021	P	Stanford University Student Housing and Dining Services Capital Improvements Program Stanford, California	Stanford University, Contract Office 855 Serra Street, 2nd Floor Stanford, CA 94305-6114	$2,000	1994

Figure 11–1 (*Continued*)

019 021 029 201 023	P	Cabrillo College Learning Resource Center Aptos, California	Vice President Business Services 6500 Soquel Drive Aptos, CA 95003	$9,000	1996
204 029 201 023 015	P	New York City School Construction Authority Capital Improvement Program New York, New York	New York City School Construction Authority 30-30 Thomson Avenue Long Island City, NY 11101	$7,500,000	1998
029 201 021 106 089 043 032	P	White Plains Elementary Schools White Plains, New York	White Plains City School District White Plains Board of Education House Five Homeside Lane White Plains, NY 10605	$50,000	1992
029 201 021 112 023	P	Marshall Elementary School Marshall Township, PA	North Allegheny School District 200 Hillvue Lane Pittsburgh, PA 15237-5391	$11,000	1992
029 043 089 023 112 021	P	Bradford Woods Elementary School Bradford Woods Borough, Pennsylvania	North Allegheny School District 200 Hillvue Lane Pittsburgh, PA 15237-5391	$6,400	1992
029 043 089 023 021 112	P	Mars Area School District Mars, Pennsylvania	Mars Area School District R.D. 2, Box 150 Mars, PA 16046	$15,000	1993
029 021 106 089 204 023 112 201	P	Leechburg Area Schools Leechburg, Pennsylvania	Leechburg School District 2000 Siberian Avenue Leechburg, PA 15656	$10,000	1996
029 201 089 112 021 023	P	Fort Cherry Junior/Senior High School Renovation and Addition McDonald, Pennsylvania	Fort Cherry School District R.D. #4, Box 145 McDonald, PA 15057-0409	$10,000	1994
112 201 021 089 023 029	P	North Allegheny School District Facilities Bradford Woods and Marshall Township, PA	North Allegheny School District 200 Hillvue Lane Pittsburgh, PA 15237-5391	$40,000	1993
021 201 029 023 112	P	Marshall Middle School Marshall Township, PA	North Allegheny School District 200 Hillvue Lane Pittsburgh, PA 15237-5391	$16,000	1993
12. The foregoing is a statement of facts. Signature: ______			Name/Title: D. Clarke Pile, Senior Vice President	Date: February 15, 1996	

Figure 11–1 ***(Continued)***

STANDARD FORM (SF) **255** Architect-Engineer and Related Services Questionnaire for Specific Project	1. Project Name/Location for which Firm is Filing: **Indefinite Delivery Contract For Architect-Engineer Design Services In Support of Military, Civil Works and Work For Others**	2. *Commerce Business Daily* Announcement Date, if any: **March 13, 1995**	2a. Agency Identification Number, if any:

3. Firm (or Joint-Venture) Name & Address	3a. Name, Title & Telephone Number of Principal to Contact
O'Brien-Kreitzberg, Inc. 4350 Haddonfield Road, Suite 300 Pennsauken, NJ 08109	Wesley F. Mikes., Senior Vice President (609) 665-2000
	3b. Address of office to perform work, if different from Item 3

4. Personnel by Discipline: (List each person only once, by primary function.) Enter proposed consultant personnel to be utilized on this project on line (A) and In-house personnel on line (B).

(A)	(B)	Discipline	(A)	(B)	Discipline	(A)	(B)	Discipline	(A)	(B)	Discipline
1	226	Administrative	2	19	Electrical Engineers		1	Oceanographers	6	55	Cost/Scheduling Engineers
3	36	Architects	4	21	Estimators		2	Planners: Urban/Regional	2	17	Attorneys/Claims Technicians
1	4	Chemical Engineers			Geologists		5	Sanitary Engineers	2	25	MIS Analysts/Computer Technicians
7	89	Civil Engineers			Hydrologists			Soils Engineers		17	Contract Administrators
7	78	Construction Inspectors			Interior Designers			Specification Writers		13	Engineering Technicians
1	4	Draftspersons		1	Landscape Architects	2	6	Structural Engineers	2	62	Construction Managers
		Ecologists	1	31	Mechanical Engineers		2	Surveyors		14	Industrial Engineers
	4	Economists		1	Mining Engineers		23	Transportation Engineers	41	755	**Total Personnel**

5. If submittal is by JOINT-VENTURE, list participating firms and outline specific areas of responsibility (including administrative, technical and financial) for each firm: (Attach SF 254 for each if not on file with procuring Office.)

5a. Has this Joint-Venture previously worked together? ☐ Yes ☐ No

Figure 11–2

7. Brief resume of key persons, specialists, and individual consultants anticipated for this project.

a. Name and Title:
Wesley F. Mikes
Senior Vice President

b. Project Assignment:
Principal-in-Charge

c. Name of Firm with which associated:
O'Brien-Kreitzberg

d. Years experience: With This Firm **22** With Other Firms **14**

e. Education: Degree(s) / Year / Specialization
Certificate/Architectural Design and Building Construction Technology/ 1958

f. Active Registration: Year First Registered / Discipline

g. Other Experience and Qualifications relevant to the proposed project:

Wesley F. Mikes has been involved with the design, planning, and implementation of construction projects for over 35 years, with extensive experience in project management, claims analysis, scheduling, value engineering, and presenting expert testimony. He has served as Principal-in-Charge on several major projects, supervising management staff, engineers, architects, estimators, schedulers, and technicians performing all aspects of construction management. He currently heads OK's Mid-Atlantic Region, headquartered in Pennsauken, New Jersey.

Indefinite Delivery Contract for A-E Services in Support of Corps of Engineers (Philadelphia Dist.) Projects
Principal-in-Charge on Support Services Delivery Order Contract with the Philadelphia District with the responsibility to staff and negotiate individual delivery orders and monitor and assure quality of performance by OK project team. Directed OK and subconsultant professional staff (including separate project managers) on 15 delivery orders under COE Contract No. DACW61-91-D-0014. The individual delivery orders included:

- South Jetty Project, Barnagett, NJ
- Lipari Landfill Superfund Site, Pitman, NJ
- Bridgeport Oil & Rental Sevice Site, NJ
- Helen Kramer Landfill, Mantua, NJ
- Saline Groundwater Intrusion Study on C & D Canal

Fort Drum Claim - Phase I - Watertown, NY ($552 Million)
OK Principal-in-Charge on an assignment to provide Construction Claims Evaluation and Litigation Support to the U.S. Army Corps of Engineers, New York District. OK evaluated RFIs and modifications in order to determine whether drawings and specifications were defective. The claims team reviewed contractor's bid, government audits, schedules as-built data management plans, correspondence, submittals, and other and other relevant project documentation to identify, quantify and allocate responsibility for project delays and cost overruns. OK findings helped the COE negotiate a settlement with the contractor for $15 million ($68 million less than contractor's original claim).

Trout Run Wastewater Treatment Plant Expansion, King of Prussia, PA ($11 million)
Principal-in-charge for upgrade and expansion of the Trout Run Wastewater Treatment Plant for the Upper Merion Municipal Utility Authority. The upgrade and expansion program, which will increase the plant's capacity from 5.5 mgd to 6.5 mgd, is being completed using multiple prime contractors.

Cinnaminson Wastewater Treatment Facility, NJ ($5 million)
As Principal-in-Charge, oversaw the OK team on the upgrade and expansion. The project involved the installation and addition of a new flow equalization tank, influent wet well system, mechanical control building, two new primary settling tanks, and two new final settling tanks.

Moorestown Wastewater Treatment Facility, NJ ($14 million)
As Principal-in-Charge, oversaw the OK team managing the upgrade and expansion of the 2.5 mgd wastewater treatment plant to 3.5 mgd. The plant expansion and upgrade involved adding two 65-foot-diameter secondary clarifiers, new aeration tanks, and the conversion of an existing chlorine disinfector system to ultra-violet disinfection.

United States Postal Service (USPS) Headquarters, Washington, DC
As Principal-in-Charge of contract construction management support services contract, provides training for USPS Project Managers that includes classes in claims analysis, project administration and inspection, cost and pricing, and critical path method (CPM) scheduling. Prepared training manuals and conducts 10-hour workshops. Also served on more than a dozen individuals USPS projects nationwide.

Figure 11–2 ***(Continued)***

8. Work by firm or joint venture members that best illustrates current qualifications relevant to this project (list not more than 10 projects).

a. Project Name & Location	b. Nature of Firm's Responsibility	c. Project Owner's Name & Address	d. Completion Date (actual or estimated)	e. Estimated Cost (in thousands)	
				Entire Project	Work for which Firm was/is Responsible
Underground Storage Tank Program New York, NY	Design Management and Construction Management	Reza Zeynali NYC Dept. of General Services One Centre Street, Room 2100 New York, NY 10007 (212) 669-4842	1994	9,900	9,900

The New York City Department of General Services (DGS) has undertaken a comprehensive underground fuel storage tank (UST) program to bring the city's tanks into compliance with all state, local, and federal regulations. DGS retained OK to manage the upgrades of petroleum product USTs at approximately 25 sites administered by the Office of Fleet Administration for various New York City agencies.

OK has overall responsibility for the design of tank upgrades and replacements, preparation of construction documents and bid packages, and execution and management of construction contracts. The program will result in UST systems for motor fuels that are protective of the environment and comply with all UST regulations through installation of vapor recovery, leak detection, cathodic protection, and spill prevention systems or by abandoning the existing facilities and installing new ones, in addition, any spills of petroleum motor fuel will be remediated to bring each site into regulatory compliance.

Figure 11–2 ***(Continued)***

10. Use this space to provide any additional information or description of resources (including any computer design capabilities) supporting your firm's qualifications for the proposed project.

The **Principal-in-Charge**, Jim O'Brien, will be accountable to the Corps of Engineers for the overall provision of services, both contractually and administratively. He is a senior member of the firm and is capable of making decisions and recommendations that are recognized as authoritative. Mr. O'Brien will be responsible for overseeing the **quality** of OK's work from a **contractual** point of view and is available to the **COE** should problems or circumstances arise that cannot be resolved at another level. He will be available as an expert witness and brings first-hand experience on negotiating claims and changes with many local and national contractors who are on your projects.

The **Project Director**, Wesley F. Mikes, will have day-to-day control of the team and is the principal point of contact for the COE. He marshals resources, directs work and interprets data collected, and is in constant contact with the rest of the team and the **COE**. With the assistance of Mr. O'Brien, he can assign resources from throughout the company to expedite the solution to events as they are presented. Mr. Mikes is responsible for overseeing the **performance** of OK's work from a **technical** point of view. He will assign specific tasks to the team and will assist in coordinating the assembly of reports, charts, oral presentations, schedules, and related documents. The Project Director will be responsible for the administration of this assignment and will be instrumental in the preparation of OK's progress reports to the **COE**.

The **Project Managers**, reporting to Mr. Mikes, will be responsible for the execution of document retrieval and management, strategy, discovery requirements, preparation of final reports, studies, CPM schedule analysis, settlement negotiations and trial support, quality assurance inspection, design analysis, hazard analysis, analysis of health and safety programs and procedures, and will serve as the day-to-day contact on all issues pertaining to an assignment. With the assistance of the Project Engineers and other resources, the bulk of the work will be accomplished by the Project Managers.

The **Project Engineers**, reporting to the Project Director and working closely with the project managers, will be responsible for the execution of claims analysis and support services with respect to this project. The Project Engineers will play a role in the preliminary evaluation, technical analysis and report preparation, site investigations, schedule work, estimates, and other support services. At times, the Project Engineers may be called upon during trial and post-trial activities. Additional support will be provided by Claims Technicians, Document Control Specialists and others on an as-needed basis.

On all major projects, OK assigns senior staff members to serve in a role of **Technical Advisors**. Since our growth and success are based solely on the job we perform for our clients, we always practice aggressive oversight of our technical assignments. The Technical Advisors will serve as a sounding board for the Project Director and Project Managers in defining the approaches OK will use to address technical issues. The Technical Advisors will be kept abreast of the status of the project throughout its life and will periodically participate in technical sessions with OK's staff and possibly the COE. We believe that the breadth and experience of the Technical Advisors will be most valuable to the project.

Subconsultants Pennoni Associates, Inc. and Spotts Stevens and McCoy will provide specialized support in environmental engineering and process engineering. Each subconsultant will work directly with OK project managers and report through the project director. The subconsultants will assist the project manager with site investigations, hazard analysis and review of health and safety programs and procedures, design analysis, perform design modification and other design work including related drawings, specifications and estimates, sample gathering, testing in the field, laboratory testing, surveys, borings and monitoring.

STRUCTURE
As illustrated on the organization chart (following page), OK's team is functionally and organizationally simple. Our Project Director is the head of our team. Reporting directly to the Project Director will be each Project Manager and Project Engineers assigned to a Task Order. The level of involvement for each individual is based on the nature, size and complexity of the claim, and his/her level of experience and specific expertise relative to the task. The chart depicts a matrix organization and was developed to show our depth of resources and the structure in which we operate. A simple change order or claims task order may only require one or two individuals, but, OK's full resources are available to support this project in the event a larger staff is required.

Figure 11–2 ***(Continued)***

PRECONSTRUCTION SERVICES

Labor	Hours	Rate	
Project Manager	1080	$40	$43,200
Architect	240	$35	8,400
Estimator	320	$25	8,000
General Engineer	960	$30	28,800
Structural Engineer	160	$35	5,600
Electrical Rngineer	360	$35	12,600
Mechanical Enginner	350	$35	12,600
Certified Value Specialistt	136	$40	5,400
	Direct Labor Subtotal		$124,640
	Overhead 1.2 x Direct Labor		149,568
	Subtotal		$274,208
	Direct Expenses: Per List Attached		15,000
	Subtotal		S289,208
	Fee 10%		28,921
	Total		**$318,129**

Figure 11–3 Cost Proposal

and select the one with the lowest cost proposal. Another is to identify the most qualified and negotiate to find a mutually acceptable scope and cost. If negotiations fail, the customer goes to the second best on the list. Another approach is to arrive at a score combining cost and qualifications.

The successful proposal is usually appended to the contract and becomes binding upon the proposer. The project-management risk group should review the proposal to be certain that the proposal team has not volunteered to add undue risk to the scope.

Contract Costs

Construction contracts in both public and private work are awarded on the basis of the lowest sealed bid. In selecting a project-management team, an owner can consider the professional capabilities and select on that basis, rather than on price alone. Most project-management contracts are selected on a professional-services basis. Progress invoices are typically issued on a monthly basis. Billing is for direct labor (as identified in the proposal staffing plan) at an hourly rate. (Figure 11–4 shows a staffing plan.) Project-management personnel are usually salaried. Although federal law requires payment on a time-and-a-half basis for all time worked over forty hours per week, management personnel are exempt from this and can be required to work overtime as part of their base salary. The usual practice, however, is to pay managers for overtime on a straight time basis rather than on a time-and-a-half basis. That is, managers are typically paid what they earn per hour for time worked beyond forty hours a week. An hourly rate is created by dividing annual salary by 2,040 hours. Payroll verification of the hourly rate is usually required by the project contract.

On the progress invoice, the sum of the direct labor is multiplied by one plus the overhead multiplier. This subtotal is multiplied by the agreed fee percentage (the agreed-to profit percent); this figure is added to the subtotal. Expenses, usually at cost (and in accordance with the proposal), are then added to complete the invoice (see Figures 11–5 and 11–6).

The professional-services contract is essentially a cost-plus contract, but in the proposal, the customer typically requires a cap figure. The progress invoices are for actual services rendered within the cost cap.

Term Contracts

The selection and negotiation process for a contract often takes six to eighteen months. To avoid this long process, many federal and state agencies award term contracts, because, once in place, the process for agreeing to work on task orders under these contracts takes about a week. The term contract is a master contract because this one contract may cover several projects—as a master key opens several locks. The master contract, known more formally as indefinite quantity (fixed) term contract covers areas such as project management, construction management, value engineering (VE), and claims management. For this contract, the general type of work is described. For example, the contract may be to manage the construction of postal facilities called a General Mail Facility (GMF) for the U.S. Postal Service (USPS). When a project team is under contract, USPS assigns work orders. The following process takes about a week to accomplish:

1. USPS gives a description of the project scope such as type of GMF, budget, time of performance, and required service (e.g., construction management, project management, and inspection).
2. The company responds with proposed staffing plan (including positions, persons, and hours) and costs with rates approved in the contract.

Tasks	STAFF HOURS PM	CVS	Arch.	Gen. Eng.	Struct. Eng.	Elec. Eng.	Mech. Eng.	Estimator
Project Pocedures Manual				320				
PM Oversight: Schematic Design Dev. Const. Documents	 160 320 320							
Design Review - Schematic	40				80			
Estimate - Schematic								80
Prepare for Schematic VE		16						
Schematic VE		40	40		40			40
Constructibility Review Des. Dev.	40			160				
Design Review Design Dev.	40					80	80	
Prepare for Design Dev. VE		40						
Design Dev. Estimate								160
Design Dev. VE		40	40		40	40	40	40
Draft General - Supp. Specifications				240				
On Board Review Const. Doc.	160		160			240	240	
TOTALS	**1080**	**136**	**240**	**960**	**160**	**360**	**360**	**320**

Figure 11–4 Staffing Plan—Preconstruction Service

Progress Invoice #2

October 1997

Direct Labor

Project Manager

Oversight - 80 Staff hours @ $40 = $ 3,200

General Engineer

Procedures Manual - 160 MH @ $30 = 4,800

Total Direct Labor $ 8,000

Figure 11–5 Progress Invoice Direct Labor Portion

Progress Invoice #2

October 1997

Preconstruction Phase

Direct Labor		$ 8,000
Overhead 1.2 x DL		9,600
	Subtotal	$17,600
	Fee 10%	1,760
	Expenses at Cost	1,500
	Total Invoice #2	**$20,860**

Figure 11–6 Progress Invoice

3. USPS accepts or negotiates the level of effort.
4. The consulting company confirms the agreement.
5. USPS issues a notice to proceed (NTP).

The difference between a traditional fixed-scope contract and a master contract is that the type of service under a master contract is specified, but the scope of service is not. After the contract is in place, the agency issues scopes of work. The consulting company responds with a proposed scope in the form of a staffing plan and a time frame. The hourly rates and the overhead markup are part of the term contract.

The typical term contract is issued with a cap amount such as $500,000 or $1 million. The contract is usually for two years with annual renewal options for several years. To accommodate this, the proposer is usually allowed to escalate the salaries and hourly rates by 5 percent per year.

Direct and Indirect Labor

The term *direct labor* relates to personnel that, per contract, can be billed to the project. From a business viewpoint, being in the direct-labor group is like being on the varsity. Key members of the direct-labor group are named in the proposal.

Indirect labor, conversely, is not billable. the positions range from receptionist, mailroom clerk, and secretary, to the chief executive officer. The indirect labor are the support and management staff known as "corporate" that either provide indirect support to the project-management team, or carry on the nonproject aspects of the company business. The project team cannot control the ratio of indirect labor to direct labor. That is the responsibility of top management. In fact, the indirect labor to direct labor ratio is the principal target in corporate downsizing and reengineering. Sometimes the project-management team gets an opportunity to transfer an indirect-labor person to a direct-labor position. Carried as an ongoing policy, this can improve the bottom line. Conversely, between projects, the project-management team (even if briefly) becomes a part of the indirect labor.

Markup

In preparing the cost proposal, the direct labor is marked up or multiplied by a factor. The factor has to cover the following:

- ***Indirect labor.*** This is support staff and direct labor personnel not assigned to a project.
- ***Corporate functions.*** These are accounting, financial, human services, insurance, legal, and other functions not directly related to the project.
- ***Fringe benefits.*** These are vacation time (accrued as well as taken), sick time, personal business time, and retirement programs (including profit sharing and 401 (k) programs). Typically, these are 30 percent to 35 percent of the direct labor cost.
- ***Travel.*** Unless travel is allowed as a direct expense, travel related to the project, including relocation, is part of the markup.

Field or Office Project

When the assignment dictates that the project-management team be located at the project (i.e., the field), the client typically provides direct support to the team. This support usually includes office (or trailer) space, furniture, telephone services, utilities (e.g., air conditioning, heat, water, and sewer), and basic equipment (e.g., reproduction and computers). In return, the client requires that the markup multiplier reflect the services provided. Typically, the multiplier for a field job would be 1.0 to 1.2 times direct labor.

In addition to the physical support provided, all personnel dedicated full time at the project site are considered direct labor. This includes many positions (such as receptionist, secretary, administrator, and purchasing agent) that would be indirect labor if in the home office. Not only are indirect-labor positions moved to direct labor, but these new direct-labor positions are now part of the direct labor that is marked up.

For an office job, the consulting company provides overhead such as the office space, furniture, computers, office equipment, copy machines, mailroom, and secretarial services. Because the consulting company provides more under the office job, a higher overhead must be carried. As in the field job, this overhead is typically measured as a percentage of direct labor.

Project Organization

The proposal should include an organization chart. This should be updated to reflect changes in personnel or assigned tasks. The organization chart should be posted, made available to the project team, and included in a monthly progress report to the client. A work-breakdown structure (WBS) should be developed reflecting the following:

- Cost and hours budgeted for each task or project component
- Personnel assigned
- Breakdown of each task or project component into appropriate levels of detail.

For more on work-breakdown structures, see Chapter 8.

Project teams often include subconsultants for various purposes. One purpose is to bring special skills to the team. Another is to meet disadvantaged-owned business enterprise (DBE), woman-owned business enterprise (WBE), and/or minority-owned business enterprise (MBE) goals. Under federal equal employment opportunity law, federal (and most state)-funded projects require a minimum percentage of subcontract jobs to go to firms certified as DBE, WBE, and MBE. The goals are determined by the agency sponsor. For example, the goals may be the following: DBE 15 percent and WBE 5 percent, or MBE 10 percent and WBE 3 percent.

Recordkeeping

It is not sufficient for project managers to perform their services well. They must also be able to prove that services were well-performed. There is no substitute for comprehensive written records in managing the project process.

Throughout the project, the project manager should check that all members of the project team keep accurate records of conversations, telephone calls, and events affecting project scope, services, quality, schedule, and cost. In fact, files should contain all information generated by the project team, including copies of submittals, transmittals, approvals, project memoranda, meeting minutes, notations of telephone conversations, project correspondence, review comments, and documents generated by the team. Good records are objective, clean, and complete. They should contain facts only; personal observations should not be included. This may help avoid associated liability.

Filing

Project files must provide easily retrievable information. When the project is completed, the project manager reviews the files, purging them of redundant materials and ensuring that they provide a complete record of the project. The baseline schedule should be updated and used as part of the regular (usually monthly) progress report.

Budget

The budget for the project-management team should be based on the proposed budget as adjusted in the negotiations. It should be on a task basis. The monthly invoice, furnished by accounting, should be accompanied by a person-by-person list of hours billed. Figure 11–7 consists of the following two plots: budgeted cost on an early basis and budgeted cost on a late basis. If the cumulative cost falls within the budget, the project-management effort is proceeding within the budget.

Another approach to monitoring cost is the earned-value approach. The budgeted value for each task is monitored. Progress is measured by a value-earned curve, as well as cost. Figure 11–8 is a sample value-earned status check. At the 50 percent point in time, the amount spent is 60 percent. This suggests that the project value of the work completed is 60 percent. However, the plot of the earned value of the completed work at the 50 percent

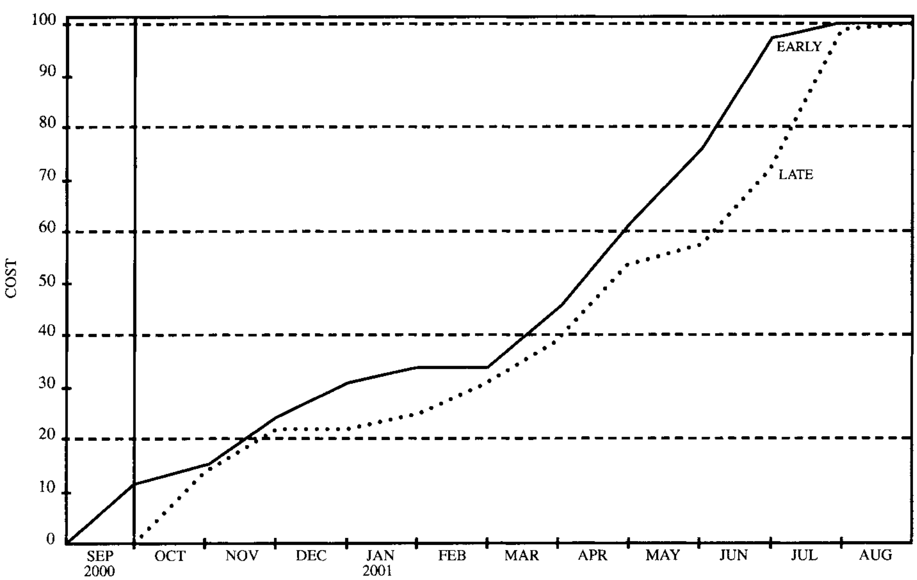

Figure 11–7 Current versus Planned Scheduled-Labor Costs

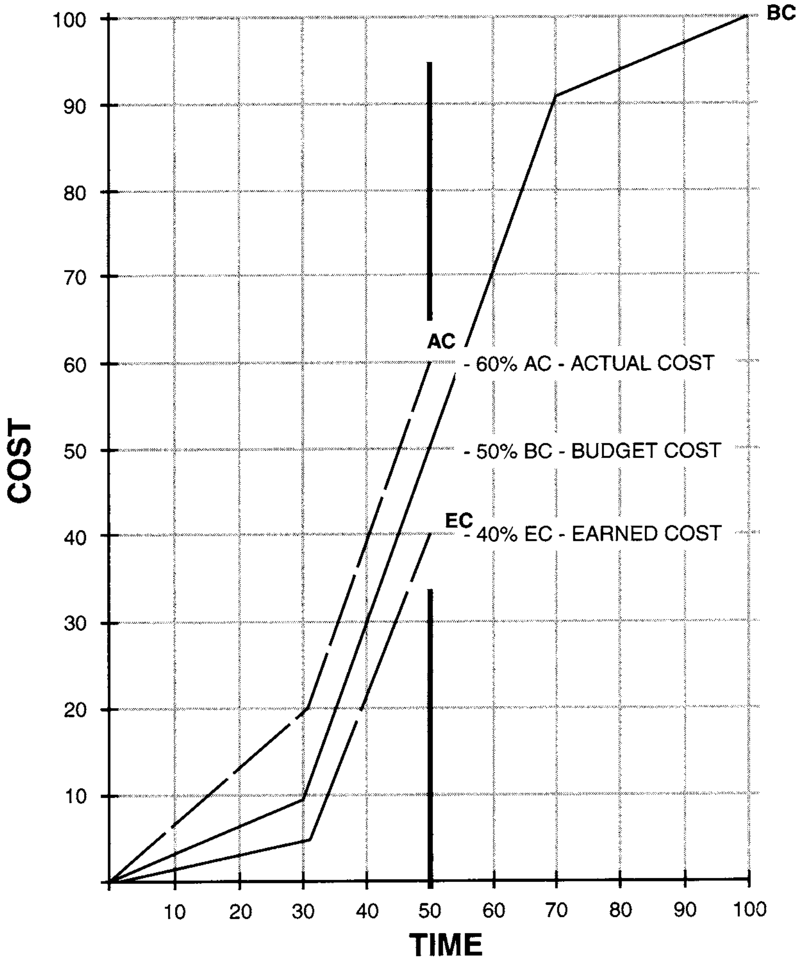

Figure 11–8 Value Earned at 50 Percent Scheduled Time

point in time is only 40 percent. This shows that the work is behind schedule and over budget by 20 percent.

Change Orders

When changes occur, they should be identified and documented. If a change is required in the project-team scope of work, a change order should be for project time as well as money. Time requests are usually accompanied by a time impact analysis based on the schedule baselines.

The contract-management team should also monitor the manner and timeliness with which the project-management team handles contractor claims for change orders. Change orders take time—and time costs the contractor money. Job morale is definitely affected when a backlog in unprocessed change orders occurs.

Two methods are available to expedite change orders. One method is to use time and material change orders. If the project-management team and the contractor cannot agree on a fixed price for a change order, the project manager can direct the contractor to work on a time-and-material (T&M) basis. This deletes the negotiation aspect because the project is approached by doing the following:

- Labor hours by worker are listed on a daily basis.
- The base costs of labor are calculated on either a weekly or a monthly basis.
- The invoice for labor (time) is base cost plus markup for fringe benefits and workers' compensation.
- This figure is marked up as allowed by the contract for overhead and profit (usually 20 percent).
- Material is billed at cost (backed up by invoices) plus the markup allowed by the contract (usually 10 percent).

A second approach is to issue an initial unilateral change order that includes the project manager's estimate of the worth of the change. Unilateral change orders are used extensively by federal agencies. If the parties cannot agree on price, and both prefer to avoid working on a T&M basis, the project manager can issue a unilateral change order. This is issued using a project manager's cost estimate, which should be on the low side. It is understood that the contractor can continue the negotiation process and/or make a claim for cost overrun if the actual cost is higher than the estimated cost. Owners and project managers may prefer unilateral change orders because T&Ms tend to be inefficient and contractors often find that they may not cover true costs.

This keeps the contractor's cash flow moving, and makes the negotiation period less critical. It also doubles the paperwork. Why go through all this? The contractor can at least get paid in part for the change-order work.

The following case study describes a major construction-management project in which the processes described in this chapter were used to select and organize a project-management team. The project-management team carried out the three-year assignment on time and under budget.

CASE STUDY

When Southeastern Pennsylvania Transportation Authority (SEPTA) assumed operation of the former Pennsylvania and Reading rail lines in 1983, it inherited a network of bridges, track, and overhead power lines (catenary) that had already been in service for many years. Decades of deferred maintenance and virtually no dedicated capital funding had resulted in a usable but deteriorating rail system.

The commuter tunnel, completed in October 1984, connected the once-separated rail lines; it allowed all regional rail lines to access the three center-city rail stations. Several months after the tunnel's completion, an engineering inspection study indicated a need for renovation of many of the system's bridges, some of which had stood for nearly 100 years.

The four-mile stretch of track north of the new tunnel was the renovation property. The stretch consisted of track and catenary system and twenty-five rail bridges—a total of sixteen track miles—forming the main line, or throat, of the old Reading line. Six SEPTA regional rail lines fed into this central corridor.

The completed project was budgeted at about $300 million. The project, named SEPTA RailWorks, entailed major infrastructure rehabilitation of this regional rail corridor. The major components of the work included the renovation of four bridges, complete replacement of twenty-one bridges, replacement of all track, a new catenary system, and replacement of related equipment, including switches and signals. All of the bridges spanned active highway crossings in a congested urban setting.

Early in 1991, SEPTA sent letters to firms that had submitted SF 254s that demonstrated construction-management capability. The letters described the project and the availability of an RFP. About ten teams responded. A short list of five were invited to make a presentation of their proposed project team. From that short list, the O'Brien-Kreitzberg (OK) team was selected as the project team.

The contract was based on direct-labor time, plus overhead, which was calculated by multiplying 1.2 times direct labor, and a 10 percent fee on the total. SEPTA had a substantial group assigned to the field office to manage the contract. Members of this group approved the actual staffing on each task and any changes in scope. They also provided quality assurance to confirm that the construction-management team was performing according to the contract and proposal.

The OK/SEPTA team had a budget of $18 million. The team handled the base contracts and change orders. In addition, new construction scope—called supplemental changes—in the amount of $10 million, was managed by the project-management team. The team underspent the team budget by $2.5 million.

Throughout the project, the contractors were faced with a local population living in close proximity to the construction operations. Two of the bridges were actually preassembled in the yards of neighbors. The neighbors continued to use the streets in spite of the barricades and all attempts to close the streets. The entire area was laced with sanitary and storm sewers from the last century, so their existing condition was documented both before the work began and again after completion. The following list highlights facts about the project:

- Contracts: total value $140 million
- Contractors: 12 primes, 74 subs
- Start data: August 1990
- Track Shutdown windows
  Phase I (April 1992–October 1992)
  Phase II (May 1993–September 1993)
- System returned to revenue service: October 1992 and September 1993
- Project closeout: December 1993
- Construction-management team (contract $15.5 million): 55 staff members

—Construction manager:	O'Brien-Kreitzberg	40 percent
—Bridges:	Michael Baker Engineers	15 percent
—Rail and power:	LS Transit Systems	15 percent
—DBEs/WBE:	Management Concepts Systems & Services; Don Todd Associates; Promatech; Vann Organization; and Mitra & Associates	30 percent

Although many different companies were represented on the construction-management team, outside allegiances were minimized. The team had its own identity in the name RailWorks, and everyone used their position title on the project rather than their home office title. Stationery, business cards, hardhats, T-shirts, and baseball caps were created for the project logo and, in general, everything feasible was done to create a sense of unity within the project team.

It was apparent from the outset that the essence of the project was the management and coordination of six prime contractors (in each phase) and their seventy-four subcontractors, combined with the sharply limited time available for the accomplishment of the work in a highly restricted and congested work area.

A project-specific procedures book was developed before the first shutdown using the OK generic procedures book as a base. In this same early time frame, a very successful partnering program was implemented. SEPTA, the construction-management team, and the initial six prime contractors were involved.

To make transition between the completion of the general contractor's work, the corresponding start of electrical work, and the integrated system tests as seamless as possible several mandatory milestones were included in the contract specifications. A special coordination schedule was developed by extracting relevant detailed window-schedule (the window periods during which the rail system was shut down) information from each of the contractors. This process permitted an accurate monitoring of work wherever interdependent operations by more than one contractor was unavoidable, or necessary to achieve early access.

Earned-Value System and Weekly Updates

An earned-value system was instituted based upon the detailed, resource-loaded window schedules. The windows were the times that the tracks were shut down. Within the windows, where work went on twenty-four hours a day, seven days a week, the construction project-management schedules were very detailed—they were known as Level III. Baseline target and minimum physical progress goals were established using the budgeted rate of direct labor-hours usage on the early and late schedules, respectively. Completed activities were credited with their budgeted labor hours. Credits for all completed and partially completed activities were added up on a weekly basis and compared against the baseline. Progress—baseline as well as actual—was expressed in terms of percentages to maintain a uniform yardstock throughout the project and across all contracts.

All window activities that met the criteria of physical progress were coded for cross-referencing with the project WBS, thus allowing computation of progress as a percentage of any related WBS element in a hierarchical configuration.

The construction-management team worked a weekend shift and prepared a detailed status report that evaluated progress through the close of business every Friday. This report was ready for management every Monday morning.

An OK senior principal was on-call for the project and attended thirty-three monthly progress meetings with the construction-management team and SEPTA. OK conducted an early internal audit of project procedures. Significant challenges and the greatest concerns were always twofold: (1) complete each shutdown on time and (2) restart rail lines successfully. OK considers the following results outstanding:

- All dates were met on time or early.
- The project was completed more than $20 million under budget.
- Change orders included enhancements (e.g., safe speed was increased from 40 mph to 60 mph) worth more than $10 million.
- There were no claims or lawsuits for disputed work, delays, disruptions, or disputed change orders. (Although the job was a relatively safe one, there were some workers' compensation claims and one death late in the job.)
- There was no need to apply liquidated damages (at $70,000 a day). Each summer, a window had a fixed "return to service" date. If that date was not met, each offending contractor would be assessed $70,000 a day until it was met. The first summer window was finished two days early, and the second summer window a week early.

Writing a comprehensive proposal requires the knowledge and experience to visualize how the project will progress. From this, the writer develops staffing schedules and a management plan for the project.

Chapter

12

Developing Winning Proposals

Hans J. Thamhain

Biographical Sketch . . .

Dr. Hans J. Thamhain has combined a career of RD&E and business management with university teaching and research. He is currently a Professor of Management and Director of MOT and Project Management Programs at Bentley College; his industrial experience includes 20 years of high-technology management positions with GTE/Verizon, General Electric, Westinghouse, and ITT. Dr. Thamhain has Ph.D., M.B.A., M.S.E.E., and B.S.E.E. degrees. He has written over 70 research papers and five professional reference books in project and technology management. He is the recipient of the Distinguished Contribution Award from the Project Management Institute in 1998 and the IEEE Engineering Manager of the Year 2001 Award. Dr. Thamhain is certified as NPDP and PMP.

Bid proposals provide the promotional vehicle for winning trillions of dollars of business each year. Resulting contracts span across all types of businesses and industries, ranging from simple services and supplies to complex multicompany defense contracts, from professional activities to business-to-business and business-to-government ventures. However, winning new business with bid proposals is a complex process. It is also expensive, exhaustive, and highly uncertain. Among the top bidders, the field is usually very close. Beating most of the competition is not good enough. In most cases, there is only one winner. Yet companies have no choice. Especially for project-intensive enterprises, new contracts are the lifeblood and must be pursued.

While the techniques for developing and winning contracts are highly specialized and differ for each market segment, they have some common dimensions, as summarized in Table 12–1. To score high, bid proposals re-

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Table 12–1 Characteristics of Bid Proposal Developments

The following dimensions characterize bid project proposals:

1. **Systematic effort.** A systematic effort is usually required to develop a new project lead into an actual contract. The project acquisition effort is often highly integrated with ongoing programs and involves key personnel from both the potential customer and the performing organization.
2. **Custom design.** Although traditional businesses provide standard products and services for a variety of applications and customers, projects are custom-designed items to fit specific requirements for a single customer community.
3. **Project life cycle.** Project-oriented businesses have a beginning and an end and are not self-perpetuating. Business must be generated on a project-by-project basis rather than by creating demand for a standard product or service.
4. **Market phase.** Long lead times often exist between project definition, start-up, and completion.
5. **Risks.** Especially for technology-based projects, substantial risks are present. The contractor must not only manage and integrate the project within budget and schedule constraints, but also manage innovations, technology, and the associated risks.
6. **Technical capability to perform.** This capability is a critical prerequisite for the successful pursuit and acquisition of a new project or program
7. **Customer requirements.** Projects are often unique regarding specific operational requirements. Applications in the specific customer environment must be properly understood and addressed in the bid proposal document.
8. **Follow-on potential.** Winning one contract often provides opportunities for follow-on business such as spare parts, maintenance, training, or volume production.
9. **Complex bidding process.** The acquisition process is often very complex and subtle, especially for larger proposal efforts. They often start a long time before the proposal writing phase.
10. **Contract negotiations.** Although the proposal serves as a very important vehicle for narrowing the selection pr potential contractors, the winning bidder is most likely selected—and its contract finalized—by negotiations. Often these negotiations involve intricate and subtle processes.

quire intense, disciplined team effort among all supporting functions and partner organizations, resulting in the following four characteristics:

1. Well-defined and articulated solution, responsive to the customer needs and requirements
2. Credibility and trust in the bidding contractor to perform according to the proposal
3. Competitive advantage, such as innovative solution, cost savings or licensing agreement
4. Competitive pricing and cost credibility

Producing such a document is both a science and an art. To be successful, it requires not only writing skills, but significant homework, customer contact, and specialized efforts. A clear understanding of the contract-acquisitions process and its tools and techniques is critically important to organizing and managing the complexities of a proposal development effectively and predictably.

The key components and activities that come into play during the life cycle of a proposal-based business development, such as

- Proposal solicitation
- Proposal types and formats
- Identification of new business opportunities
- Assessment of new business opportunities
- Writing a winning proposal
- Contract negotiation and closure

will be discussed in this chapter with focus on the procedures and actions necessary for winning new contract business.

Proposal Solicitation

Bid proposals come in many different types, shapes, sizes, and formats. They can be *solicited* or *unsolicited*. Most proposals are in response to a formal request for proposal (RFP), request for quotation (RFQ), or request for information (RFI). However, they can also be based on a less formal inquiry by letter or personal discussion. But regardless of its type or format, proposals are sales instruments that try to persuade potential customers to buy goods and services. More specifically, *bid proposals offer suggestions for filling a specific customer need, or solving a particular problem.*

Depending on the scope and complexity of the customer requirements, solicitation, such as an RFP, can range from a simple note to highly complex, multivolume documents. For the more complex programs, solicitations often stipulate not only the specific deliverables, but also the conditions under which the work is to be done, delivered, and procured.

Proposal Types and Formats

The responses to these solicitations or client inquires are termed *bid proposals*. They are classified in two major categories:

- Qualification proposals
- Commercial bid proposals

THE QUALIFICATION PROPOSALS

The qualification proposal provides general information about the company, its organization and management, qualifications to perform, procedures, methods, and technologies that would be appropriate for the type of work under consideration. Qualification proposals make no specific offer to perform services or deliver goods, nor make any commitments for contracting with the client. These documents are also called informational proposals if the contents relate just to company organization, general qualifications, and procedures. Furthermore, qualifying proposals are often presented under the label of *white papers* or *technical presentations*. Yet another special form of the qualification proposal is the *oral presentation*.

THE COMMERCIAL BID PROPOSAL

The commercial bid proposal offers a definite commitment by the company to provide specific work, goods, or services in accordance with explicit contract terms and conditions. In addition to the specific performance commitment, commercial bid proposals usually contain the same type of information found in qualification proposals, but in more detail.

PROPOSAL FORMS

Both qualification and commercial proposals may be presented to the client in various forms under a wide variety of titles, depending on the situation, the client's requirements, and the firm's willingness to commit its resources. No sharp distinctions exist among these proposals on the basis of content. The difference is mainly in the format and extent of preparation effort. The most common forms are *letter proposals, preliminary proposals, detailed proposals,* and *presentations.*

Letter Proposals

These are either qualification or commercial proposals. They are brief enough to be issued in letter form rather than as bound volumes.

Preliminary Proposals

These are either qualification or commercial proposals, usually large enough to be issued as bound volumes. They are sent to the client for the purpose of dialogue, eventually leading to a detailed proposal development, rather than an immediate proposal evaluation.

Detailed Proposals

These are most often commercial bid proposals, which, aside from the technical part, include a detailed cost and time estimate. They are the most complex and inclusive proposals. Because of the high cost of preparation and the bid commitments offered, organization and contents of these documents are defined and detailed to a much greater degree than for other kinds of proposals.

Presentations

These are generally in the format of *oral proposals*. Selected personnel, specialized in certain areas, discuss their proposed offerings verbally with client representatives. Typical presentation time periods vary from an hour to an entire day. While oral presentations have been common in business-to-business biddings for a long time, they have become a new and very important element in the federal government procurement process. Most oral presentations are conducted after the written proposal has been evaluated. Sophisticated use of information technology in support of audio-visuals is very common and necessary for optimizing presentation effectiveness.

Identifying New Business Opportunities

Identifying quality business opportunities is the first step toward any new business acquisition. New business opportunities do not just happen, but are the result of sophisticated, systematic customer relation efforts, supported by effective market research. Much can be done to drive and lead market activities and to increase the number of qualified target opportunities consistent with the company's business objectives. Managers who find the process of identifying new business opportunities subtle and unfairly biased toward "insiders" often do not utilize effectively the wealth of information available in the market and within their own customer community. Customer meetings on current programs, professional meetings, conventions, trade shows, trade journals, customer service, competitor announcements, and personal contacts represent just a few of the many sources for identifying new business opportunities, such as shown in the listing of contract information sources at the end of this chapter.

Effective customer relations management (CRM), systematic data mining of the business environment and contemporary tools, such as joint ventures, professional networking, on-line data services, consulting services, and the Freedom of Information Act, can result in identifying more timely and better qualified opportunities. All of these front-end efforts must be well orchestrated as part of new business development plan that is fully integrated with the overall business mission.

ONGOING PROCESS

Identifying new bid opportunities is an ongoing activity. The primary responsibility falls on the marketing or sales department, but personnel at all levels throughout the company can help significantly in identifying new business leads. For most businesses, ongoing program activities are the best source of new business leads. Not only are the lines of customer communication better than for new markets, but, equally important, the image of an experienced, reliable contractor helps in creating a favorable environment for open communications, and often results in sharing of privileged information, clearly a desirable competitive advantage!

ACQUISITION LIFE CYCLE

Developing a new opportunity into a contract takes considerable time and resources. For large programs, this could take several years and millions of dollars. Few companies rush into a major proposal development without carefully evaluating the new opportunity or having a clear win strategy. The formal bid proposal process provides the toolset for pursuing new business opportunities and for systematically developing them into contract awards. Realizing both the complexities and the significance of new business acquisition, many companies have established an *internal proposal development group* or are seeking consulting help from the outside. To make the process more manageable and to break up its complexities, new business acquisitions are typically broken into six phases:

1. Identifying new business opportunities
2. Assessing new contract opportunities
3. Planning the business acquisition
4. Developing the new contract opportunity
5. Writing a winning proposal
6. Negotiating and closing the contract

All phases have strong interdependencies and time overlaps, as well as opportunities for selective concurrent execution.

Assessing New Contract Opportunities

Pursuing new contracts is a highly intricate process, involving technical complexities, functional interdependencies, evolving solutions, high levels of uncertainty, and highly complex forms of work integration. It is a risky business that requires significant resources and specialized skills. Yet the win probability is often low. Furthermore, investment into acquisition activities alone does not guarantee success. In fact, many less successful companies find themselves in the quandary of bidding on too many opportunities without realizing the amount of resources and skills necessary for seriously competing for any one contract. For a realistic chance of winning, new bid opportunities must be carefully analyzed and assessed. The result of this analysis is a preliminary acquisition plan that provides the basis for a bid decision and the starting point for the final acquisition plan. Table 12–2 describes the bid decision process and suggests a checklist for determining the win potential for a new contract. Since the components for organizing a winning proposal effort do not add up linearly, it is often better to consider the bid opportunity in perspective with the overall strength and weaknesses of the enterprise, rather than trying to quantify a narrow set of selected variables. Table 12–2 suggests a broadly defined framework of questions for gaining collective insight into the basic viability of the new opportunity. Brainstorming, focus teams, Delphi groups, and other expert group assessment techniques can be useful in determining the chances of winning the new business and justifying further resources for developing a detailed win strategy and acquisition plan, as characterized in Table 12–3.

Analyzing a new business opportunity and preparing the acquisition plan is a highly interactive effort among the various resource groups of the enterprise, its partners and the customer community. Often, many meetings

Table 12–2 The Bid Decision

Few decisions are more fundamental to new business development than the bid decision. Resources for pursuing new business come from operating profits. These resources set aside for new business development must be carefully allocated to opportunities with payoff potential. Bid boards serve as management gates for the release control of these resources. Bid boards are expert panels that analyze the new business opportunity relative to its importance to the company mission and competitive strength, to determine the readiness of the company to invest the necessary resources for a winning proposal effort. Four major dimensions must be considered in a bid decision: (1) Desire and value of acquiring the new business, (2) cost of the acquisition effort, (3) relative strength of the company versus its competition, and (4) readiness of the company to execute the contract. The new business acquisition plan provides a framework for the bid board deliberation and ultimate decision.

Major acquisitions usually require a series of bid board decisions, ranging from preliminary to final. Some preliminary bid decisions are being made as early as eighteen months before the RFP. Subsequent bid boards reaffirm the bid decision and help in updating the acquisition plan. They may also redirect or terminate the acquisition effort. It is the responsibility of the proposal manager to gather and present pertinent information in a manner useful to the bid board for analysis and decision making. The following checklist provides a simple tool for stimulating critical thinking toward an integrated bid evaluation and decision-making.

Checklist for Evaluating Bid Decision

Evaluate conditions on a 5-point scale (1 = Strongly Unfavorable . . . 5 = Strongly Favorable)	**Status**
1. We have sufficient resources and capabilities to perform	[1] [2] [3] [4] [5]
2. We can meet the client's schedule	[1] [2] [3] [4] [5]
3. We are in a strong technical position to perform	[1] [2] [3] [4] [5]
4. We have unique technical solution for client	[1] [2] [3] [4] [5]
5. We have unique approach to project execution	[1] [2] [3] [4] [5]
6. We have unique resources for project/contract execution	[1] [2] [3] [4] [5]
7. We have competitive cost advantage	[1] [2] [3] [4] [5]
8. We have favorable reputation in this type of work	[1] [2] [3] [4] [5]
9. Client is ready to start the project (including budget)	[1] [2] [3] [4] [5]
10. We are on preferred contractor list	[1] [2] [3] [4] [5]
11. We have established strong client relations on this bid	[1] [2] [3] [4] [5]
12. We have competitive pricing strategy	[1] [2] [3] [4] [5]
13. Contract has significant follow-on potential	[1] [2] [3] [4] [5]
14. Contract is consistent with enterprise mission and plans	[1] [2] [3] [4] [5]
15. Contract will enhance future technical capabilities	[1] [2] [3] [4] [5]
16. Contract will enhance future market position	[1] [2] [3] [4] [5]
17. Contract will result in significant economical gain	[1] [2] [3] [4] [5]
18. We understand the competition	[1] [2] [3] [4] [5]
19. Number of qualified bidders	[1] [2] [3] [4] [5]
20. We are very familiar with this bidding process	[1] [2] [3] [4] [5]
21. We have unique advantage over competition	[1] [2] [3] [4] [5]
22. We have a realistic chance of winning the contract	[1] [2] [3] [4] [5]

Table 12–3 The New Business Acquisition Plan

The new business acquisition plan is an important management tool for supporting the bid decision and for providing a roadmap for guiding the contract acquisition process. The plan also provides the basis for the resources required to pursue the new contract acquisition, and the roadmap for organizing and executing the bid proposal development. Typically, the new business acquisition plan should include the following components:

- *Brief description of the new business opportunity.* A statement of the customer requirements, including specifications, schedules, budgets, and key decision-makers.
- *Rationale for bidding.* A statement discussing the reason for bidding on the new contract opportunity, including perspectives against established business plans and desirable results such as profits, markets, and technology.
- *Competitive assessment.* A description of each competing firm with regard to relevant past activities, related experiences, current contracts, customer relations, strength and weaknesses, and potential baseline of approach.
- *Critical win factors.* A listing of specific factors important to winning the new contract and their rationale.
- *Ability to write winning proposal.* Discussion of the specific resources and timing required for preparing a winning bid proposal. Factors to be considered should include: available personnel, understanding of customer problems, competitive advantage, ability to meet customer budget constraints, willingness to bid competitively, special factors such as licensing, joint ventures, and long-range investment.
- *Win strategy.* A statement describing the actions to be taken for positioning the enterprise uniquely in the competitive field, including a chronological listing of critical actions and milestones necessary to guide the acquisition effort from its current position to contract award. Responsible personnel and timing should be defined for each milestone.
- *Capture plan.* A detailed action plan that supports the win strategy, integrated with the overall business plan. All actions should include timing, budgets, and responsible personnel. The capture plan is a working document that serves as a roadmap in a dynamically changing competitive landscape. It should be updated regularly.
- *Ability to perform under contract.* This is often a separate document. However, a summary should be included in the acquisition plan, including ability to meet technical requirements, staffing, facilities, program schedules, and subcontracting.
- *Problems and risks.* A list of problems, challenges, and risks regarding the capture plan implementation should be presented.
- *Resource plan.* A budget summary including the key personnel, support services, and other resources needed to capture the new contract.

are needed between the customer and the performing organization before a clear picture emerges of both customer requirements and matching contractor capabilities. A valuable side-benefit of such customer involvement is the potential for building confidence, trust, and credibility with the customer community. These meetings provide a platform for communicating the understanding of customer requirements and the capacity to perform, both an important prerequisite for winning the contract. The acquisition plan, as outlined in Table 12–3, provides the foundation and framework for winning the new contract, providing a roadmap for favorably positioning the enterprise. Four dimensions are crucial for positioning a winning proposal:

- Significant customer contact
- Relevant experience
- Technical readiness to perform
- Organizational readiness to perform

SIGNIFICANT CUSTOMER CONTACT

Customer liaison is vital to learning the specific customer requirements and needs. It is necessary to define the project baseline, potential problem areas, and risks involved. Customer liaison also allows participation in customer problem-solving and building a favorable image as a competent, credible contractor. Today's complex customer organizations involve many people in the bid decision-making process. Confusing requirements and customer biases are realities and must be dealt with. Multinational involvement at various levels of both contractor and customer organizations is often necessary to reach all decision-making parties. The *new business acquisition plan* is a good source of information and a roadmap for the development effort.

PRIOR RELEVANT EXPERIENCE

Nothing is more convincing to a potential customer than demonstrated prior performance in the area of the proposed program. It reduces the perceived technical risks, as well as the associated budget and schedule uncertainties. This image of an experienced contractor can be communicated in many ways: (1) field demonstrations of working systems and equipment; (2) listing of previous or current customers, their equipment, and applications; (3) model demonstrations; (4) technical status presentations; (5) promotional brochures: (6) technical papers and articles; (7) trade show demonstrations and exhibits; (8) audio-visual presentation of equipment in operation; (9) simulation of the systems, equipment, or services; (10) specifications, photos, or models of the proposed equipment; and (11) media advertisements. Demonstrating prior experience should be integrated with the customer liaison activities.

TECHNICAL READINESS TO PERFORM

Once the basic requirements and specifications for the new program are known, it is often necessary to mount a substantial technical preproposal effort to advance the baseline design to a point that permits a clear definition of the new program. These efforts may be funded by the customer or absorbed by the contractor. Typical efforts include (1) feasibility studies, (2) system design, (3) simulation, (4) design and testing of certain critical elements in the new system or the new process, (5) prototype models, (6) developments necessary to bid the new job within the desired scope, or (7) developments necessary to minimize technical and financial risks. Although these precontract efforts can be expensive, they are often essential for winning new business. These early developments reduce the implementation risks and enhance the contractor's credibility to perform under contract.

ORGANIZATIONAL READINESS TO PERFORM

Another element of credibility is the readiness of contractor organization to perform under contract. This includes facilities, key personnel, support groups, and management structure. Credibility in this area is particularly critical when bidding on a large program relative to the contractor. Organizational readiness does not necessarily mean reorganization prior to contract award, but it requires a clearly defined organization plan, detailed procedures that can be followed after contract award. The following checklist defines typical organizational components that might be required, and should be clearly defined in the proposal and discussed with the customer. If possible, such a customer dialogue should be conducted prior to submitting the formal proposal:

- Organizational structure
- Authority and responsibility relationships
- Project charter
- Company policy, procedures, and management guidelines
- Staffing plan
- Job descriptions of key contract personnel
- Type and number of laboratories, offices and facilities
- Floor plans
- Milestone schedule and budget for reorganizing under contract

Writing a Winning Proposal

Bid proposals are payoff vehicles. They are the final deliverable in the bid proposal cycle (of course, contract negotiations and closure are yet another phase of the overall acquisition process). Regardless of the type or nature of the work, whether bidding on a service or hardware contract, a government or commercial program, the basic process is the same.

The bid proposal is the most important marketing tool, and often the only one, for formally communicating the contract offer. The program requirements, soundness of proposed approach, possible alternatives, the company's credibility, etc., hopefully have been established during the preproposal phase of the contract development. Yet a superior proposal is still necessary for winning a new contract in a competitive environment. Your competition is most likely working with great intensity toward the same goal of winning this program. They, too, may have sold the customer on their approaches and capabilities. Usually only one company will emerge as the winner. Therefore, writing a superior proposal is crucial to winning. It is a serious business by itself.

ORGANIZING FOR GROUP WRITING

Proposal development requires hard work and long hours, often in a work environment filled with tension and constant pressure to perform against deadlines. As any projects, proposal developments require multifunctional efforts, well orchestrated for disciplined execution. Special tools are available to help, especially large programs to integrate the many activities needed for developing a high-scoring proposal. Smaller proposals often can be managed with less formality. Yet any proposal plan should include at least the following components:

- Proposal-team organization
- Proposal schedule
- Win strategy
- Categorical outline
- Writing assignments and page allocation
- Synopsis of approach for each topic
- RFP analysis
- Technical baseline review
- Proposal draft writing
- Development of illustration
- Reviews
- Cost estimating and pricing
- Proposal production
- Final management review

STORYBOARDING FACILITATES GROUP WRITING

Most bid proposals are group writing efforts. Organizing, coordinating, and integrating these team efforts can add significantly to the complexities and difficulties of managing the proposal development. Especially for larger efforts, storyboarding is a useful technique that facilitates the group writing process. It helps in breaking down the complexities and facilitates incremental integration of the proposal document.

Storyboarding is based on the idea of (1) splitting up the proposal writing into modules, assigned to various contributors, and (2) developing the text incrementally via a series of writing, editing, and review phases. The development sequence for a typical proposal effort is listed below, with the percentage-effort relative to the overall development shown in brackets:

1. Categorical outline [3 percent] .... Completion at day 01
2. Synopsis of approach [6 percent] .... Completion at day 03
3. Roundtable review [4 percent] .... Completion at day 04
4. Topical outline [5 percent] .... Completion at day 05

5. Storyboard preparation [20 percent] .... Completion at day 10
6. Storyboard review [4 percent] .... Completion at day 11
7. Storyboard expansion [25 percent] .... Completion at day 22
8. Staff review [3 percent] .... Completion at day 24
9. Final proposal draft [15 percent] .... Completion at day 26
10. Final edit [10 percent] .... Completion at day 28
11. Publication and delivery [5 percent] .... Completion at day 30

The number and type of phases, and the relative effort, might be typical for a major bid proposal development with a 30-day response cycle. In addition, this listing can serve as a guide for smaller or larger proposals. For smaller proposals, the effort can be scaled back to include fewer phases, possibly eliminating the first three, and requiring fewer iterations. For very large proposal efforts, more formal project-management systems and additional stages and iterations are being used. In recent years, integrated product development (IPD) concepts, including concurrent engineering and stage-gate concepts, have gained wide acceptance for managing more complex, large proposal efforts with the primary objective of reducing project cycle time. Each of the eleven phases is briefly described below.

Categorical Outline

Whether managed by storyboarding or conventional methods, the first step in the proposal process is the development of a categorical outline. This is a listing of the major topics or chapters to be covered in the proposal. The outline should also show, for each category, the following information: responsible author, page estimate, and references to related documents. The categorical outline can often be developed before the receipt of the RFP, and should be finalized at the time of proposal-writing kickoff. A sample categorical outline is shown in Table 12–4 for a typical technology system proposal, subdivided into three major sections or volumes: (I) Technical, (II) Management, and (III) Cost.

Synopsis of Approach

A synopsis is developed for each proposal category by each responsible author. As an alternative, the proposal manager can complete these forms and issue them as writing guideline to each of the responsible authors. This approach works especially well for developments that have a professional proposal support group. These synopses can further be used as a basis for technical brainstorming and search for innovative solutions. The synopsis is a top-level outline of the proposed approach to be articulated in each category. At the minimum, the synopsis should address three questions for each of the categories:

1. What does the customer require?
2. How are we planning to respond?
3. How is the approach unique and effective?

Table 12–4 Categorical Outline for Technology System Proposal, Subdivided into Three Sections

Section I Technical Proposal	Section II Management Proposal	Section III Cost Proposal
1. Executive summary	1. Executive summary	1. Executive summary
2. Problem statement and analysis	2. Management commitment	2. Scope of work and cost model
3. Recommended solutions	3. Recommended solution	3. Contract type
4. Alternate solutions	4. Statement of work	4. Cost summary by workgroups
5. Scope of work and limitations	5. Work breakdowns	5. Cost escalation
6. Method of approach	6. List of deliverables	6. Taxes
7. Detailed solutions Subsystem I Subsystem II Subsystem III	7. Project organization	7. Subcontracting
8. Prototyping	8. Task responsibilities	8. Progress payments
9. Field installation, testing	9. Project management process	9. Options
10. Specifications	10. Project tracking and reporting	10. Basis of cost estimate, and assumptions
11. Reliability assessment	11. Project control	11. Liabilities
12. Maintenance	12. Make-buy analysis	12. Overhead rates
13. Training	13. Subcontracting	13. Support facilities
14. Risk analysis	14. Quality control	14. Assurances for cost-effective contract work
15. Related experiences	15. Qualifications of key personnel	15. Detailed cost schedules
16. Appendix	16. Contractor qualifications	16. Appendix
17. Index	17. Appendix	17. Index
	18. Index	

The typical synopsis of approach format is an 8-1/2 × 11″ sheet of paper, subdivided into six sections:

1. Proposal category and responsible writer
2. Objective to be communicated within this proposal category
3. Understanding of customer requirements
4. Proposed approach and compliance
5. Soundness of approach and effectiveness
6. Risks, alternatives, and options

In preparation for the review, the categorical outline and completed synopsis forms are posted on a wall in sequential order. This method of display facilitates effective open group reviews, analyses, and integrated proposal development.

Roundtable Review

During this phase, all synopsis forms are analyzed, critiqued, augmented, and approved by the proposal team and its manager. This is the first time that the proposed approach is displayed in a complete and continuous summary form. In addition to the proposal team, key members of functional support groups, such as technical resource managers, marketing managers, contract specialists, and upper management, should participate in this review. The review typically starts four days after the proposal kickoff.

Topical Outline

Concurrent with the review and revision of the synopsis, or shortly thereafter, the categorical outline is expanded into the specific topics to be addressed in the proposal. This topical outline becomes the table of contents for the bid proposal. The number of pages needs to be estimated for each topic, and references to other documents should be made. Similar to the categorical outline, a responsible individual should be assigned for each topic.

Storyboard Preparation

Storyboards are expansions of each synopsis according to the topical outline. All storyboards put together represent the complete bid proposal in summary form. Preparation is straightforward. Typically, a one-page storyboard is prepared for each topic by the responsible writer. As shown in the list below, the storyboard represents an outline and content summary of the author's approach to the write-up for a topical module. Often the storyboard template (A-size form) is divided into the following four parts:

1. ***Writing guidelines (given by proposal manager):*** Proposal category, topic, objective and proposal address; responsible writer and due date
2. ***Theme section (given by proposal manager):*** Tone and emphasis of this proposal topic
3. ***Text summary (to be prepared by responsible writer):*** To be developed in blank space on *left side* of form
4. ***Illustration summary (to be prepared by responsible writer):*** To be developed in blank space on *right side* of form

The storyboard takes a first cut at articulating the key issues and proposed solutions for each topic. The lead-in statement and conclusion should be written in detailed draft format, as they are intended for the final text. Storyboard text must be relevant, responsive, logical, and emphatic to be useful for final proposal text development. Sophistication of expression is important.

If done properly, the completed storyboards can be given to a professional writing team for storyboard expansion, the final composition and editing effort. Storyboards are one of the most important elements in the proposal-development process. They should be typed for clarity and easy comprehension, hence ensuring effective review sessions.

Storyboard Review

The completed storyboard forms are pasted on the walls of the review room in a logical sequence, together with the earlier displays of outlines and synopses. The set of storyboards is in essence the bid proposal. It presents the complete project plan, that is, the total story the contractor wants to tell the customer.

Typically, storyboard reviews should start within eleven working days after the proposal writing kickoff. The reviews should be held in the same room that has been established as a control and display room for the ongoing proposal development. All storyboards are displayed on the walls. Reviews should be attended by the entire proposal team, including the acquisition-management group, authors, and key members of the resource support functions. The storyboard review permits a dialogue among the author, the proposal team, and its management. For very large proposals, it may be impractical to bring the whole proposal team together in one meeting, but it may be necessary to review storyboards in categorical modules. This increases the challenge for the proposal manager of developing a fully integrated, seamless document. Professional proposal-development teams, such as proposal specialists, professional writers, and consultants, can provide useful resources in these more complex situations.

The storyboard review provides the team with the single most important opportunity to change approaches or direction in the proposed bid. It provides the team with an integrated overview of the proposed work and a forum for collectively deciding what material to insert, modify, or eliminate. Like the synopsis review, storyboarding is an interactive process. During the reviews, a copy of the latest storyboard of the entire proposal should be on display in the control room.

Storyboard Expansion

After the storyboard review, each author prepares a storyboard expansion. Storyboard expansion is the development of each topic from the original storyboard into a narrative of approximately 500 words. As part of the storyboard expansion, all authors finalize their art work and give it to the publications specialist for processing. This is the first draft of the final proposal. The material is given to the technical editor, who will edit the draft for clarity. Each responsible author should review and approve the final draft, which might cycle through the editing process several times.

This final text generation is the major activity in the proposal-development process. All prior activities are preparatory, yet incrementally cumulative to this final writing assignment. If preparations are done properly, writing the final text will be a logical and straightforward task without the need for additional technical clarification and worries about integration with other authors.

As a guideline, 10 working days out of a thirty-day proposal-development cycle may be a reasonable time for this final text generation. Because of its relatively long duration, it is particularly important to set up specific milestones for measuring intermediate progress. The process of final text generation should be carefully controlled. The proposal specialist, copyeditor, and other internal consultants, if available, will play a key role in the integration, coordination, and controlling of this final text generation and its publication. The final text should be submitted incrementally to the publication department for editing, processing, art preparation, and final integration.

Staff Review
The final proposal review is conducted by the proposal team, its management group, and selected functional managers. In addition, a specialty review committee may be organized to fine-tune the final draft for feasibility, rationale, and responsiveness to the RFP. Typically, this staff review is completed in less than a day. The comments are reviewed by the original authors for approval. The staff review can be repeated if necessary.

Final Proposal Draft
Each author finalizes his or her section of expanded storyboards, incorporating the staff review, comments, and recommendations.

Final Edit
After the final revision, the entire proposal is turned over to the publication department for copyediting and final layout. The authors should be given a last opportunity to look at the completed proposal in its final form. Any major flaws or technical errors that may have slipped into the document are corrected at this time.

Publication and Delivery
The proposal is now ready for, printing, binding, and delivery to the customer.

Negotiating and Closing the Contract

Sending off the bid proposal signals the start of the postsubmission phase. Regardless of the type of customer or the formalities involved, even for an oral proposal, the procurement will proceed through the following principal steps:

1. Bid proposals delivery and verification
2. Proposal evaluation (by customer)
3. Proposal values competitively compared (by customer)
4. Alternatives assessed (by customer)
5. Clarifications solicited from bidders
6. Proposal ranking by value
7. Negotiations
8. Source selection and contract award

Although bidders have no direct influence on the proposal evaluation or source-selection process, they can prepare for upcoming opportunities of customer inquiries and negotiations. Depending on the type of procurement, opportunities for improving the competitive position come in many forms, such as:

- Follow-up calls and visits
- Responses to customer requests for additional information
- Fact-finding requested by customer
- Oral presentations
- Invitations to field visits
- Samples or prototypes
- Supportive advertising
- Contact via related contract work
- Plant or office visits
- Press releases
- Negotiations

Postsubmission activities can significantly improve the bidder's competitive position. Any opportunity for customer contact should be used. Follow-up calls and visits are effective in less formal procurements, whereas fact-finding and related contract work are often used by bidders in formal procurements. Many companies use the bid-evaluation period to conduct postproposal reviews, trying to emulate the customer's evaluation process. Although the bidding company mounted an outstanding effort and prepared the best proposal document possible within the given time and resources, this postreview can provide valuable additional insight into the strength and weaknesses of the submitted proposal. This insight provides the basis for clarifications, corrections, enhancements, and image-building during the upcoming postsubmission period.

The proposal-evaluation period is highly dynamic in terms of changing scores, particularly among the top contenders. Only through active customer contact is it possible to assess realistically the competitive situation and improve the emerging proposal score. The bidder who is well organized and prepared for interacting with the customer community stands the best chance of being called first for final contract negotiations.

Recommendations to Management

Winning contracts involves more than just price, market position, or luck. Winning a piece of new business via bid proposals depends on many factors that can be controlled by management, at least to some degree, during the acquisition process. Successful contract acquisitions start with a keen assessment of the bid opportunity and a sound bid decision, followed by significant homework during the pre-RFP period, intense efforts at developing a responsive and unique bid proposal, and postsubmission customer interactions.

While aggressive pricing is important and can win certain contracts, research shows that for most solicitations, a low price bid is advantageous primarily for contracts of low complexity and modest technical risk. In most other situations, price is a significant factor toward winning, but only within the context of many other competitive components, including compliance with customer requirements, unique best-fitting solution, past experience, soundness of approach, cost credibility, delivery, and after-sale support. The better a firm understands its customer, the better it will be able to communicate the value of the proposed solution and the strength of its organization in performing under contract. The following recommendations can help business managers and bid proposal professionals in preparing their organizations for effectively competing for new contract acquisitions:

- ***Develop a detailed business acquisition plan*** that includes a realistic assessment of the new opportunity with specific milestones.
- ***Form a committee of senior personnel,*** ensuring that the right people become involved early in the acquisition cycle.
- ***Maintain close contact with the customer community,*** trying to understand the customer requirements well and to develop credibility regarding the ability to perform.
- ***Select bid opportunities carefully.*** Submitting more proposals does not necessarily improve your win ratio, but most certainly will drain your resources.
- ***Be sure you have the resources to go the full distance.*** Up-front, develop a detailed cost estimate for the entire proposal effort. Decide what to do in case the customer extends the bid-submission deadline, which will cost additional money for the extended proposal effort.
- ***Obtain commitment from senior management.*** Make the necessary resources and facilities available when needed.
- ***Gain competitive perspective.*** Before starting the proposal writing, ensure a clear picture of strengths, weaknesses, and limitations of all competing firms relative to your position. Gather marketing intelligence from trade shows, bidder briefings, customer meetings, professional conferences, competitor's literature, and special market service firms.
- ***Take a project-oriented approach.*** Plan, organize, and manage your proposal development as a *project.*
- ***Use proposal specialist.*** Enhance the effectiveness of the proposal effort with a professional proposal specialist.
- ***Cultivate your "unfair advantage."*** Define your market niche by understanding and exploiting your company's strength relative to your competition, and focus your win strategy on this ''unfair advantage.''
- ***Use a storyboard process*** to develop your proposal text incrementally.
- ***Don't allow exceptions to customer requirements*** unless they are absolutely unavoidable.

- ***Demonstrate your ability to perform.*** Focus on past related experiences that will score the highest points. Showing that your company performed well on similar programs, you have experienced personnel, and you have thoroughly analyzed the requirements will score favorably with the customer and enhance the value of other advantages such as an innovative solution, streamlined schedules, or competitive pricing.
- ***Review proposal effectiveness.*** As part of the incremental proposal development, ensure effective reviews, checking compliance with customer requirements, soundness of approach, effective communication, and proper integration of topics into one proposal.
- ***Use red-team reviews.*** Set up a special review team, especially for ''must-win'' proposals. This review team evaluates and scores the proposal, emulating the evaluation process used by the customer. Deficiencies that may otherwise remain hidden can often be identified and dealt with during the proposal development. Such a review can be conducted at various stages of the proposal development. It is important to budget the time and money needed for revising the proposal after a red-team review.
- ***Use editorial support.*** Have a professional editor work side by side with the technical proposal writers.
- ***Price competitively.*** For most proposals, a competitively priced bid has the winning edge. Pricing should be considered at the time of the bid decision.
- ***Prepare for customer inquiries and negotiations*** immediately after proposal submission.
- ***Conduct post-bid analysis.*** Review the proposal effort regardless of the final outcome. The lessons learned should be documented for the benefit of future proposal efforts.

Taken together, winning new contract business competitively is a highly complex and resource-intensive undertaking. To be successful, it requires special management skills, tools, and techniques that range from identifying new bid opportunities and making bid decisions to developing proposals and negotiating the final contract. Companies that win their share of new business usually have a well-disciplined process that is being fine-tuned and improved continuously. They also have experienced personnel who can manage the intricate process and lead the multidisciplinary team through the complex effort of developing a winning bid proposal. Successful companies target specific bid opportunities very selectively, using careful judgment in the bid decision-making. They position their enterprise uniquely in the competitive field by building a strong image of a contractor well qualified to perform the required work, and by exploiting their strengths. Finally, winning proposals are fully responsive to the customer requirements and are competitively priced. Winning new contracts in today's continuously changing word of business is not an easy feat. No single set of broad guidelines exists that guarantees success. However, the bid proposal process is not random! A better understanding of the customer criteria and market dynamics that drive contract awards can help managers in fine-tuning their acquisition processes and organizational support systems and will therefore enhance the chances of winning new business via bid proposals.

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Chapter

13

Techniques for Managing Project Risk

Guy M. Merritt and
Preston G. Smith

Biographical Sketch . . .

Guy M. Merritt, has extensive experience in leading project management efforts with product development teams. His pragmatic approach to project management consistently receives high praise from various industry sources and he is a much sought after conference speaker on topics ranging from developing R&D productivity measures, aligning metrics to company strategy and risk management. Guy has a B.S. degree from Herzing College and he is the coauthor of *Proactive Risk Management.*

Preston G. Smith, as a principal with the consultancy New Product Dynamics, has pioneered in helping dozens of companies in 20 countries to develop new products faster and more effectively. A major part of his work has been in identifying and mitigating the project risks that lead to schedule surprises. Preston is coauthor of *Proactive Risk Management* and several articles on project risk management. Before becoming a consultant in 1986, he served as an engineer and engineering manager for 20 years. He holds an engineering Ph.D. from Stanford University and is a Certified Management Consultant.

In the context of a project, *risk* is defined as the possibility that an undesired outcome—or the absence of a desired outcome—disrupts your project. *Possibility* is an important word in this definition, because risk is always connected with uncertainty. If something is certain to occur, we call it an issue instead of a risk. Issues are just as important as risks, but since they are managed differently, we separate them at the outset.

Consequently, risk management is a set of techniques for controlling the uncertainty in a project. Depending on the type of disruption that concerns you, the uncertainty could be reflected in project expense growth, schedule

 Field Guide to Project Management, Second Edition. Edited by David I. Cleland

slippage, lack of quality in the deliverables, or deliverables that fall short in some other way, such as being too expensive.

Apart from project management, risk management is often associated with the insurance industry. In fact, risk management is sometimes a synonym for insurance. This connection provides some valuable insights about project risk management. For example, project risk management is not free. Just like insurance, you pay for it, but it yields benefits in reducing uncertainty. In general, the higher the "premiums" you pay, the greater the "coverage" you receive in terms of reducing uncertainty, but there is a point of diminishing returns. The balance between the premiums you are able to pay and the coverage you desire to receive is a matter of judgment, tempered by your tolerance for risk. It is important to discuss this balance openly and arrive at one that is comfortable for your organization.

Risk is inseparable from opportunity, and this is also important to keep in mind constantly. If you manage risk inappropriately, you can drive out the opportunity you seek in your venture. This is very important in projects that depend on innovation, such as product development: a risk-free project is a sure route to a me-too product. Consequently, risk management is not a matter of driving out all risk, but rather one of understanding the risks the project faces and choosing to avoid some of them and turn others in your favor.

As you can see from the insurance viewpoint and from the opportunity viewpoint, project risk management is a constant balancing act.

Principles of Effective Risk Management

Here we cover some general principles of effective project risk management that pervade the chapter. Please keep these in mind as you read on, because they will help you to place emphasis where it is needed. Our experience with project risk management is mostly related to product development projects, so our treatment and our examples may be biased somewhat in this direction. This is actually advantageous, because product innovation is a demanding application of risk management.

When managing the risk in a project, you should look at the project broadly. Usually, an appropriate perspective is that a risk is anything that will keep the project from achieving its business objectives. The tendency is to view it more narrowly from a functional perspective. Then you not only miss the risks that could occur in other functions, but you also miss more subtle ones that could arise between functions. For example, in product development, engineers normally complete most of the project, so it seems natural to let engineering be responsible for risk management. When this happens, the engineers will typically focus only on technical risks, missing market, scope, supplier, resource, and management risks that are actually more likely sources of business failure.

This implies that a cross-functional team must conduct all parts of risk management—especially the risk identification step. Sometimes you should look even beyond the functions that are usually involved in the project. For instance, we once conducted a risk management session for a new product that was the company's first one aimed at the consumer market (they had made only professional tools). This firm was concerned about product liability risks when amateurs used their equipment. Consequently, they included a corporate lawyer in their risk management group.

Another earmark of good project risk management is that it is proactive. That is, you seek to identify the risk and plan how you will deal with it *before* it occurs. Often it is advantageous to plan your responses long before the risk might occur. As you will see when we describe the action-planning step, the actions you can take against a specific risk usually become fewer and more expensive the longer you wait. Unless you are proactive, not only will some preventable risks occur, but others will also be more difficult and expensive to deal with.

Finally, your project risk management should be based on facts. This may seem obvious, but because risk has so many emotional undertones, it is essential in managing a risk on a rational basis to base it as solidly as you can on the facts that support it. Although people may prefer to sweep the risk itself under the carpet, they are more willing to discuss the facts behind it. Also, using the facts makes it easier to quantify the risk's seriousness, which is essential in balancing the risk's potential consequences against the cost of mitigating it.

We use a tool that will help you base your risk on its facts. We call it the standard risk model (this model, as well as the rest of this chapter, is covered in detail in Smith and Merritt).[1] The model appears in Figure 13–1. We will

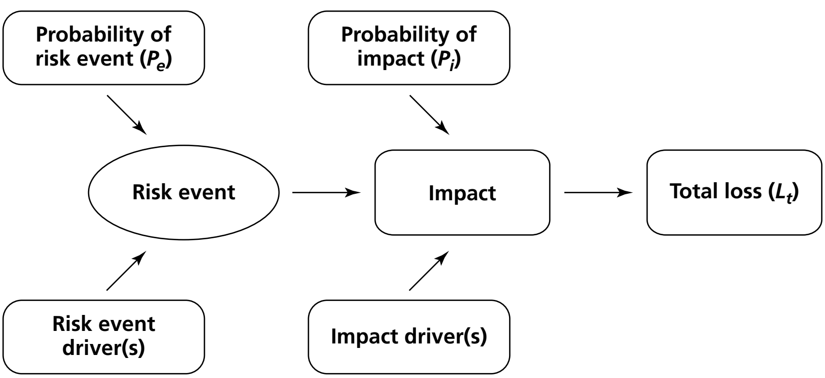

Figure 13–1 The Standard Risk Model. This model helps you to understand the components of a project risk and base it on facts that support it

Source: Adapted from Fastrak Training Inc. training material. Used with permission. © 1996 outline its elements here, and you will see how it is applied as we employ it in a case study that runs through the five risk management steps later.

The starting point of the model is the *risk event*, which is the happening or state that triggers a loss. It leads to the *impact*, which is the consequence or potential loss that might result if the risk event occurs. The *total loss* is closely tied to the impact; it is the magnitude of the actual loss accrued when the risk event occurs. The *drivers,* at the bottom of the figure, are the facts in the project environment that lead one to believe that the risk event or the impact, respectively, could occur. Finally, both the risk event and its impact have probabilities of occurrence associated with them, as shown at the top of the figure.

We will describe the risk management process by using this model, so you will see, as we work through the case study, how the pieces of the model fit together to provide a complete picture of a risk that guides you naturally toward means of mitigating it. The model offers several benefits:

- It separates the risk event from its impact, which clarifies cause and effect and thus helps to focus action plans.
- It encourages quantifying total loss, which is advantageous when prioritizing risks in a project.
- Perhaps most importantly, it facilitates basing the risk on its facts (drivers), which allows the team to discuss it more objectively and reach consensus faster in dealing with it.
- It naturally divides action plans into useful groups, so that action planning becomes more complete and methodical.

Step 1: Identify Risks

We divide the risk management process into five steps, and here we will guide you through these steps by both explaining them and illustrating them with a running example of a risk we managed recently. There is nothing special about these five steps, and indeed, if you consult other authors on this subject or organizations devoted to it, such as the Project Management Institute,[2] the U.S. Department of Defense,[3] or the Software Engineering Institute,[4] you will find a somewhat different process. What matters is that certain vital activities occur, so watch for them and ensure that they are carried out well in your process. In contrast, we believe that our risk model adds a great deal of value to the process, and we know of no other author or organization that does anything similar. Consequently, pay particular attention to how we employ the model.

PREPARATIONS

You should invite a diverse group to participate in this first step, for two reasons. First, you will need a cross-functional perspective in order to uncover the variety of business risks you seek (recall our earlier example about inviting the corporate lawyer). It will be easy enough to eliminate inappropriate risks later, but you must get them on your list first. Second, this is where the very important phenomenon of ownership begins. Ultimately, in order to obtain action against your most important risks, certain individuals will have to believe in them wholeheartedly and appreciate their nuances. The individuals who will be expected to take action against the risks should therefore be involved now to start building this ownership in the outcome.

Now that you have an eclectic group, you will need a skilled facilitator to lead them through the process. The facilitator should know something about the risk management process and the project at hand, but the primary requirement is skill in drawing ideas from a diverse group and balancing the discussion. The facilitator should *not* be a major participant in the project, such as the project leader. A major player is likely to have too much of a stake in the project, which can lead to bias. Also, the major players should be devoting full mindshare to identifying risks, not running the meeting. Such a facilitator could be a senior member of another project, someone from your human resources or training department, or a consultant specialized in this field.

Make sure certain logistics are in place. You will need a room isolated from day-to-day activities and with plenty of usable wall space. Flipcharts, markers, sticky notes, whiteboards, and overhead transparencies will be needed to capture and share the risks. Finally, prepare a spreadsheet on a portable computer that can be used to record your risks. See Smith and Merritt for details on spreadsheet format.[5]

WAYS OF FINDING RISKS

There are several frameworks you can use for identifying risks. For a given project, we suggest that you pick two of them for thoroughness, one relatively specific to the needs of your project and the other intentionally broad to highlight risks that the narrower approach may miss. Here are some possibilities.

- ***Schedule-based.*** We tend to work on projects in which meeting an aggressive schedule is paramount. In this case, you can post a top-level project schedule (one that includes the activities of all organizational functions) and proceed through it phase-by-phase or activity-by-activity to precipitate risks.
- ***Process-based.*** Many important but subtle risks occur at organizational interfaces. If you have a process diagram for your project that shows how work must flow between organizational units (including outside units), you can use it to prompt risks. The facilitator simply works through it piece by piece.
- ***Work-breakdown structure-based.*** Work-breakdown structure (WBS) is a basic tool of project management (see Chapter 8). Once you have a work-breakdown structure for your project, you can use it to find project risks. However, be aware of a couple of limitations. One

is that there are various architectures for building a WBS, such as organization-based or product subsystem-based, and these will lead you to different risks; that is, the type of WBS you use will flavor the risks you find. Second, WBS tends to be a rather technical approach to project management, so there is likely to be a technical bias to the risks found.

- ***Success-thwarting.*** This is a general-purpose one. First, you reverse your perspective and identify approximately a half-dozen indicators of success for your project, such as a certain profit margins, success in a specific market, or a low level of customer complaints. Post these success factors, then ask the group what might stand in the way of achieving this picture of success.
- ***Prompt list-based.*** After you have been doing project risk management for a while, you will notice that certain types of risks specific to your business keep appearing. By capturing these and organizing them, you can create a list that you can post and use to prompt risks for the current project. Clearly, this technique will work best for a project that fits your project pattern well.

RECORDING YOUR RISKS

Regardless of the framework used to identify your risks, risk identification is essentially a brainstorming activity, so media such as sticky notes are handy for capturing each risk as it arises. Then you can easily organize them into clusters, eliminate duplicates, and combine similar ones. Referring to the risk model, for each risk you should capture both its risk event and its impact on the sticky note. After you have organized your risks, transfer the risk-event/impact pair for each risk to either a copy of the risk model or to your spreadsheet.

WHEN TO DO RISK IDENTIFICATION

Because project risk identification interacts with other parts of project planning, there is no ideal time to identify project risks. If you identify your risks too early, you will not have enough information specific to that project, so you are apt to imagine phantom risks with little basis in this project. On the other hand, if you wait until you have completed project planning, the risks you identify may then be serious enough that you will have to revise the schedule, budget, or tasks to accommodate the risks. Consequently, the best solution is to initiate project planning, then complete the initial steps of risk management (including risk identification), and finally update your project planning in light of the risks you face, as shown in Figure 13–2.

CASE STUDY BACKGROUND

To illustrate how the model and the process help you to manage a project risk, we provide a case study. This example comes from an actual project, although some names and the type of product have been disguised. Our

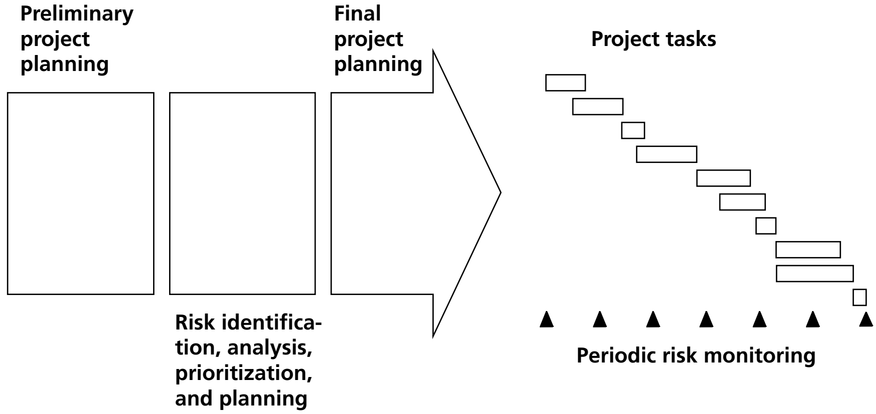

Figure 13–2 Activities specific to risk management are shown at the bottom, and other project activities are listed at the top. During the project front end, the initial steps of risk management occur after initial planning but precede final planning, and during subsequent task execution, the risk-monitoring step occurs periodically

project manager, Kim, has been assigned responsibility for delivering a prototype piece of equipment to a customer site for test and evaluation.

Kim's company develops and manufactures professional camera equipment. This new camera model has been in development for 18 months and incorporates multiple lenses along with sophisticated digital processing to produce an adjustable, wide-field image of up to 180°. For this specialized application, the company is targeting markets such as surveying and real estate companies, billboard advertisers, tradeshow companies, and print media. New technology introduced in this camera for the first time allows a significant price reduction relative to alternative solutions.

The product development team has received strong market interest in the product; however, most prospects are hesitant to purchase due to the new technology. Thus, a billboard advertising company has requested that a demonstration unit be delivered to them for test and evaluation.

IDENTIFYING CASE STUDY RISKS

Kim has been tasked to arrange and coordinate all activities regarding this customer test and evaluation (T&E). He assembled a cross-functional team to plan support for this T&E, and one of their first tasks was to develop a schedule specifying the dates and resources needed to acquire the equipment, develop the test plan, ensure that all nondisclosure agreements are in place, and stage the equipment prior to shipment.

Using the schedule-based approach mentioned earlier, the team conducted a risk identification workshop by reviewing each phase of the project to identify any potential risk events that could disrupt the T&E. They identified fifteen risks.

One of these risks was that the prototype camera could be damaged during shipment. We will use this risk with each step of the process to demonstrate how the risk management techniques are applied. As the team discussed this risk to determine what its impact would be, they decided to review the request for proposal (RFP), which stated that this customer would commit to purchasing $15,000,000 worth of equipment over the next three years, contingent upon a successful test and evaluation of a multiple lens camera. Kim's business unit expects a 45 percent gross profit margin for specialty camera equipment. Using the gross profit margin from the RFP potential, the team determined that if the prototype equipment were damaged and the T&E could not be completed successfully by the required date, the impact would be a $6,750,000 opportunity loss.

Thus, Kim identifies this risk as

Risk event. Prototype camera may be damaged during shipment to customer test and evaluation (T&E) lab.

Impact. If the July 14 start date for the T&E period is delayed, our customer will select our competitor, which will cause us to lose a three-year contract worth $6,750,000 gross profit margin.

Step 2: Analyze Risks

Risk analysis is perhaps the most time-consuming step, and it should be done well, because it is the foundation for all that follows. If you produce a clear analysis, the rest of the process falls into place naturally with the help of the risk model.

The objective of risk analysis is to place facts under each risk to support it. These facts, which we call drivers, help you assess how serious the risk is. Drivers can make the risk either more or less serious. For instance, if the risk that concerns me is making a spelling mistake in this manuscript, then a driver that I lack a dictionary will increase this risk's likelihood, but a driver that that the spelling checker is active will decrease the chance of misspellings.

Please refer to Figure 13–1 (the risk model). In the risk identification step, you filled in the risk event and the impact boxes. During risk analysis, you will fill in all of the other boxes. Because the drivers support the information in the remaining boxes, you should complete in the drivers first, then use them to complete the other boxes. In fact, if you have difficulty in completing the other boxes, consider whether some additional drivers might help you fill in the model and thus understand the risk better.

Normally, you complete the model for one risk before proceeding to the next one. Within a risk, the preferred sequence is to list the risk event drivers first, then use them to estimate the risk event's probability. Then proceed likewise for the impact drivers and probability of impact. Finally, estimate the total loss from your drivers.

For a given risk, you might have only a couple of risk event or impact drivers, or you might have dozens of each. As you proceed later, you should be alert to adding more drivers that might help you understand—thus manage—the risk better. You can never have too many drivers, because they put the risk on a factual foundation and help the team to reach consensus on how the risk should be handled. Otherwise, there are likely to be a multitude of opinions and no concerted action against the risk. In short, focusing on the drivers rather than the risk itself moves the discussion to a more objective level that leads to action.

Once the risk model is complete for a risk, you should calculate its expected loss from the quantities in the model:

$$L_e = P_e \times P_i \times L_t$$

The expected loss, L_e, is an overall measure of the seriousness of this risk, which is used in the next step to prioritize the project's risks. It is important to understand what this formula is saying. The total loss, L_t, is loss you would suffer if the risk and its impact happened. However, risks are uncertain, so they will only happen sometimes. The probabilities, $P_e \times P_i$, tell you what the chances of it happening are. Thus, expected loss is the total loss tempered by the chances of it happening. It is the loss you would expect, on average, from such a risk. Its main value is to compare this risk against others for the project to help you decide which ones you will devote effort toward mitigating.

There are many details involved in risk analysis that we do not have space to cover here. For example, should total loss be expressed in monetary terms, lost time, or, indeed, can you simply use high, medium, and low as loss ratings? How do you estimate the probabilities? Please see Smith and Merritt for these details.[6]

ANALYZING CASE STUDY RISKS

Now that Kim's team has determined the risk event and the impact, they are ready to do a "deep dive" into the risk to determine the facts, or risk drivers, that lead them to believe that this risk could occur.

The team discovered these risk event drivers:

1. Previous prototypes that have been delivered from the prototype manufacturing line have arrived damaged at customer sites 75 percent of the time.
2. The packaging material used by the prototype manufacturing line is different than the type used by the regular manufacturing line.
3. Current equipment shipper was selected solely based on their bid, which was significantly less than previous shipper.

After they listed the risk event drivers, the team evaluated the facts and estimated that P_e should be set to 0.75 (75 percent) using their expert judgment.

Next, the team listed the impact drivers:

1. Our customer has already completed evaluation of our competitor's product, and it has been deemed acceptable.
2. Our customer has committed to their executive management to replace their entire camera inventory no later than September 8.
3. Our customer has issued a request for proposal (RFP) that is worth \$15,000,000 over three years.

The team must now estimate the probability of impact, which is the probability of suffering the total loss, L_t, if the risk event occurs. They decide to set P_i to 1.0 (100 percent), since they were extremely confident they would lose the business if the prototype equipment arrived damaged, because the test and evaluation would not be completed on time.

The total loss is easy in this case, because it is stated right in the impact statement: \$6,750,000.

Finally, they calculate the expected loss. Recall that the expected loss is calculated by multiplying the risk event probability, impact probability, and total loss together:

$$\begin{aligned} L_e &= P_e \times P_i \times L_t \\ &= 0.75 \times 1.0 \times \$6{,}750{,}000 \\ &= \$5{,}062{,}500 \end{aligned}$$

Figure 13–3 is a representation of the completed analysis.

Step 3: Prioritize Risks

This is easily the shortest of the five steps, but it is an important one. This is where you make the difficult choices of which risks you will devote effort toward mitigating. At this point, you probably have many more risks identified and analyzed than you can afford to manage actively. Recall the insurance analogy at the beginning of the chapter. You will not only have to choose the risks against which you will take action, but you will also have to decide which ones you knowingly will leave inactive in order to limit your ''premiums.'' Every hour that you devote to managing a risk is an hour that becomes unavailable for project tasks. Although such tough choices are uncomfortable, they are advantageous to the team. By consciously deciding not to manage a certain risk (and reporting this choice to management), you will be gaining management concurrence with your choices in case this inactive risk occurs later.

There are four substeps to prioritizing. First, you arrange all of your analyzed risks in order by expected loss. If you have entered them into a

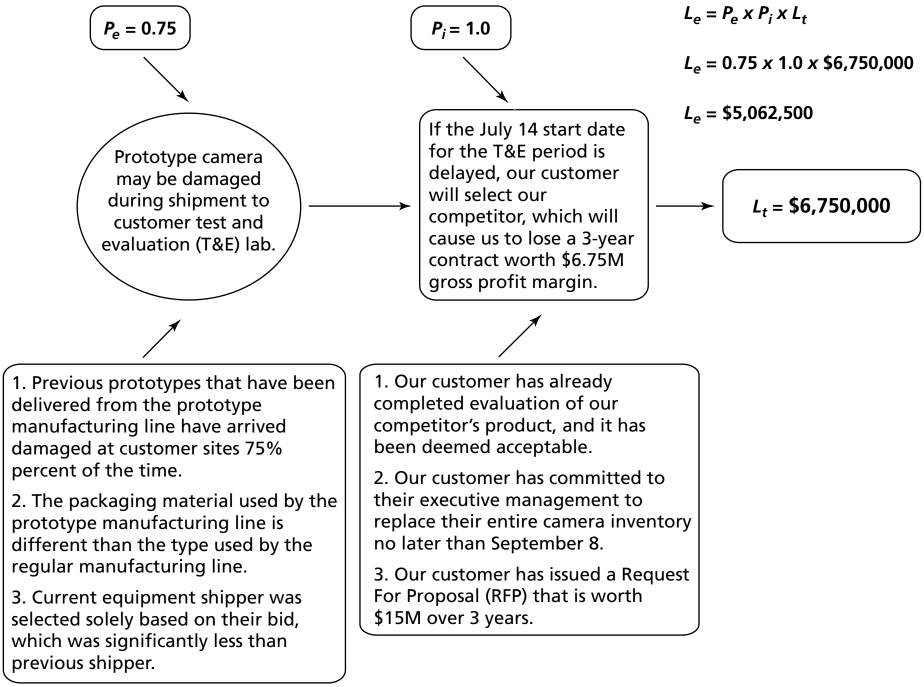

Figure 13–3 This risk illustrates the loss that could occur if a prototype camera is damaged during shipment. If the risk event occurs, the company could lose $6,750,000; however, the expected loss is $5,062,500

spreadsheet, you can do this is easily by sorting them on the expected loss column. Next, you build a risk map (see the next paragraph) so that you can see your overall risk picture for the project. Using this map, the team makes adjustments using its judgment (discussed later) to override the raw sort by expected loss. Finally, the team communicates its choices to management to gain the overall organization's concurrence to the types of risks managed and the overall level of risk assumed for the project.

A risk map (Figure 13–4) provides an excellent picture laying out all of the project's risks so that you can, as a team and in conjunction with management, ensure that you are covering your most serious risks. The risks that lie in the upper right corner of the map are the most serious ones, and the threshold line is a line of constant expected loss that roughly separates the risks above it that are actively managed from those below it that are only monitored. Smith and Merritt describe how to draw the threshold line.[7]

The risk map highlights risks that the team may wish to reassign according to their judgment. For example, a risk on the right side of the map is a catastrophic one that you may wish to actively manage regardless of its likelihood, because you cannot afford its consequences. This is analogous

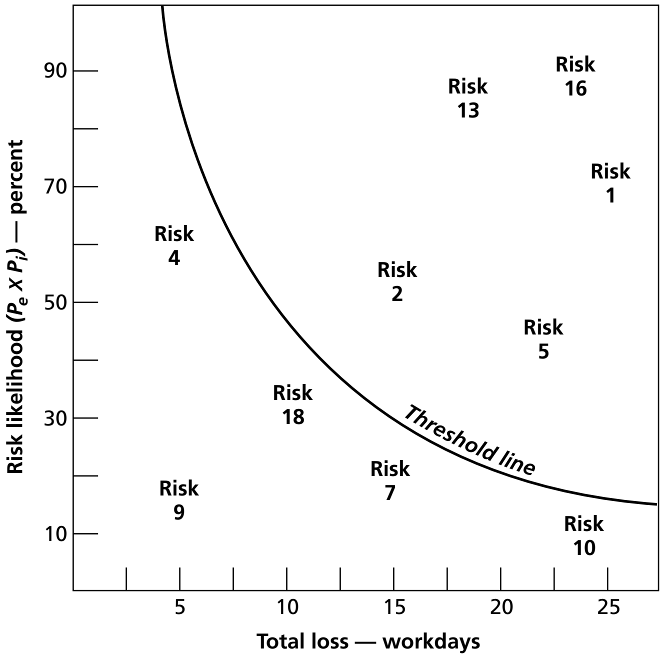

Figure 13–4 A risk map showing risks 1, 2, 5, 13, and 16 under active management and five more monitored candidates. Risk 10 could be considered a catastrophic one that the team also decides to manage actively

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to bodily injury coverage in automobile insurance. In contrast, a risk on the left side, independently of its likelihood, is one you can afford if it occurs—analogous to breakdown coverage in your automobile policy—so you can downgrade it to monitoring status. There are other strategic reasons for adjusting risks, for instance, a risk may affect the firm's reputation.

PRIORITIZING CASE STUDY RISKS

During the risk-identification workshop, Kim's team identified fifteen risks that could disrupt the upcoming test and evaluation. The team's next step was to prioritize these risks based upon their expected losses. They applied expert judgment regarding which risks to manage actively. Even though the number of risks being considered was small, the team decided to create a risk map that used the risk likelihood ($P_e \times P_i$) on the y-axis and total loss on the x-axis (see Figure 13–4). A threshold line on the risk map, which also suggested which risks should be managed actively, was used as a check on the prioritized risk list they had developed previously.

Step 4: Create Action Plans

This is where your drivers become valuable, because if they are complete and well stated, they lead you naturally to a robust set of action plans for resolving the risk. There are several different kinds of action plans, including avoiding, accepting, and transferring the risk. Here we describe only the two most common and powerful types of plan: prevention plans and contingency plans. For others, please consult Smith and Merritt, Project Management Institute, or Department of Defense.

Prevention plans are intended to reduce the probability that the risk event will occur, or reduce its impact if it does occur. With reference to the risk model, your risk event drivers prompt prevention plans. Normally, you simply proceed down through your list of risk event drivers and ask at each one what kind of action plan(s) it suggests. Some drivers will prompt multiple candidates for prevention plans, and some will not suggest any, for example, if the driver is a fact that cannot be changed. Seldom does a single prevention plan completely preclude the risk. If this is the case, you can add other prevention plans or plans of another type to reduce the risk's severity to an acceptable level.

Contingency plans deal with the risk after it has occurred to reduce its severity (although they must be planned and prepared for before the risk event occurs). Thus, contingency plans are less desirable than prevention plans, although they may be less expensive to enact. Interestingly, contingency plans are prompted by your impact drivers, just as prevention plans emanate from risk event drivers.

Moreover, the other types of action plans, such as avoidance and transfer, are also related to certain parts of the risk model, as shown in Figure 7–2 of Smith and Merritt. This is yet another benefit of using the risk model.

You will likely discover far more action plans than you need or can afford to implement. Consequently, you assess them on their cost effectiveness, that is, how much they reduce the risk's expected loss relative to what they cost to carry out. The cost can be calculated in monetary terms, effort (person-hours), or schedule slippage, whatever means the most to your project.

In general, each plan also has a trigger, that is, a time or condition at which it is implemented. For example, if you plan to prevent malaria on a trip to the tropics by taking antimalarial tablets, you need not actually start taking the tablets until you depart.

CREATING ACTION PLANS FOR CASE STUDY RISKS

The first set of action plans for Kim's project address changing the risk event drivers to decrease the probability that the risk event would occur. This is what we mean by being proactive—prevent the risk from occurring in the first place. After reviewing the first risk event driver, which was simply an historical statement of previous damage (see Figure 13–3), the team determined that one of the reasons equipment was being damaged was that those responsible for shipping were not adequately trained in proper packaging techniques; therefore, the prevention plan was simply to provide appropriate training. The second driver revealed that the packaging material used on the prototype manufacturing line was different than that used at the main production facility. (It turned out that the prototype line's packaging material was obsolete and they never were informed of the change. You can see that this opens a new line of investigation, which in fact was later pursued by the team.) Once again, a very simple prevention plan was to order the same type of packaging and to scrap the obsolete material at the prototype manufacturing facility. Regarding the third driver, the team decided that the total cost savings realized with this shipper, for all prototype shipments, was significant enough to warrant continuing to use them. However, the team did investigate previous shipments that were damaged, and they did not appear to be related to shipping and handling.

The second set of action plans deal with the unfortunate reality that some risks will not be prevented, even with the best prevention plans in place. Therefore, the team reviewed the impact drivers for possible actions to be enacted in the event that the risk event still occurs. The first impact driver dealt with the fact that the customer has already evaluated the competitor and deemed their solution to be acceptable. The team realized that their ability to change this driver was too limited to consider pursuing. They then evaluated the second impact driver to see what could be done. Kim's team learned that the entire inventory of older cameras was being replaced with this next-generation camera, which had to be completed by September 8. Apparently, the inventory replacement date was triggering the July 14 deadline. The team decided to ship spare prototypes in case one of the primaries failed, which would enable the test and evaluation to continue. The last driver was the key piece of data to allow the team to fully determine the total loss they could be facing. No contingency plans were needed to change this driver.

Step 5: Monitor Progress

The previous four steps are executed at the outset of the project, as explained in connection with Figure 13–2. In contrast, this one occurs regularly throughout the project, as indicated by the small triangles in Figure 13–2. How often is "regularly"? Our answer stems directly from the concept of proactivity: by managing project risks, you are trying to preclude problems with the project's budget, schedule, or outcome. Consequently, you should monitor your risks as frequently as you monitor project budget, schedule, or outcome.

Many tools are available for monitoring a project's risk, so you can choose one that fits you needs and style:

- ***Tracking list.*** This is simply a list of your active risks (the ones with action plans) for the project followed by the inactive (planless) ones, showing the current expected value for each one.
- ***Tracking chart.*** Here you create a thoughtfully formatted one-page chart for each project risk, for example, see Smith and Merritt.[8] Relative to the tracking list, this one has the advantage of showing much more detail for each risk, such as its prevention plans, but the corresponding disadvantage that you cannot see all of your project risks at once.
- ***Graphical tracking list.*** This one is like a tracking list but is portrayed as a chronological bar chart; see Smith and Merritt.[9]
- ***Risk map.*** Using a chart like Figure 13–4, you can add expected loss trend information by simply showing the trajectory of each risk on the map over time (for both active and inactive risks). You can add a legend that indicates the dates involved. This is an excellent portrayal to illustrate your progress to management; the goal for each active risk is to move it below the threshold line, and you can check your inactive risks to see that they remain below the threshold line.
- ***Risk dashboard.*** This is a collection of telling metrics for the project that illuminate various facets of your risk mitigation performance, much as a car's dashboard indicates the car's health by various measures. See Figure 8–6 in Smith and Merritt, and note that this dashboard is an aggregate that hides the status of any individual risk.

An important part of the ongoing risk-monitoring step is scanning for and processing any new risks that appear while you are working on the project. The project's environment is in constant flux, and you may also notice risks that had not been apparent before, for example, risks that occurred on sister projects. Any new risks you find should pass through mini-versions of steps 1–4 and then be treated the same as the older risks.

Conversely, as you monitor your risks, if you find ones that have passed below the threshold line (regardless of the monitoring medium you use), you should retire their action plans. This will conserve resources that you are putting into actively managing them, and it will keep your active list uncluttered so that you can see your currently most serious risks clearly.

MONITORING CASE STUDY RISKS

Kim takes the leading role in monitoring implementation of the action plans and will ultimately be the decision-maker for enacting the contingency plans, if needed. These action plans are entered into the project schedule and treated like any other task needed to complete the project.

Outcome: The team's efforts paid off: the equipment arrived undamaged after the prevention plans were implemented successfully. However, during the T&E period, one of cameras developed a latent defect that ultimately turned out to be related to a faulty component. The on-site test engineer had to bring in a spare to enable the T&E activity to continue. The testing was completed successfully and, after root cause analysis of the defective camera was provided to the customer, Kim's company was awarded the three-year contract.

Implementation Pitfalls

We close with a few cautions to keep in mind as you build your project risk management capability.

First, do not think of risk management as only identifying your risks (our step 1). Curiously, many project teams do this unwittingly, and it is worse than doing nothing at all. When the risks they had identified start occurring later but they had done nothing to preclude them, they are embarrassed. You gain benefit from the process only when the later steps are completed and your action plans take effect.

If you are applying this technique to product development, your team is likely to be dominated by engineers, and they have a tendency toward analysis. You do not need complex analysis, high-precision probabilities, or computer simulations of your risks in order to manage them well. Understanding your drivers and building consensus around the actions you will take are far more important.

Using the risk model, finding and stating drivers, and jointly understanding the terminology we have used (such as *expected loss*) do not come automatically. Plan to train your teams in these techniques and try the process out on a real project. Also plan to train management in the basics, or they are likely to argue with the model and your definitions of terms when they review your risk management results.

As suggested at the outset, risk management can never be perfect, and it can become quite expensive if you try to approach perfection. Think of it instead as a means to improve your odds and to choose the areas in which you wish to accept uncertainty. Viewed in this way, risk management can yield great rewards for what it costs you.

Finally, it should be clear by now that managing the risks in your project must be a cross-functional activity. Make sure that you maintain involvement from all key functions throughout, in particular with your ongoing risk identification and monitoring.

ENDNOTES

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2 Project Management Institute. *A Guide to the Project Management Body of Knowledge*. Newtown Square, PA: Project Management Institute, Inc., 2000
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4 Software Engineering Institute. *Software Acquisition Risk Management Key Process Area*, Version 1.02. CMU/SEI-99-HB-001. Pittsburgh, PA: Software Engineering Institute, 1999

5 Smith and Merritt, pp. 44, 122
6 Ibid., pp. 68–80
7 Ibid., pp. 90–91
8 Ibid., p. 124
9 Ibid., p. 126

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Chapter

14

Building the Foundation for Project Success—The Statement of Work*

Michael G. Martin

Biographical Sketch . . .

Michael G. Martin, PMP, is an internationally recognized consultant, speaker, trainer, and author with more than eighteen years of program and project management experience in the information technology and construction industries. During his career he has been instrumental in helping organizations in both the public and private sectors achieve excellence in program and project management worldwide. A certified project management professional, Michael is a frequent speaker to professional organizations, companies, and universities and has been published extensively on the subject, including his latest book, *Delivering Project Excellence with the Statement of Work* (Management Concepts, Inc., 2003). He has held numerous positions within the Project Management Institute (PMI), including past President and Chair of the Atlanta Chapter, PMP exam development committee member, and most recently as a member of the PMI Research Membership Advisory Group. Michael holds an M.B.A. from the University of North Florida and a B.S. in Civil Engineering from West Virginia Tech.

Research has shown that U.S. businesses and government agencies are losing billions of dollars annually on failed and mismanaged projects. Some of the fundamental problems contributing to these failures include lack of clear, specific, and detailed requirements; absence of a change-management processes; and the failure to communicate and coordinate the goals of cross-functional groups within the organization and with the client.

*This chapter is derived in part from Martin, Michael G. *Delivering Project Excellence with the Statement of Work*. Lawrenceville, GA: Management Concepts, 2003. This work may be purchased from Management Concepts at www.managementconcepts.com.

As a result, organizations are constantly searching for ways to manage projects more efficiently, productively, and successfully.

One method currently gaining a great deal of attention for counteracting this trend of project failures, particularly in the private sector, is the development and application of a detailed statement of work (SOW) on projects. Historically, the SOW has been used primarily in the government-contracting arena as part of the procurement process. However, in recent years the private sector has recognized the need for and importance of this document for planning and managing projects successfully throughout their life cycle. This chapter provides an overview of what the SOW is; its importance and benefits; when it should be developed; who should develop it; how it should be developed and applied on a project, including a brief discussion of the F3 methodology (foundation, framing, and finalizing); and how to use it in managing change to the project.

What Is the Statement of Work (SOW)?

If you were asked what document or tool in your project-management toolkit is most important for ensuring the successful completion and delivery of a project, what would your answer be? Would it be the project charter or the work-breakdown structure (WBS)? The project plan or the schedule? A customized project-management software package? An argument could be made for each of these; however, the true litmus test in determining the importance of each of these tools is to answer the question, If they weren't used, would it make a difference in the outcome of the project? Each of these can contribute to the success of the project, but they are secondary to the one document that establishes the contractual foundation of the project. That document is the statement of work (SOW).

The SOW is important in the management of a project, in that it provides the project team with a clear vision as to the scope and objective of what they are to achieve. Of the other tools, the one that comes closest in importance to the SOW is the work-breakdown structure (WBS). Although the WBS plays an extremely important role in developing the SOW, it does not carry with it the contractual obligation that the SOW does. As for the other project-management tools, if the objective and the scope of work to be performed are unknown or not clearly defined, then the project team will not have a clear understanding of what they are to do. In turn, developing a detailed project plan, schedule, or any other document based on an unknown scope is pointless.

Over the years, many aliases have been used to describe the SOW, including scope of work, needs assessment, design document, and even project charter. The frequent use of these misnomers clearly indicates a lack of project-management knowledge and the immaturity within private industry on a whole in managing projects.

In the government-contracting arena, standards for the SOW have been established and the definition of an SOW only varies slightly across agencies. The private sector, however, does not have a definition of the SOW that is used consistently within the industry, or for that matter even within an organization in some cases. The closest thing to an industry standard definition is that from the Project Management Institute's (PMI's) Project Management Body of Knowledge (PMBOK®). The PMBOK® defines a statement of work (SOW) as "a narrative description of products or services to be supplied under contract." This definition, however, is of limited use for the private sector, particularly for those in professional services. As written, it can be interpreted to mean only those products and services to be provided to the client; however, for those in professional services it should also encompass the needs and requirements of the contractor or service provider to properly perform the delivery of the products and services.

Therefore, it is proposed that the PMI definition of the SOW be expanded to reflect the needs of private industry today and in the future. As such, the proposed revised definition reads as follows:

> A narrative description of the products and services to be supplied to the client and the needs and requirements of the contractor to properly perform the delivery of such products and services under contract.

The proposed revised definition better reflects the importance of the SOW, from the perspective of both a client and the service provider. It is this definition upon which the rest of this chapter will be based.

Importance and Benefits of the SOW

The genesis of most project failures is in the initiation and planning phases. It is during this time that the foundation for the project is established, which will ultimately determine whether the project will succeed or fail. The foundational document for the management of projects is the detailed statement of work. Without a detailed SOW, you are managing a project with an unknown objective. This makes it difficult to determine what is to be accomplished, when you are finished, and what method will be used for measuring the success of both you and the project. You also have no baseline against which to measure progress or change (i.e. scope, cost, schedule, etc.). It is important to note that change is inevitable regardless of how good and detailed the planning is for the project. However, change, of and by itself, will not cause a project to fail, but rather it is an organization's inability to properly manage changes that will ultimately lead to its demise. In the absence of an established baseline or foundation (i.e., SOW) for a project, you will be left trying to manage change on an undefined and unknown scope.

Project failure is nondiscriminating and can occur in any industry and in any organization at any time. Reasons for failed and challenged projects include incomplete and changing requirements, scope creep, lack of executive support, lack of skilled resources, lack of client input, changing priorities, lack of planning, unrealistic schedule and reduced funding, just to name a few.[1] These are all valid concerns; however, I believe that the single most significant cause of project failure is the lack of a clearly defined and detailed statement of work.

You don't have to look far for reasons why you need an SOW for your projects. Evidence is provided every day on the nightly news on projects that have failed or been mismanaged to the tune of millions and sometimes billions of dollars. Typically, we only hear about the projects that are politically sensitive or in the public's eye. These are only the tip of the iceberg.

One particular engagement I am familiar with was losing approximately $50,000 per month providing IT support services to a client. The project consisted of providing support for shrinkwrapped software, network operating, and workstation operating system software and proprietary software for approximately 12,000 workstations and laptops. After a couple of months of losing significant revenue and profit, a project-recovery team was called in to determine the reason for these losses and recommend a corrective action plan.

The recovery team's first step was to meet with the members of the project team and perform due diligence on the project documentation. The recovery team found that a SOW had indeed been done for the project; however, it was poorly written and very broad in its definition of the work to be performed. It consisted of only five pages, four of which addressed the roles and responsibilities of the individual team members and stakeholders; only one page was dedicated to specifying the work to be performed.

Poor documentation and poor writing were only two of the things wrong with this SOW. To identify everything wrong with this document would require a full-blown case study. However, a couple of major errors that contributed to the genesis of this project failure require additional attention. First, there was no communication between the service provider and client during the development of the SOW, resulting in a SOW that did not provide a clear and detailed description of the services to be provided that was understood and agreed to by both parties.

For example, one section of the SOW stated that the service provider would provide break/fix support to the customer. That was it! Nothing more, nothing less. The problem was that the service provider intended break/fix to mean only support to hardware items, whereas the customer interpreted it to mean support to both hardware and software. It doesn't take a psychic to tell you that there's going to be problems on this project in the future. The service provider, in turn, had not staffed the engagement properly to account for the support of software calls. Thus, the technicians and help desk personnel were spending a large amount of time on calls they were not qualified to address. This resulted in significant financial penalties for not meeting the service levels agreed to for the other aspects of the project. The project was quickly becoming unprofitable. The service provider was reaching the point of having to decide whether to withdraw from the contract and cut its losses, or renegotiate the contract. The customer was also unhappy, as you might expect. However, they were willing to renegotiate the contract and revise the SOW.

The SOW was ultimately redrafted and expanded from 5 pages to over 50 pages. The revised version was very detailed and specific in the type of services to be provided to the customer, as well as the requirements the service provider needed to properly deliver the stated services. This project was ultimately turned around and very soon became profitable, bringing in over 30 percent in gross profit. However, most of the problems that occurred on this project could have been avoided if time had been taken up front to properly plan, document, and draft a detailed SOW.

David Maister identifies what he calls ''The First Law of Service'':[2]

$$\text{Satisfaction} = \text{Perception} - \text{Expectation}$$

In other words, if the customer perceives the level of service or work effort that they are receiving to be less than what they originally expected, then they are going to be dissatisfied. However, if the perceived the level of service is greater than what they expected, then they will be satisfied.

The SOW is the document that will help in ensuring that expectations are properly established with the client and that the project team doesn't commit to perform work they are incapable of performing. Having expectations properly established greatly increases the probability of the project team delivering to, and possibly above, what was expected of them. This, in turn, will equate to a higher client satisfaction rating.

Caution should be exercised, however, in trying to exceed client expectations. Service providers are sometimes focused so much on exceeding clients' expectations that they do work outside the scope of the project. Care should be taken to ensure that if work is done on a pro bono basis, it is documented and communicated to the client. Otherwise, any work done outside of the agreed-upon scope should be handled as a change and billed appropriately.

The benefits of having a detailed SOW on your project can be enormous. They include:

1. The basis for responding to a request for proposal (RFP) and negotiations
2. The basis for determining the price of the project
3. The baseline upon which change (i.e., scope, cost, and schedule) is measured
4. The baseline to measure when work is satisfactorily completed and payment is justified
5. The determining factor as to how profitable the engagement will be
6. Method of recording, measuring, and analyzing the services and products provided
7. Serves as a necessary baseline for audit purposes

8. Protects both the service provider and client by clearly defining the roles and responsibilities of each party
9. Provides a snapshot in time of what the parties agree to in case of personnel turnover, memory lapse, difference in perception, and disputes

When to Develop the SOW?

There is a great deal of confusion in industry as to when a SOW should be required. If it is developed too early, information needed to develop a detailed description of the work to be performed may not be available. If it is done too late in the project life cycle, some of the work may have already been completed or changes may have occurred without being properly managed. This often puts the project manager and the team behind schedule for the rest of the project or can lead to significant rework later in the project.

The disparity between organizations in when the SOW is developed is most clearly illustrated when comparing practices in the public and private sectors. In the public sector, the SOW is considered the most critical document in the acquisition or procurement process. As part of the request for proposal (RFP) or purchase request (PR) process, the SOW has several purposes, including:

- Describing the products or services to be delivered
- Serving as a basis for the contractor's response
- Providing a basis for evaluating the proposals
- Defining the role of the public agency and the contractor
- Providing a point of reference for both the public agency and the contractor to determine when the project has been successfully completed[3]

As part of the procurement process, planning for the SOW starts as soon as possible to ensure that sufficient time is available to draft a quality document. The development may start prior to project authorization in order to ensure that the SOW is completed and integrated into the procurement package before it is distributed. This approach also helps avoid costly program and project delays later on.

When should SOWs be developed in the private sector? The answer to this question is not as clear-cut as it is in the public sector. In the private sector, there is generally a misunderstanding of what an SOW is and how and when it should be used on projects.

One of the reasons for the lack of consensus over when SOW development should occur is because of the way projects originate. In the private sector, most of the work comes from responding to RFPs or from a sales and marketing group generating leads and selling new work. A SOW may or may not be included in the RFP or as part of the proposal for new work. In most cases, it is not developed as part of the sales process. This practice can then lead to one of the most significant problems facing project managers in the private sector—delivering on unrealistic expectations.

During the sales process, a business developer or sales and marketing group establishes expectations with the client; these expectations are often unrealistic or simply beyond the capabilities of the firm. It's not that these individuals or groups are malicious in their intent, but they often lack the knowledge of what it takes to deliver a project and either don't know or underestimate the importance of having a detailed SOW developed prior to finalizing the sale or commitments with the client. Unlike in the public sector, there are no federal regulations (e.g., the FAR) that impose the discipline of a company doing work in the private sector to develop a SOW during a project's life cycle.

In determining when a SOW should be developed, two situations need to be addressed: the competitive bidding situation and the noncompetitive bidding situation. When potential work comes about through an RFP or similar process, this is typically referred to as a *competitive bidding* situation. However, when a sales or marketing group generates work through direct sales to a client without going through a formal solicitation process, this is referred to as a *noncompetitive bidding* situation. The following paragraphs examine when the SOW should be developed in both of these situations.

Competitive Bidding Situation

In a competitive bidding situation, the client should make every effort possible to develop a detailed SOW as part of their RFP or procurement package, (similar to what the U.S. federal government requires, in accordance with the FAR). If the client fails to provide a detailed SOW the service provider should strongly recommend or request it. Another option would be for the service provider to develop a proposal SOW (PSOW) as part of their response.[4] This will provide the client with a detailed description of the work to be performed, as interpreted and understood by the respondent. If the service provider develops the SOW, it is extremely important that the appropriate personnel be part of the development team. This is particularly true when the sales or marketing function is leading the proposal development. If the individuals responsible for delivering these services are not part of the team, then the probability of unrealistic expectations being established with the client are greatly increased.

Noncompetitive Bidding Situation

In a noncompetitive bidding situation, the client typically does not issue an RFP. It may be that the contractor is a sole-source provider of services to the client or that a business developer or a marketing and sales group has generated the potential work. In these situations, it is almost certain that a

SOW does not exist. The onus is then placed on the service provider to develop the SOW as soon as possible.[5]

Ideally, it should be developed and agreed upon by both the client and service provider prior to moving forward with the execution of the contract. If the contract is executed with a poorly written SOW, or without an SOW at all, then the service provider should have, at a minimum, an agreed upon change-management process in place with the client. A change-management process is extremely important, however, even with one in place, it will be difficult, if not impossible, to determine whether a change has occurred.

A project manager taking over a challenged project that does not have a SOW in place should, as a first step, meet with the client and request that a SOW be jointly developed immediately. Using this approach to develop the SOW will ensure that both the client and service provider are in agreement with what work is to be performed under contract. This simple step can turn a challenged project into a success story very quickly.

Types of SOWs

There are essentially two types of SOWs that may be used on an engagement: the proposal SOW (PSOW) and the contract SOW (CSOW).

PROPOSAL STATEMENT OF WORK (PSOW)

As the name infers, the PSOW is developed during the sales or proposal process of an engagement. It can be defined as the SOW developed to support the work being proposed to a client in a noncompetitive bidding situation, as well as the supporting document for the solicitation of work by a client or a contractor to support its response to a solicitation where an SOW was not provided. Characteristics of the PSOW include:

- First or initial draft of the SOW
- Based on information provided in the RFP or gathered during the sales process
- Supporting document to the proposal
- May be developed and used by both the client and the service provider
- Used to facilitate the development of the bid price
- May be used in both a competitive and noncompetitive bidding situation

CONTRACT STATEMENT OF WORK (CSOW)

The CSOW is defined as the document that identifies the specific requirements and performance measures of the work to be performed, and supports the contractual terms and conditions of a project. Characteristics of the CSOW include:

- Supporting document to the contract
- Written factually, based on validated information from performing due diligence
- Technical and schedule requirements stated in terms of desired results
- Defined methods and processes for measuring performance
- Clearly defined deliverables and reporting requirements
- Does not contain marketing, sales, or advertising language

Who Should Develop the SOW?

One of the most important, and sometimes most difficult, steps in developing a SOW is identifying and acquiring the appropriate resources to be part of the development team. The best way to determine the appropriate resources is to first develop a work-breakdown structure (WBS) for the project. The WBS is a decomposition of the products or services to be provided to the client down to the lowest manageable level possible. Once the WBS has been developed, the project manager or proposal manager can identify the skills and resources required to perform the various tasks.

A representative from each of the functional groups responsible for a portion of the project is then asked to participate in the development of the SOW. This helps ensure that the expectations established in the SOW are realistic and achievable. It also helps the service provider deliver services more expeditiously and at a lower cost while still meeting the client's expectations. Integrating the functional SMEs into one team allows the team to respond immediately to changes that occur on the project, rather than having to go through a sequential or hierarchical escalation process. This added flexibility helps to ensure that changes are addressed expeditiously and by the appropriate resources.

What does this integrated, cohesive project team look like? The team is composed of SMEs from each of the functional disciplines responsible for a portion of the project, along with a project manager who acts as the team's lead. This integrated concept allows the SMEs to pool their knowledge of requirements, processes and procedures, assumptions, constraints, and solutions to ensure that this knowledge is captured and documented appropriately within the SOW.

This integrated project team is referred to as the TIGER team (an acronym for Totally Integrated Groups of Expert Resources).[6] A sample TIGER team for an IT outsourcing project, for example, may include a project manager, account (sales) manager, help desk SME, network SME, process consultant, reporting SME, acquisition SME, asset-management SME, and the client. Every member of the TIGER team has an important role to play in ensuring the successful completion of the project. However, the one member who is critical to the success of the team and project, and must be on every TIGER team, is the client representative. Without the client's participation, input, and support, the likelihood of accurately capturing and meeting their needs and expectations is greatly decreased.

The TIGER team concept can be applied universally to any industry or organization that is performing projects. In addition to flexibility, applying a TIGER team strategy within an organization offers many benefits:

- Services will more frequently meet the customer's requirements and specifications.
- Achievable service levels will be established in the SOW.
- Customer satisfaction will increase.
- Teamwork and partnering with the client will be improved.
- Cycle time for implementing services will decrease.
- Probability of reactivating or reinitiating the project at a later date will be reduced.
- Revenue and profit margins will increase.
- Probability of project failure will be reduced.
- Employee retention will be improved.
- Flexibility to respond quickly to changes in the customer requirements will be improved.[7]

Implementing the TIGER team approach will drastically improve the quality of the SOWs developed. It will also systemically influence positive improvements in client satisfaction, employee moral, and the success of future projects.

TIGER TEAM CONSIDERATIONS

Implementing the TIGER team approach is critical to the development of quality SOWs for an organization. If the correct resources aren't identified and acquired for the team, then the quality of the SOW will be in question, as will the future of the project on which it is based. Important considerations in implementing and applying the TIGER team approach are as follows:

1. Develop a detailed work-breakdown structure to determine the appropriate resources.
2. Keep the team small, but fully represented.
3. Select SMEs who are team players and have approval authority.
4. Collocate team members if at all possible.
5. Maintain consistent and frequent communications.

If TIGER teams are to reach the level of excellence, they first need to ensure that they have a common goal and objective and that each member of the team understands these without exception. There is a direct correlation between the cohesion of the team and the quality of SOW developed. If cohesion is achieved, then the quality of the SOW will be high. These, in turn, will more than likely correlate to the project being successful. If these simple things are done, excellence can be achieved in the development of SOWs and delivery of successful projects for the organization. To illustrate this, I developed Martin's Cone of Team Cohesion© (see Figure 14–1).[8]

From the illustration, you can see that at the initiation of the project the objectives are not clearly defined and therefore each team member is doing his or her own thing. The team at this stage is often in chaos. As the objectives of the project become more clearly defined and understood, the team starts to come together as a cohesive unit. When a team has a common objective and each team member becomes laser-focused on that objective, the potential to succeed is unlimited.

Developing the SOW—F3 Methodology

What the statement of work is, *why* it's needed, *when* it should be done, and *who* should do it have been established in the preceding sections. Understanding the answers to these basic questions is critical not only to the development of a quality SOW, but also to the success of the project. Without this basic knowledge and understanding, both the SOW and project will be at serious risk.

We will now take the process to the next level, which is the development of a SOW. The next couple of sections will cover what I refer to as the *F3 methodology*. This methodology consists of three simple phases: Foundation, Framing, and Finalizing the SOW.

PHASE 1—FOUNDATION

The foundation phase deals with laying the foundation for the development of the document. During this phase, as much information as possible is gathered about the engagement and client. This phase is critical to the quality of the SOW. If little information is available or the information gathered is not accurate, the quality of the document will be negatively affected. However, if the information is detailed and accurate, the probability of developing a quality document will be much greater.

This phase consists of two parts: performing a due diligence analysis and developing a work-breakdown structure. The due diligence analysis is a detailed investigation or analysis of the client's requirements and specifications to determine the true scope of the product or service being proposed or sold to the client. This step is extremely important in both a competitive and noncompetitive bidding process, and it may be repeated throughout the development of both the PSOW and the CSOW. The detail of this analysis directly correlates with the detail of the next element, which is the development of the WBS. The WBS is a decomposition of the product or service being provided to the client. The detail of the WBS plays a critical role in determining the quality of the SOW. As with building a house, it is critical that the foundation of the project (i.e., the SOW) be firmly established. These elements will help ensure that the foundation of the SOW is structurally

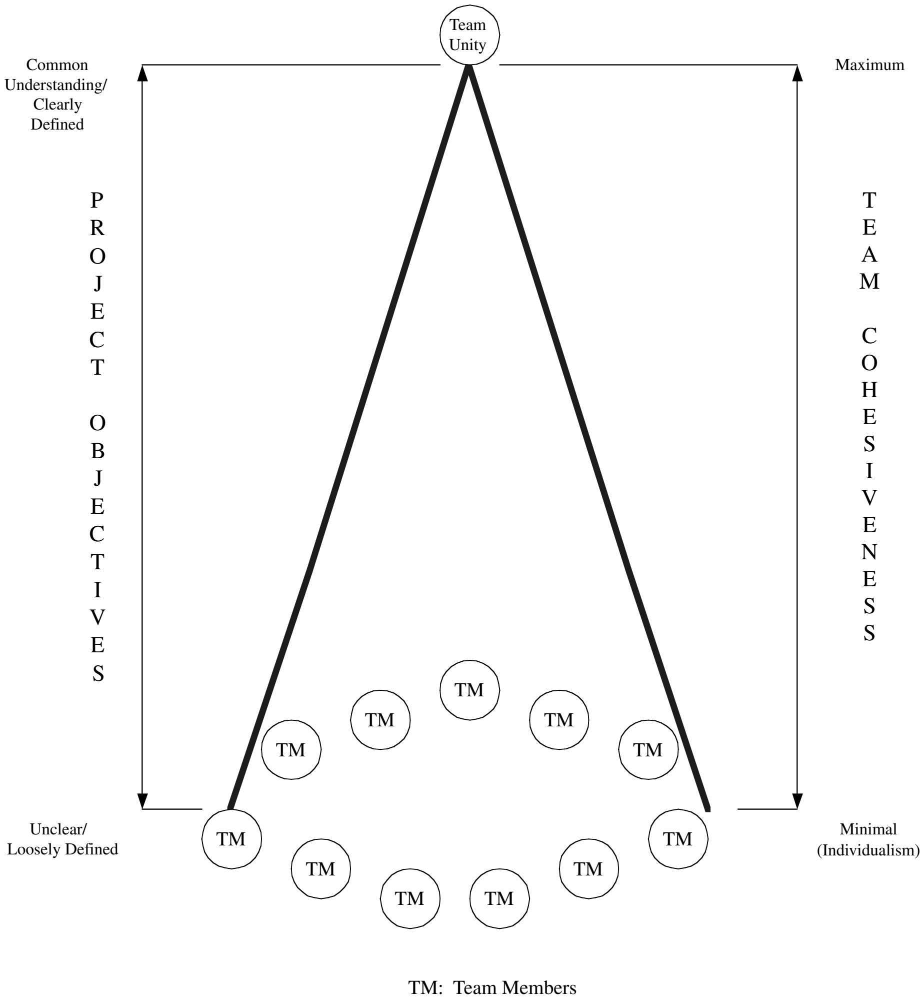

Figure 14–1 Martin's Cone of Team Cohesion©

Source: Martin, Michael G. *Delivering Project Excellence with the Statement of Work*. Lawrenceville, GA: Management Concepts, 2003. Copyright © 2003 Management Concepts, Inc. Reprinted by permission of Management Concepts, Inc.

sound and will adequately support the delivery of the final product or service to the client.

The evolution of the data from the initial requirements definition through the development of the SOW is depicted in Figure 14–2. This evolution is what forms and builds the foundation for the SOW. Without this process, the data supporting the SOW may be corrupted or not of the quality desired. Following this process will help to form and build a solid foundation for the SOW, which will contribute significantly to the ultimate success of the project.

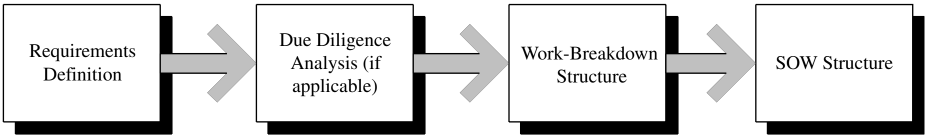

Figure 14–2 Evolution of Data

Source: Martin, Michael G. *Delivering Project Excellence with the Statement of Work*. Lawrenceville, GA: Management Concepts, 2003. Copyright © 2003 Management Concepts, Inc. Reprinted by permission of Management Concepts, Inc.

PHASE 2—FRAMING

The framing phase addresses how the SOW should be structured or customized for a particular client or engagement. The structure and type of content to be included in the document will also be identified during this phase. This phase plays an important role in building consistency and improving the quality of SOWs developed within an organization. To help ensure the desired quality, it is important that the team responsible for developing the SOW follow some very important guidelines for developing its framework. The following paragraphs will provide guidance on how to develop the structure properly, as well as a detailed description of the key elements making up that framework.

An SOW framework that may be appropriate and applicable to one organization may not be appropriate and applicable in another. Once the initial data have been gathered and the foundation has been formed, the next step is to develop and customize the framework of the SOW specific to the client or engagement that it is supporting. A customized framework will help to organize the content into areas of information, which will allow the development team to identify and assign the appropriate resources easily to specific sections. This will make it easier for the team to draft the content, in turn reducing the probability of duplication and redundancy. Having the document organized into a clear and concise framework will also allow the reader to review and understand the content contained within it more easily, which will help to prevent any misinterpretations or misperceptions of what was intended.

While a single comprehensive framework is not applicable for all projects, a baseline framework consisting of key elements can serve as a starting point for an SOW in any organization or project. For this baseline framework to be useful and flexible, it has to have both *static* and *dynamic* characteristics. It must be static in that all sections of the framework have to be addressed for every engagement, regardless of the type of project being performed. It must be dynamic in that the content within the sections can be customized or new sections can be added to the framework to fit the needs and requirements of the client or project.

Developing a standard framework for an SOW is not an easy process. No single, static framework is applicable to every industry, organization, and project. What may work well for one organization and industry may not work well for another. Nonetheless, a baseline framework that has both static and dynamic characteristics can generally provide a starting point for any industry, organization, and project. An example of a standard baseline SOW framework may include the following sections:

- Table of contents
- Statement of confidentiality
- Introduction
- Services (or products) provided
- Roles and responsibilities
- Management procedures
- Hours of operation
- Facilities/tools/equipment requirements
- Schedule
- Pricing
- Signature block
- Glossary of terms
- Attachments

These sections may be stand-alone elements, or they may act as a summary heading over multiple subsections that address the element in more detail.

Benefits realized from using the baseline framework with its own unique coding structure are as follows:

- Provides a standard framework for developing SOWs within an organization
- Helps to build consistency, not only in structure but also in content
- Improves the quality of SOWs being developed
- Reduces the difficulty of managing changes made to the project, and, in turn, to the SOW, during project execution
- Provides for better knowledge management and transfer of information for future projects

Following the structure described above, a brief description of the recommended sections for the baseline SOW framework and the content that should be contained within them are as follows.

TABLE OF CONTENTS

Every SOW longer than two pages should contain a table of contents (TOC).[9]

1.0—STATEMENT OF CONFIDENTIALITY

This section addresses the confidentiality of the SOW to ensure that the client understands that unauthorized duplication or distribution of the information contained within the document is not permitted.

2.0—INTRODUCTION

The introduction section may consist of several subsections, including purpose, description of work, assumptions, and constraints. A brief description of these subsections is as follows:

- ***2.1—Purpose.*** This subsection describes the purpose of the SOW and the project for which it is supporting.
- ***2.2—Description of Work.*** This is a written description of the scope of work to be performed. The description provides a summary of the services or products to be provided, with reference to the section number described in the framework.
- ***2.3—Assumptions.*** Assumptions are data elements or factors that are considered to be true or factual and are used as part of the decision-making process. An assumption may be based on information provided by the client or obtained as part of a preliminary evaluation.
- ***2.4—Constraints.*** This section describes all constraints that may negatively impact the successful completion of a project. Constraints on a project may include budget, security, facility, geography, and resources. Any constraint identified during the development of the SOW must be considered a potential risk, and mitigation plans should be developed as a preventative measure. A constraint is defined as, any event or situation that may:
  - Prevent the service provider from delivering the services or products required
  - Limit the availability of alternative solutions
  - Inhibit the client from meeting their obligations

3.0—SERVICES (OR PRODUCTS) PROVIDED

This section addresses in detail each product or service to be provided to the client. As such, it is the most dynamic section of the entire framework. This section will include a separate subsection for each service or product being provided to the client.

The following information should be captured for each product or service being provided to the client:

- ***Description.*** This provides a detailed written description of the product or service to be provided to the client. The description should be as detailed as possible, without overspecifying. This section should not exceed more than a few paragraphs; however, the length will often be contingent upon the technical difficulty of the product or service being delivered. Keep in mind that the description should only address *what* is being provided to the client, not *how* it is being delivered.
- ***Key assumptions.*** These are assumptions specific to the product or service being delivered to the client. Reference the definition of assumptions above.
- ***Roles and responsibilities.*** Identify the roles and responsibilities of the service provider, client, and any third parties specific to each product or service being delivered.
- ***Change enablement.*** This captures all elements required to support the implementation of a product or service within a client's environ-

ment. It includes requirements such as training and communications specific to the implementation.

- ***Service level agreements* (*SLAs*).** SLAs specify service levels required by the client. Service levels are quantitative measures, established or requested by the client, upon which the performance of the service provider will be measured.
- ***Key requirements.*** This describes all specific requirements requested by the client. This will often pertain more to the delivery of a product than to a service. Unlike service levels, which identify a quantitative performance target against which the service provider is to be measured, the requirements section identifies specific characteristics that a product must have for it to be acceptable to the client.
- ***Deliverables.*** Any required deliverables specific to the service or product being delivered to the client should be addressed in this section.

4.0—ROLES AND RESPONSIBILITIES

This section addresses the roles and responsibilities of the service provider, the client, and any additional third parties that have not been captured in the services or product section above. This section tends to be more focused on the roles and responsibilities at the executive level of these parties.

5.0—MANAGEMENT PROCEDURES

This section addresses the processes and procedures for managing the delivery of the product or service to the client. It is important to note that this section does not describe the specific aspects of *how* a product or service is going to be developed or implemented. Rather, it focuses specifically on the management aspect of certain processes and procedures that are required to manage the SOW and deliver the project successfully to the client. The processes and procedures to be covered in this section would include, but not be limited to:

- Change-control process
- Billing process
- Dispute-resolution process
- Reporting procedure
  - Status reports
  - Client satisfaction reports
- Meetings

Any process flow diagrams associated with or supporting these various management elements may be included in the attachments section of the SOW.

6.0—HOURS OF OPERATION

This section addresses the hours the service provider will, or will not, perform services or charge to the development of a product. The hours of operation may be defined by service, product type, or location/site. This section should clearly define overtime, holidays, and after hours. It is also important that the time be specific to a time zone, particularly if work is being conducted across multiple geographic locations and time zones.

7.0—FACILITIES/TOOLS/EQUIPMENT REQUIREMENTS

This section describes the facilities, tools, and equipment required by the service provider to deliver the product or service properly. This is one of the most overlooked areas of a SOW, yet it can be one of the most critical in delivering a project successfully. If the client is unable to provide adequate facilities, tools, and equipment, it can be almost impossible for the service provider to be successful.

8.0—SCHEDULE

This section addresses the schedule for delivering the product or service to the client. The schedule should include a list of major milestones against which progress can be measured throughout the life of the project. Due to the potentially large number of data elements in the schedule, it is recommended that this section cover only the scheduled completion dates of the major milestones identified for the project. The full schedule may be included as an attachment to the SOW.

9.0—PRICING

This section details the price for delivering the product or service to the client. The pricing may be segmented into various categories, including:

- Initial ramp-up and one-time fees
- Base fees
- Time and material
- Travel and expenses
- Mailing fees
- Third-party expenses
- Acquisition fees (if applicable)
- Termination fees

10.0—SIGNATURE BLOCK

This section captures the signatures of all representatives, from both the service provider and client, responsible for approving the SOW. Having the client sign off on the document will show its agreement to the scope of the project as described.

11.0—GLOSSARY OF TERMS

This section addresses the agreed-upon definitions of the concepts, words, and phrases used in the text of the SOW. Having a detailed glossary will eliminate any misinterpretation and avoid ambiguity.

12.0—ATTACHMENTS

This section contains all additional information referenced within the text of the SOW. This would include items such as:

- Detailed schedule
- Change order form (with/instructions)
- Process flow diagrams (referenced in the section on management procedures)
- Sample reports

The following guidelines summarize several key aspects in the development and application of a standard baseline SOW framework:

- Every project will need a SOW customized specifically for the client and project the document is supporting.
- Every SOW developed by an organization must follow the current baseline SOW framework approved by both the project-management directorate and the office of counsel.
- Additional sections may be added to the SOW; however, no section should be eliminated from the approved format until the CSOW has been finalized.
- The development team should address each section of the baseline framework. If a particular section does not apply, then it should still be addressed by identifying that it is not applicable (N/A) for that engagement.
- Prior to finalizing the CSOW, those sections that have been identified as N/A can be eliminated from the document.

PHASE 3—FINALIZING

The third and final phase of the F3 methodology is the finalizing phase. During this phase the development team will start writing content for the various sections of the SOW. The successful completion of this phase is largely contingent upon the quality of information and data gathered and developed during the foundation and framing phases. If detailed, quality data were obtained during the foundation phase, this will help to ensure that the content within the contract SOW (CSOW) will be accurate and valid.

Due to the importance and use of the SOW, it is imperative that it be organized and clearly written to avoid any misinterpretation or confusion among the various parties who will be referring to it throughout the life of the project. An organized and clearly written document will also help the delivery team in better managing changes that may occur during project implementation. Some do's and don't's of writing a quality SOW include:

Do's

1. Use simple and direct language for clarity.
2. Use the active voice.
3. Use positive and specific words and phrases.

4. Use technical language sparingly.
5. Define acronyms and abbreviations.

Don'ts

1. Don't use vague or obscure words and phrases with multiple or legal meanings.
2. Don't hedge.
3. Avoid terms of art.
4. Avoid redundancy.
5. Don't use nonspecific words or phrases.
6. Don't use catch-all and open-ended phrases.
7. Avoid using big words.
8. Avoid incorporating extraneous material and requirements.
9. Avoid bias.
10. Avoid certain types of terminology.

Completing the *finalizing phase* of the SOW entails more than just drafting the document. It also addresses the SOWs role in developing the cost of the project as well as its role in negotiating the contract between the service provider and the client.

Before finalizing the SOW, the development team must develop a price for delivering the product or service to the client, which is also required to complete the pricing section of the document. It does so by identifying and capturing data points throughout the text, which in turn are used as input into a pricing or cost-estimating model.

Once the SOW has been completed, the next step is to review the document to ensure that nothing has been overlooked and that all requirements and obligations for delivering the product or service to the client have been properly captured. It is recommended that a review checklist be developed to assist in this process. This will help both to ensure that nothing has been missed in the review process and to build consistency in the way SOWs are reviewed within the organization. A sample review checklist is provided in Figure 14–3.

If time and resources are available, it is recommended that a peer group of subject matter experts review the document. Ideally, this team of SMEs will mirror the makeup of the development team. If the makeup of the review team varies from that of the development team, then there is a potential risk that if a critical element is missing from the document, it will not be caught during the review process. If the element is significant enough, it could possibly challenge the success of the project. Once the review has been completed and all comments have been addressed, the SOW is ready to be finalized and attached as a reference in the legal contract.

The SOW is an integral part of the legal contract, sometimes referred to as the legal terms and conditions (T's & C's). A contract is a mutually binding agreement that obligates the service provider to provide a specified product or service and obligates the client to pay for it.[10] Although the SOW is part

Checklist Item	Yes	No	If "No, Provide Explanation
1) Does the SOW follow the approved format?			
2) Has a multidecimal or alphanumeric coding structure been used in the SOW?			
3) Is the SOW specific enough to estimate the human and nonhuman resources required to deliver the project?			
4) Did a multidisciplined TIGER team develop the SOW?			
5) Have all sections of the SOW been satisfactorily addressed?			
6) If a section of the standard SOW format didn't apply, was it marked as nonapplicable (N/A)?			
7) Is the SOW specific enough to price the project?			
8) Has each product or service being delivered to the client been addressed within a separate subsection in the SOW?			
9) Are the requirements and obligations of both the service provider and client clearly identifiable?			
10) Have all service levels been clearly defined and quantified?			
11) Are the deliverables to be provided and their acceptance criteria clearly defined?			

Figure 14–3 SOW Review Checklist

Source: Martin, Michael G. *Delivering Project Excellence with the Statement of Work.* Lawrenceville, GA: Management Concepts, 2003. Copyright © 2003 Management Concepts, Inc. Reprinted by permission of Management Concepts, Inc.

12) Have documents referenced in the SOW been properly described and cited?			
13) Have quality requirements been clearly defined to determine whether the service provider has complied with all contractual requirements?			
14) Have appropriate industry standards been researched and referenced in the SOW, if necessary?			
15) Have all extraneous references and materials been eliminated?			
16) Has the SOW been checked for format and grammar?			
17) Are all supplemental data requirements referenced in the SOW and attached to the document?			
18) Has the change order process been clearly defined?			
19) Are all terms clearly defined, including "industry-wide" accepted terms?			
20) Does the SOW conflict with or contradict the language in the contract to be used?			
21) Does the review team have knowledge or experience about the type of project being supported by the SOW?			

Figure 14–3 (*Continued*)

of the contract, it is important to note that they are two separate and unique documents and should not be interpreted as being one in the same. The contract addresses elements such as force majeure, termination clauses or penalties, employee-retention clauses, confidentiality, warranties, and non-solicitation clauses. The SOW, on the other hand, defines *what* product or service is to be provided to the client and *what* the service provider requires to properly deliver the product or service. This distinction becomes extremely important in managing changes to the project during the execution or delivery phase. If the SOW and contract were one and the same, then every time a change was proposed on a project, legal counsel would have to be involved in the process. This would not only add unnecessary time to the review and approval process of the change order, it would also dilute the authority of the project manager to approve those changes within his or her authority.

To ensure segregation of the documents, the SOW should be attached or referenced within the contract. The change order process should also address how changes will be managed on the project and clearly identify the process for managing those changes to both the contract and SOW. A final review should be conducted prior to finalizing the contract and the CSOW to ensure that both documents are complete and do not contain any conflicts or contradictions.

Managing Change with the SOW

One of the main responsibilities of the project manager is to maintain a balance between the scope, cost and schedule of a project. This is typically referred to as the *triple constraints* of a project and is illustrated as an equilateral triangle in Figure 14–4. The SOW establishes the initial parameters for the triangle by defining the baseline scope, cost, and scheduled comple-

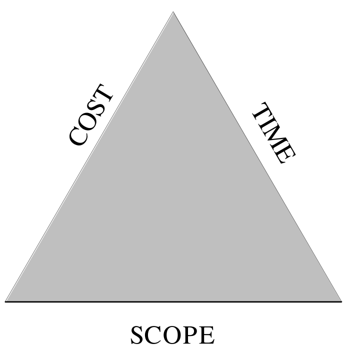

Figure 14–4 Triple Constraint Triangle

Source: Martin, Michael G. *Delivering Project Excellence with the Statement of Work*. Lawrenceville, GA: Management Concepts, 2003. Copyright © 2003 Management Concepts, Inc. Reprinted by permission of Management Concepts, Inc.

tion date of the work to be performed for the client. When one side of the triangle is increased or decreased, it will have a direct impact on the other two. To maintain a balance between these triple constraints, a detailed change-management process must be in place. If changes to any of these constraints are not documented and managed properly, the triangle will get out of balance very quickly. When this happens, the project is heading for trouble.

To manage change to a project properly, one first must be able to identify when a change is being proposed or has occurred. For the purpose of this discussion, a change is defined as any deviation from the scope agreed to in the contract SOW (CSOW). Any change that is outside the general scope of this document is referred to as a *cardinal change*.[11] There are three factors that must be considered when determining whether a change is significant enough to be classified as a cardinal change:

1. Has the magnitude of the work to be performed been significantly changed, or will it be?
2. Is the change requiring the procurement of a totally different product, or is it altering the quality, character, functionality, or type of work defined in the CSOW?
3. Does the cost of the proposed change greatly exceed the baseline cost established in the CSOW?[12]

If the answer to any of these questions is ''yes,'' then the proposed change is a cardinal change. This doctrine is extremely important and should be understood by both the client and service provider. Clients should understand that according to the cardinal change doctrine, they are generally restricted to requesting changes that are within the general scope defined in the CSOW. If it is determined that a proposed change is a cardinal change, then the service provider will not be required to implement the change unless specific clauses are included in the SOW that address how changes of this nature will be managed.

An organization's failure to manage change on a project can lead to a multitude of problems, including scope creep, cost and schedule overruns, poor utilization of resources, reduced quality of the product produced, and lost profitability. In addition, if either the client or service provider, without having an approved change order, were to try and seek retribution through the legal system for any negative impacts that a change may have caused to their organization, the probability of winning the suit would be very slim.

At first glance, the concept of managing change seems simple. So why do so many organizations have such a hard time doing it? The reality is that managing change can be one of the most difficult things to do, particularly if your organization is immature in its project-management processes and procedures. The difficulty is not in the project being technically complex, but simply in getting the project team members to follow the process. Some of the factors that contribute to a team not managing change properly on a project include:

- Lack of a detailed SOW to establish the baseline information upon which future change will be measured
- Lack of a change-management section in the SOW that is understood and accepted by all parties involved in the project delivery
- Lack of discipline and rigor among the project team in adhering to and enforcing the change-management process
- Poor communications among the project team, where good communications would help to identify when a change has occurred
- Lack of understanding by the project team as to what was agreed to in the SOW
- Perception that a change is not significant enough to warrant or justify doing a change order
- Decision by the service provider to perform additional work for the client on a pro bono basis, simply to build the client relationship

Each of the factors noted above can easily impede the management of changes to a project. Therefore, it is important that you understand what they involve and how they can be avoided on your projects.

Conclusion

The ultimate goal for every project manager and organization is to deliver successfully all projects within their portfolio (e.g., on time, within budget, and of the quality desired by the client). Achieving this level of project excellence does not come free and it does not come easy. It takes time, discipline, and the commitment of every member of the organization to make it happen. Following the guidelines and methodologies presented throughout this chapter on developing and applying the SOW will help bring you and your organization closer to achieving project excellence.

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3 *Statements of Work Handbook*. NASA Handbook: NHB 5600.2A, July 23, 1993, p. 6
4 Kerzner, Harold. *Project Management: A Systems Approach to Planning, Scheduling and Controlling*, 5th Edition. New York, Van Nostrand Reinhold, 1995, p. 583
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SECTION III

Project Leadership

Chapter 15

The Tasks of Project Leadership

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Biographical Sketch . . .

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Field Guide to Project Management, Second Edition. Edited by David I. Cleland

Jayashree Venkatraman is currently working as COE leader in GE India Business Centre. Prior to that, she was an independent consultant providing business-to-business solutions and other software solutions to varied industries. She holds a B.S. in physics and an M.S. in coputer applications from the University of Madras, India, and an M.B.A. from Xavier University. She also earned a certificate in project management from the University of Cincinnati. She has more than 12 years of experience in leading, designing, developing, implementing, and integrating software applications in a project environment for varied industries. She is a member of PMI. Jayashree is a coauthor of *Project Leadership*.

Introduction

In this chapter, we will first discuss the need for project leadership and the differences between project leadership and project management, and then develop a framework for understanding project leadership. The framework will include a brief introduction to the typical roles project leaders should play, a typical project life cycle, the categories of project leadership responsibilities, and the specific project leadership tasks at each life-cycle stage. The main body of the chapter will describe in more detail how each of the seven types of leadership responsibilities vary during the project life cycle.

The Need for Project Leadership

Among the myriad of definitions of leadership, one that is particularly appropriate to project leadership is the notion that ''a leader must constantly balance the needs of the enterprise, the needs of the individual employee, and her own needs.''[1] Many individuals and groups have strong needs that must be met and also wants that they would like to meet. In the context of effective and efficient project completion, each of the needs will be paramount at certain times, and the more they overlap the more likely the project is to be successful. Project leaders should strive to find the overlap in the needs of various individuals involved in a project as shown in Figure 15–1 and in the needs of various organizations involved as shown in Figure 15–2.

In any endeavor, the participants play different roles at different times. In implementing a project, there are times when a leader has the traditional responsibilities of leadership. There are times when a specific team member may have more expertise or experience and should lead the team in the

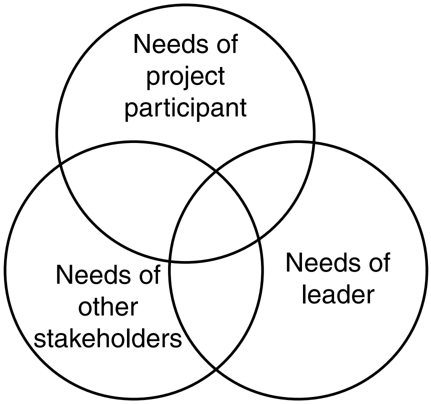

Figure 15–1 Human Needs

endeavor while the formal or official leader is actually a follower. Therefore, good leaders must be good followers and good followers must be good leaders. In a well-functioning team, these roles naturally flow back and forth based on expertise, competence, and experience, and not on formal titles.

Leadership versus Management

Management is a well-defined concept. Most major management textbooks contain similar definitions. Management is the process of planning, organizing, administering, staffing, evaluating, and continuously improving activities that lead to a preestablished goal. Managers' tasks are to accomplish this in the most efficient and effective manner possible.

The definition of leadership varies vastly depending upon the approach that various authors take. Rost indicates that defining leadership is some-

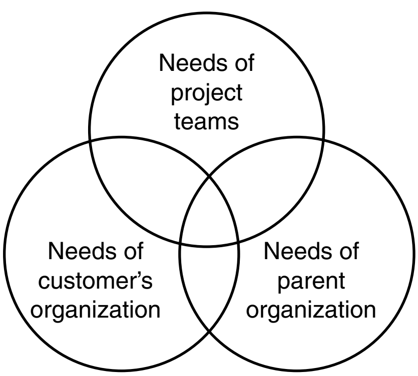

Figure 15–2 Organization's Needs

what similar to the way that Justice Potter Stewart defined pornography. ''I cannot define it, but I know it when I see it.''[2] His book *Leadership for the Twenty-First Century* has numerous definitions of leadership.

Many argue that leadership is doing the right thing while management is doing things right. Cronin points out, ''Leaders are people who perceive what is needed and what is right and know how to mobilize people and resources to accomplish mutual goals.''[3] Aburdene argues, ''Leadership requires a wholeness and the ability to contain two seemingly contradictory qualities simultaneously, 'power and humility.'''[4] Rost suggests that ''Leadership is an influence relationship among leaders and their collaborators who intend real changes that reflect their mutual purposes.''[5] Bensimon and Neumann argue, ''The ideal leader will be someone who knows how to find and bring together diverse minds—minds that reflect variety in their points of view, in their thinking processes and in their unique capacities as well as unique limitations. . . . Moreover, as the world grows more complex . . . it is likely that we will stop thinking of leadership as the property or quality of just one person. We will begin to think of it in its collective form: leadership as occurring among and through a group of people who think and act together.''[6]

While much has been written about the generic concept of leadership, very little has been written about leadership in a specific project context. Leadership and management are compared in Table 15–1. Many personality dimensions need to be envisioned from both a manager and a leader perspective, and both managers and leaders have activities they need to perform in the process of empowering subordinates.[7]

Project leadership needs to combine the best of the management principles and the leadership principles in the context of a project with a limited life. In each step of the project, the approach of a manager and the approach of the leader are both needed, and it is important that the team have people who bring both perspectives.

Language can be confusing. Whether an individual is called a manager, a supervisor, an administrator, or a leader is not the important issue. How he or she performs the function is the key issue. A skilled individual can use both leadership and management techniques as needed. Most individuals tend to gravitate to either the leadership model or the management model. The most skilled among us will be able to use both of these approaches effectively. The expectation is that the leader will discern which approach is needed to accomplish a task.

Project Leadership Roles

Several leadership roles must be filled on a typical project. Sometimes, particularly on small projects, a person may perform more than one role. Most people feel that the roles of sponsor and project manager should be filled

Table 15–1

Personality Dimension	Manager	Leader
Attitudes toward goals	Has an impersonal, passive, functional attitude; believes goals arise out of necessity and reality.	Has a personal and active attitude. Believes goals arise from desire and imagination.
Conceptions of work	Views work as an enabling process that combines people, ideas, and things, seeks moderate risk through coordination and balance.	Looks for fresh approaches to old problems; seeks high-risk positions, especially with high payoffs.
Relationships with others	Avoids solitary work activity, preferring to work with others; avoids close, intense relationships; avoids conflicts.	Is confortable in solitary work activity; encourages close, intense working relationships; is not conflict averse.
Sense of self	Is once born; makes a straightforward life adjustment; accepts life as it is.	Is twice born; engages in a struggle for a sense of order in life; questions life.
Empowering Process	Leader Activities	Manager Activities
Providing directions for followers/subordinates	Via ideals, vision, a higher purpose, superordinate goals.	Via involvement of subordinates in determining paths toward goal accomplishment.
Stimulating followers/subordinates	With ideas.	With action; things to accomplish.
Rewarding followers/subordinates	By inspiring them to do more than they thought they could.	By involving them in important decision making activities and providing feedback for potential learning by giving them training.
Appealing to follower/subordinate needs	Appeal to needs of followership and dependency.	Appeal to needs for autonomy and independence.

Sources: Zaleznik, A. Managers and leaders: are they different? *Harvard Business Review,* May–June 1977, 67–77; adapted and reprinted with permission from Burke, W. W. Leadership as empowering others. In *Executive Power.* Edited by S. Srivasta. San Francisco: Jossey-Bass, 1986, p. 73

by two different people whenever possible. The people filling each of the following common project roles are sometimes called upon to lead:

- ***Steering team.*** A group of senior executives who authorize a project and give broad guidance to those performing the work
- ***Sponsor.*** An executive who represents the steering team, champions the project, represents any external customer, and mentors the project manager
- ***Project manager.*** A person who has responsibility to plan, organize, lead, monitor, and control the project on a daily basis and represent the project both internally and externally
- ***Customer.*** The senior representative of the group, to whom the project outcome will be delivered (on internal projects, this person may be the sponsor)
- ***Functional manager.*** A person who controls a specific type of human resources within the parent organization and who is often instrumental in determining who (in their technical area) will work on the project and what methods will be used
- ***Technical lead.*** A person who is responsible for planning and implementing work in a specific portion of the project
- ***Core team.*** The project manager and the technical leads, who jointly perform much of the planning, execution, and control for the project as a whole
- ***Subject-matter experts.*** People brought in on an as-needed basis to execute specific project tasks

Project Life Cycle

All projects go through predictable stages called a life cycle. Leaders should be aware of the demands at various stages of the project life cycle so they can be prepared to face them. A typical list of project life stages includes:

- ***Initiating.*** When a project is proposed, planned at a preliminary level to ensure it fits in the organization, and the core team and executive team commit to it in broad terms
- ***Planning.*** Starts after the initial commitment occurs, includes all types and levels of planning, and ends when all stakeholders accept the entire detailed plan
- ***Executing.*** Authorizing, executing, monitoring, and controlling work until customer accepts project deliverables
- ***Closing.*** All activities after customer acceptance to ensure project is completed, lessons are learned, all resources are reassigned, and contributions are recognized

Categories of Project Leadership Responsibilities

Project leaders must perform or ensure a myriad of activities. One method of organizing them is to use the seven categories of priorities, details, integration, human resources, human relations, promotion, and commitment, as detailed below:

- ***Priorities.*** Project leaders need to determine and communicate the priorities for their project, within their project, and between their project and other activities of the parent organization. These priorities should guide everyone's planning, decision-making, and actions throughout the project.
- ***Details.*** While dealing with details sounds like a management responsibility (as opposed to a leadership one), in fact leaders do need to ensure that details are accomplished. The trick is to communicate what must be done—to set the parameters—and have a feeling for how much detail they can let others decide. In ideal circumstances, many of the detail decisions can be left for others to decide. However, until a worker has proven to be capable and trustworthy, the leader may have to be more involved in details. Project leaders can run into trouble if they delegate work either too soon or too late.
- ***Integration.*** Most organizations have a variety of work that must be accomplished. Project leaders need to justify potential projects, select the ones that best fit the organization's needs, combine the many detailed plans into one logical whole, coordinate all of the work of various projects and other work of the organization, and lead in the capturing and sharing of lessons learned.
- ***Human resources.*** The first key to most endeavors is to get the right mix of people in terms of their competencies, insights, needs, and desires. Then the workers must be supervised and mentored while the project proceeds, and reassigned once the work is completed. When the right mix of people is found, synergy on the team is more likely, which will lead to a greater probability of success.
- ***Human relations.*** The team needs to work together in a creative, effective, and efficient manner. This rarely just happens; it requires appropriate interventions and nurturing.
- ***Promotion.*** A successful project requires buy-in and support from the top and from all other stakeholders, especially the customer and team members. A leader must constantly promote the project to these groups and should lead the celebration of milestones.
- ***Commitment.*** Project leaders need to guide all parties to commit to both the project approach and the project deliverables. This is vital since there are many parties that have varied interests in a project. Some of these stakeholders may willingly commit only to certain aspects of the project. It is also vital since many workers do not really

enjoy their work. Wise project leaders will seek to find or create overlaps in personal, task, team, project, and organizational values so that win–win situations exist.

Project Leadership Stage-Specific Task Matrix

Table 15–2 is a matrix that lists specific project-leadership tasks that relate to each category of responsibility (such as priorities) and each project life-cycle stage (such as initiating).[8] Each task represents one or more decisions to be made on the part of a project leader and one or more actions to be taken by a project leader and/or follower. The tasks are interrelated and can sometimes be blended or accomplished simultaneously. If one particular project leadership task is not done or done well, it will frequently have a negative impact upon other tasks. The following seven sections discuss each category of project-leadership responsibilities.

PRIORITIES

Initiating	Planning	Executing	Closing
Align project with parent organization	Understand customer's priorities	Authorize work	Audit process

One key to being successful is to develop and be guided by a well-chosen set of priorities. Priorities need to be understood, agreed upon, and communicated to be effective, and they should be used to guide people's daily activities. When acting upon priorities, a person must understand the difference between something that appears to be urgent (demanding current attention) and something that is critical (must be accomplished). Since project environments are frequently fast-paced and rapidly changing, too often urgent activities take our attention away from critical ones. Whether an activity appears to be urgent or not, sometimes we must just say no, we cannot do that activity. Projects often have strict limits on schedule, budget, and other resources. These limits create a strong need for establishing and utilizing a wise set of priorities.

During the initiating stage, the prioritization task is to align potential projects with the goals of the parent organization. Essentially, this consists of assessing the parent organization's project leadership capability and assessing each individual project to ensure a fit with organizational values. In difficult economic times, organizations may be happy to secure any work they can get and may minimize this step for external projects. Even in the bleakest times, however, an understanding of organizational capability and identification of potential projects is needed for all external projects. Internal projects in particular always require an assessment for fit, since there is an opportunity cost. If one project is pursued, the organization may not have resources to pursue a competing project.

Table 15–2 Project Leadership Task Matrix

Category of Project Leadership Task	Initiating	Planning	Executing	Closing
Project priorities	Align project with organization	Understand and respond to the customer	Authorize work	Audit project
Project details	Perform risk assessment	Oversee detail plan development	Monitor progress and control changes	Terminate project
Project integration	Justify and select project	Integrate project plans	Coordinate multiple projects	Capture and share lessons learned
Human resources	Select key project participants	Select remainder of participants	Supervise work performance	Reassign workers
Human relations	Determine operating methods	Develop communications plan	Lead teams	Reward and recognize participants
Project promotion	Develop top management support	Motivate all participants	Maintain morale	Celebrate project completion
Commitment	Commit to project	Secure key stakeholder approval	Secure customer acceptance	Oversee administrative closure

Source: Adapted from Kloppenborg, Timothy J., Shriberg, Arthur A., and Venkatraman, Jayashree. *Project Leadership*. Vienna, VA: Management Concepts, 2003.

Organizational capability can be assessed formally using a project-management maturity model or a project leadership assessment instrument such as Project Leadership Assessment: Organizational.[9] Organizational capability should be understood in terms of work culture, teamwork, risk tolerance, communications, decision-making, and trust.[10] The level of each of these dimensions in an organization sets the stage for project success. Finally, each potential project needs to be assessed to see how well it fits in the organization. Many questions should be asked, including the value of the project, resource requirements, priority in comparison to other potential and current projects, and how it will fit within the organization's culture. As a project leader, one must have the courage to insist that each potential project be assessed on how well it will help the organization reach its goals. Project leaders must exhibit courage to resist making selection decisions based exclusively upon personal desires.

In the planning stage, the main prioritization task is to understand and respond to the various customer groups and their respective needs and then to help the customers make difficult trade-off decisions. Projects often have a variety of customers. For example, if a church and school are being modernized and expanded, all the hundreds of parishioners are customers. The senior citizens probably have very different needs than the school children. The parishioners may be more interested in finishing quickly, while neighbors may want to mitigate traffic, noise, and dust. All of the varied customer desires must be elicited and prioritized. The project leaders should have candid talks with the senior customer representatives, saying that they wish to be able to make the same kind of decisions every day that the customers would if they were on the job site. Therefore, the customers must determine which project objectives and which subset of each objective (scope, quality, cost, and schedule) should be enhanced, if possible, which must be maintained, and which can be compromised (by how much and under what circumstances this can occur). The hard part of this discussion is that for each objective that the customers want to enhance, they often need to compromise another (at least to a point). Failure to be willing to prioritize among cost, scope, and schedule often leads to quality problems.

During the executing stage, the priority is to decide who can authorize work, under what circumstances, and with what level of spending authority, so that the execution of the project can happen seamlessly[13] and smoothly. This should start to be defined in the charter and be clarified in the detailed planning. It is also a priority to establish who authorizes revision and change control. For decisions to be timely, the leader needs to be present when the decision has to be made. Less experienced leaders generally have more time and are closer to action, hence they are frequently available to make timely decisions. More experienced leaders, while deciding on authorization, must delegate and empower decision-making among less experienced leaders. More experienced leaders often have a broader perspective. For people to have confidence in decision-making, there needs to be training, experience, affirmation, etc. Many decisions need to be made during the execution stage of the project and be communicated effectively. Empowering less experienced leaders to authorize work they are capable of doing and developing them enhances decision-making during project execution and directs the project toward a successful completion. There must be a balance between mentoring junior leaders and getting the project completed.

During the closing stage, a prioritization issue is to audit the project, to determine how well the project priorities were achieved, the reasons for the success in achieving each priority, and any corrective actions that are needed. Auditing serves a very useful function if it is performed in a positive manner. During this stage, all aspects of project leadership are covered and project leaders take active roles in utilizing the audit results. If changes are required, they need to take a positive approach in communicating the need for and implementing any corrective actions. The project leader needs to be supported by his or her team members in implementing the corrective actions and the senior leaders of the organization need to support this effort and assist by providing adequate resources.

DETAILS

Initiating	Planning	Executing	Closing
Perform risk analysis	Oversee detailed plan	Monitor and control	Terminate project

Project leaders need to understand the importance of project details and ensure they are done on time and correctly. This may entail personally performing some of the detail work and delegating the rest. Both washing one's hands of details and micromanaging are to be avoided. Generally, a wise project leader tries to develop his or her team so that progressively more details can be delegated to an empowered workforce.

In the initiating stage, the primary reason for the leader's involvement in details is to identify currently unknown project risks and make appropriate decisions concerning these risks. A major project task is continually to expand understanding of risks and reduce the amount of unknown risks. Early in the project, project leaders need to understand and communicate that uncovering risks may prevent serious problems later. One way to accomplish this is to have the project sponsor and the core team together brainstorm all of the possible risks they can envision. The sponsor and the core team should then simultaneously and independently rate each risk. The sponsor needs to decide how much of each identified category of risk he or she is willing to tolerate. The team needs to use two scales—both how likely each risk is to happen and how severe the consequences are if the risk event materializes. Then the two parties should rejoin for discussion. Any risk that the team feels is much higher than the sponsor is willing to tolerate should be reviewed. Any risk event that has high consequences should also be reviewed. In each case, either a different approach to the project or a contingency plan may need to be developed.

Many details need to be considered during project planning. A wise project leader will note throughout the initiating stage how much and what kind of work various project participants can handle. One method of deciding how much detail the leader must personally undertake is to start the planning hierarchically. That is, the sponsor and the core team should jointly determine the high-level approach and then each technical lead should be initially responsible for working out details within his or her broad area (the functional manager needs to be involved in this decision-making with the technical leads to ensure buy-in). Now that the high-level plan has been developed and the various technical areas have been planned in detail, it is important to integrate all the detail into a more comprehensive plan. If the project manager is convinced that the detailed plan is adequate, he or she should inform the sponsor and proceed. If some portions of the plan are not done well enough, the project manager should work in those areas until the technical leads prove they can handle the details themselves. The sponsor and the project manager should have frequent dialogues so they can jointly decide how much detail each needs to be involved in to ensure the project is progressing satisfactorily.

Identifying useful metrics is one aspect of detail planning that project leaders need to ensure is done well. Each project should have a few well-chosen metrics to respond to the specific needs of various stakeholders. Metrics can include cost, schedule, quality, etc. and can be either in the form of in-progress metrics or end-of-project metrics. A leader should insist on enough metrics to understand the health of the project, but no more than necessary. One of the most difficult, but most important types of metrics is the in-process quality metric. In other words, each project should have a clearly delineated way to assess how the quality of the project deliverables is progressing.

During the executing stage, project leaders must monitor and control the project work activities. The metrics established during the planning should be used on a consistent basis. A system needs to be developed to compile periodic updates. Project leaders must practice a bit of management by walking around—they should make it a point to be present so progress and problems can be communicated quickly and effectively.

Many possible changes are proposed on typical projects. Leaders must insist that a simple change-control process and form be established and used. The pressures of time will tempt many participants to ignore any change-control system. Therefore, it must be simple to encourage widespread use. Leaders must continually insist that all changes that have an impact be recorded and approved (if they fall within the approval guidelines). Small changes add up. Projects without adequate change control often end up late and over budget, with poor technical results and inadequate documentation.

During the closing phase, project leaders need to ensure projects are terminated correctly. Some projects will need to be terminated early, and these can pose a special challenge for project leaders since there may be either a real or perceived failure. If the project is unsuccessful (either through the fault of participants or because of external circumstances), it is often detrimental to the careers of the individuals involved. Leaders need to make sure that people who are involved in an unsuccessful project are not unduly harmed. In fact, an individual who rapidly identifies a project in trouble and recommends its early termination should be rewarded for saving the organization's resources, which could be better used on other opportunities. Project leaders also should try to keep the relationships with suppliers, customers, and other parties as healthy as possible during this stressful time.

INTEGRATION

Initiating	Planning	Executing	Closing
Justify and select project	Integrate project plans	Coordinate work	Capture and share lessons

Integrating all aspects of the project and the project as a whole into the organization is an important task for project leaders. They have to ensure that the project not only aligns with the organization's vision but also fits into the organization financially, physically and emotionally. It is the project leaders' task to communicate to the whole organization how the project fits into the broader picture of the organization. The project sponsor, project manager, and steering team should continuously evaluate whether the project reflects the organizational values and vision. Project leaders also need to coordinate multiple projects. Their concern should not only be completing their project but also integrating their project with other projects and prioritizing the common resources used among them.

During the initiating stage of the project, justifying and selecting the project by the senior management of an organization should integrate both the organization's and the stakeholders' best interests. The team should use the broader mission and vision of the organization as a guide in selecting projects. All potential projects selected by the steering team must align with the organizational needs. The project manager and project sponsor need to look at all projects and describe how each integrates with the needs of the parent organization. Project leaders need to articulate a business case for their project to get the relevant stakeholders' buy-in. The steering team should have a method of screening the potential projects to select the feasible ones. The project leaders must be able to accept or reject projects based on their merits.[10]

During the planning stage, integrating different detailed plans is easier said than done. Usually, when most of the planning is taking place, there is time pressure to move along and iron out details later. This often creates disruptive problems that could have been minimized with more detailed planning. On many projects, several different individuals or groups plan various details. The project manager and core team need to act as leaders to ensure all the parts really integrate. This is quite possible since those planning each portion of the project should have tried to create a schedule in which the work and that portion could be completed as efficiently and effectively as possible. Now the leaders need to ensure the same for the entire project. When the project is not looked at as a whole, suboptimizing may occur. The core team needs to think systematically in two ways: how do all the parts of the project fit together, and does the plan really reflect the relative priorities of scope, quality, cost, and schedule as determined by the customers? Project leaders should also remember that both ideas and numbers are important in an integrated project plan, to analyze complex tradeoffs to help in integrated decisions, to understand cause-and-effect relationships, and to know when to make decisions personally and when to allow decision-making by the project team or the stakeholders in order to get a shared sense of ownership.[11]

During the executing stage, coordinating work between multiple projects is a task for project leaders to do while they are championing the project's execution. Most organizations will have multiple projects and many ongoing activities occurring simultaneously. While some project team members will be totally committed to the project, some members will be working on multiple projects and ongoing jobs. A project leader's task is to help all those associated with the project to balance their work on multiple projects and also accomplish the work for their project. This is one of the interesting challenges for project leaders since they are responsible primarily for the successful completion of their project but must also keep in mind the broader picture of the organization's needs and hence resolve conflicts between other work and their project.

During closing, integrating the experiences throughout the project as lessons learned for future projects is a task for the project leader and the team. The lessons learned can be categorized as lessons for organization and lessons for individual development. The project leader must provide lessons for individuals in a very positive manner. A lesson should not be seen as a performance review but as learning for the future. Most organizations do not handle lessons learned very well. Sometimes they are gathered, organized, and available but not used, or accessible to very few. A project leader, as part of his or her planning, needs to allocate time to capture lessons learned throughout the project at different touch points so that they help the project in subsequent stages. He or she must also ensure that information is available and not forgotten, which helps for continuous improvement of projects. Project leaders should develop an integrated methodology to collect information and share benefit from the lessons learned. Project leaders must insist on using lessons learned in their projects and encourage the continuous improvement of the process.

HUMAN RESOURCES

Initiating	Planning	Executing	Closing
Select key participants	Select other participants	Supervise work	Reassign workers

Some of the key responsibilities of any project leaders are selecting, developing, empowering, supervising, rewarding, and helping reassign all project participants. In accepting prime responsibility for this task, the skilled project leader will first assess all the people already involved in the project. This includes senior management, customers, collaborators, and other stakeholders. The assessment's goal is to understand better the mix of people who are already involved in the project and to be able to add to the mix those who bring diverse skills and approaches. The project manager should have the ability to supplement and complement the team to ensure that tasks will be accomplished in a creative and cohesive manner. This is a challenging task and often one that is overlooked.

In determining who the key participants are, much of the success or failure of the project will also be determined. It is often said that if you have the right team, you can accomplish almost any task, and with the wrong team, the simplest task will not be accomplished. The first human relations challenge is figuring out who is ''right.'' Obviously the expertise, experience, and specialized understandings that are needed have to be decided upon. It is often useful to add a personality profile inventory, such as the Myers-Briggs,[12] to understand better how the various individuals on the team function and what they value.

An understanding of diversity is necessary to accomplish this task well. It is important to bring together a team that is diverse in many elements, as depicted in the diversity wheel[13] in Figure 15–3. The wheel has four dimensions: personality, internal, external, and organizational.

A key to any team is to have a balance of personalities, learning styles, and people who are motivated in very different ways. It is also useful to have people who see and feel and touch the world from different perspectives based upon their internal dimensions. It is particularly helpful to mirror the experience and approach of customers and other stakeholders. For example, if a project is providing a series of services or activities for senior citizens and all the individuals on the team are under 30, obviously that could create a disconnect between the team and the client. The internal dimensions of age, gender, sexual orientation, physical ability, ethnicity, and race all impact how we experience life. The external dimensions in organizational dimensions also define how various individuals experience life, and therefore, again, a mix is extremely helpful. This does not imply that every element of the wheel must be represented on every project team. In fact, many may not apply to a given project and may be less relevant. However, it is important to keep the wheel in mind when choosing a team to ensure diverse

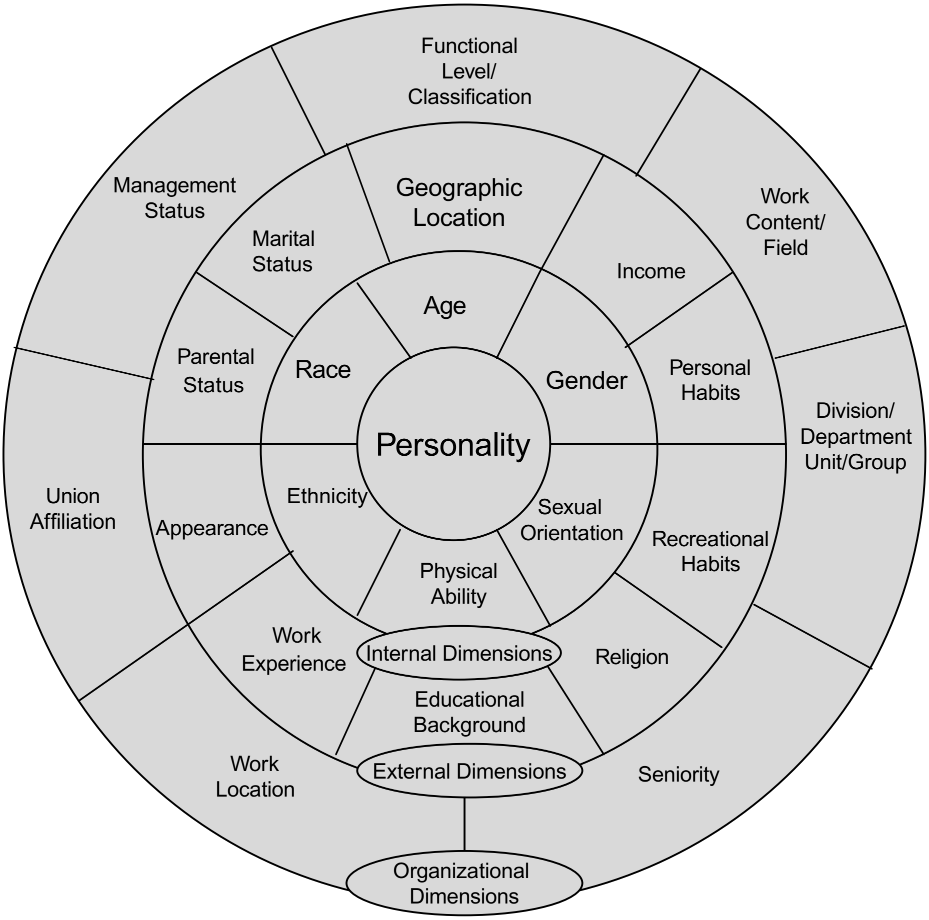

Figure 15–3 The Diversity Wheel

Source: Gardenswater and Rowe; adapted by Lodan and Rosener, Workforce America

thought, experience, and approaches. All these cautions apply to the initiating stage, when the human relations task is to select key participants, and to the planning stage, where various core team members select other individuals who will be involved in the project. As much as possible, the project team needs to mirror the population that will be utilizing the project outcomes, i.e., the customers, both internal and external.

All managers have the fundamental task, in the executing stage, of supervising the workers. What is the most effective way to supervise? The answer, of course, is, it depends! Another answer is to supervise people in a way that will help them to be as efficient and effective as possible, that will motivate them to meet their goals and the project goals, and that will find a synergy between the two. In other words, different people need to be motivated in different ways.

The classic work done by Blanchard in the area of situational leadership indicates that the formal leader should direct, coach, support, or delegate, depending on the situation and the needs of the individuals involved.[14] Typically, in the beginning phases of a project, participants need a great deal of direction in understanding their tasks and minimal support. After a brief period of time, participants still need more direction as new tasks emerge, but they also want support for what they have accomplished. They want to be told they are doing a good job when they are doing so, and other times they need to be told how they can improve their work. This phase is called coaching. The third phase, counseling, is when a person has done a task long enough not to need much instruction or direction, but would appreciate positive feedback. Finally, when a person is skilled enough to do the task well and needs neither support nor instruction, comes the fourth phase, delegation. A skilled supervisor knows which kind of feedback every person involved needs and gives them the appropriate supervision.

A key step in managing human resources is to ensure that during the closing stage everyone involved in the project is reassigned to work that they find interesting, challenging, and appropriate. Project leadership requires everyone in the hierarchy to assist those below them in moving on to appropriate assignments when the project is completed. This requires understanding of the political process in the organization, the strengths of each person involved, and the needs of the organization. Project leaders need to be very active in this phase, not only because it is the right thing to do, but also because, when it is understood in an organization that project leaders assist those involved in getting an appropriate next assignment, recruiting people for future assignments becomes much easier.

HUMAN RELATIONS

Initiating	Planning	Executing	Closing
Determine team operating means	Develop communications plan	Lead teams	Reward and recognize

It is not enough to have the right people to do the project. The right people also have to work together as a team to implement the project and establish a cordial relationship with customers, the steering committee, and all stakeholders of the project. During the initiating stage of the project, the team is in the forming stage of team development and the members show excitement and anticipation but also fear about working as a team. During the project-planning and executing stages, the team grows through the storming, norming, and performing stages of the team-development cycle. The team displays competition and positioning during storming, starts to form its own procedures and practices in the norming stage, and finally reaches the performing stage when it becomes self-directed. During the project-closing stage, the team is in the adjourning stage of team development where work comes to an end. The project leadership task is to ensure that relationships among team members and with customers and stakeholders during the team development are healthy. To do this, the project leader has to communicate to the team and to the stakeholders as required. The relationship between the core team and the steering team and the various project stakeholders must be based on trust and honesty so that there are no surprises at the end. The project leader needs to let the team function and steer only as needed, at the performing stage of team development, without falling into the micromanagement trap. During the performing and adjourning stages of team development, the project participants and contributors to the project have to be recognized and rewarded to keep up their morale and gain their support.

During the initiating stage, as the team is put together for the project, establishing team operating methods is essential for the team members to establish effective working relationships. This is a time to capitalize on the initial excitement of the team and also to answer the members' fear of working together by coming up with procedures to work effectively as a team. The team operating methods include a team charter put together to prevent certain problems from occurring, smooth out difficulties, to help with working efficiently as a team, and create an atmosphere for making decisions with minimal conflict. Effective team operating methods help the leader to chart the course rather than merely steer the ship. Project leaders can directly impact team development by insisting that the team develop methodologies for decision-making, meeting management, meeting minutes recording and distribution, and interim reporting, and by developing an atmosphere conducive for personal growth and learning. Once the team creates operating methods (or enhances organizational procedures that already exist), the team should openly discuss the different personalities of the members and stakeholders and come up with a plan to work together. This is the stage where project leaders build structures and procedures for making decisions. A leader needs to accept that individual team members work differently but utilize agreed-upon team operating methods.

During the planning stage, a project leadership task is to develop a communications plan for the team to communicate with each other, with the steering team, with customers, and with other stakeholders. The concept behind effective project communications is first to understand who needs to know what, in what format, at what time, and under what circumstances. The challenge is to differentiate between the needs of the stakeholders and their desires. Once this is understood, it is time to construct a plan to give the different stakeholders the information they need, precisely, honestly, and in a timely fashion. Project leaders need to articulate their vision continually to all stakeholder groups. A project communications plan is a tool for a project team to communicate and establish relationships with the different stakeholder groups. The communication plan should be balanced between too much and not enough communication. The communication plan must be developed and discussed with all the participants, and the leader has to make sure it satisfies the needs of all stakeholders. The communication plan is the formal communication process, but project leaders should also encourage informal communication in all directions in the team and make it easy for the project participants to approach them with suggestions or concerns. Project leaders should also encourage feedback on the formal communication.

During the executing stage of the project, the teams are hopefully in their performing stage of team development. The project leader's challenge is to lead the team but not micromanage. During the performing stage of team development, team members are committed to the project, so leaders should focus on directing actions towards project accomplishment. The project manager and the sponsor should help the team reach its collective potential by assessing the team's strengths and weaknesses. The leaders should encourage self-management using the procedures established during the initiating and planning stages of the project. The leaders should be role models and serve by ''walking the walk.'' This creates trust among the project team members and lets them concentrate on their work with one less reason for stress affecting them during the project. The leaders should emphasize the important work being done by the project team and gain the team's support in completing their project. Project leaders need to be facilitators. They should let the team work but also monitor the progress of the project and intervene if necessary.

A very important leadership task during the closing stage of the project is to recognize and reward the project participants, stakeholders, and even customers. A project is successful as a result of effective teamwork. To honor the team, there should be formal and informal recognition. More than monetary benefits, many team members would like formal recognition for their achievement, and project leaders must ensure that they get it. This will help the leaders gain support from the organization for future projects. It is also necessary to recognize participants from the customer's organization because without their input and help the project would not have been a success. Other important stakeholders should also be recognized. The leaders should know by now what each project participant would consider a reward. The leaders should be sensitive to individuals' needs and values and culture when rewarding.

PROMOTION

Initiating	Planning	Executing	Closing
Develop top management support	Motivate all participants	Maintain morale	Celebrate completion

Often, individuals are chosen to lead projects because of their technical competence or their skill in planning and organizing. The role of cheerleader is usually not discussed and indeed is often not seen as important. However, project leaders have the responsibility, throughout the life cycle of the project, to keep the morale of everyone involved as high as possible. This includes customers, project participants, top management, and other stakeholders who are involved with the project. It also includes the project leaders themselves. They need to understand their own motivators and ensure they act as appropriate models. Part of the process is to celebrate various milestones as appropriate. For example, everyone in the construction industry understands the value of a topping-out party to celebrate when the last of the structural steel is in place and the top floor deck is complete. People celebrate in very different ways, and skilled project leaders understand that the celebration should be culturally appropriate for different individuals involved. The skilled leader involves not only the participants but top management and the customer at the celebrations throughout the project.

In initiating the project, a leader needs to ensure that senior management understands all aspects of the project in enough detail that they will be supportive of the project throughout the process. In all projects, low periods occur when there are competing needs in the company, or some aspect of the project appears to be at a standstill, or some other factor is creating issues in terms of the successful completion of the project. Top management may have a tendency to step in and stop the project and move people on to other tasks. This is the time when it is crucial that top management show continued support, and a project leader must prepare them for this from the initial stages of the project.

During the planning stage, all participants need to be motivated. A skilled project leader is well aware that different people have different motivators. Some are motivated by tangible rewards; others are motivated by more intrinsic rewards such as giving them authority, supporting their ideas, and empowering them to feel a sense of ownership in the project. A project that involves a lot of people (and most projects do) creates a significant challenge for leaders at various stages as they find the appropriate motivators for all of the individuals involved. People's culture, age personality, lifestyle, and other diversity variables impact on how they are motivated.

In Figure 15–3, the classic diversity wheel is presented. It shows 28 different aspects of an individual that may well impact what motivates them and what demotivates them. Since all teams are diverse by the definitions of the wheel and should be as diverse as possible to ensure the most creativity and variety of perspectives in developing the project, the project leader needs to understand what motivators will work best for his or her project team. One of the first principles of diversity is to ask, and the wise leader who is unsure about what will motivate people simply asks them.

It is one challenge to motivate individuals in the planning stage, but a different challenge to maintain motivation during the execution stage. While some conflict is inevitable and healthy, too much conflict obviously can impact a project negatively. As Blanchard and Johnson teach in *The One Minute Manager,* it is important to give one-minute praise in public, and at times one-minute reprimands in private (in a nonjudgmental way).[15] Finally, one-minute planning is an excellent tool in working with individuals to allow them to develop more effective ways of getting tasks done and keeping their morale up. The effective leader continuously asks himself or herself if he or she is giving the support that people need and develops plans for each individual or group of individuals to best meet their needs.

During the closing phase of the project, or at the closing phase of various aspects of the project, it is often appropriate to celebrate. One question leaders need to answer is what kind of celebration they should have. Celebrations are often culture-bound, and what is appropriate in one setting may not be appropriate in another. A clear example is the use of alcoholic beverages. While this is the custom in many subcultures, it violates religious norms and cultural patterns in many areas of the world. It is important that the type of music used at a celebration (or indeed at any aspect of the project) not be culturally offensive and vary enough to meet the needs of different generations, lifestyles, and cultures. Another question is who should be involved in celebrations. In many cultures, family members are involved, while the Euro-American tradition includes only individuals directly on the team.

In the politically correct times we live in, some leaders choose not to celebrate rather than risk offending some individuals. However, not celebrating can be offensive to large numbers of people and is inappropriate. As in many other challenges during a project life cycle, it is often wise to involve a cross-section of people to make decisions as to what is appropriate. Certainly in setting up celebratory events or even in plans for motivational approaches, it is wise to involve a team of people in decision-making. Leaders who understand the importance of promotion, developing top management support, motivating all participants, maintaining morale, and celebrating completion of projects, tend to be involved with the most successful projects.

COMMITMENT

Initiating	Planning	Executing	Closing
Commit to the project	Secure key customer approval	Secure customer acceptance	Oversee administrative closure

Projects can be highly stressful, difficult work. People are frequently doing unfamiliar work. It can be frustrating. For all these reasons, it is vital that people commit to the successful completion of a project. All stakeholders must not only commit to a project initially, but recommit for as long as the project takes. If all of the other project leader responsibilities have been performed well, commitment is much easier to obtain. Commitment can be envisioned as the culmination of all the other work (especially project promotion) during each stage in the project life cycle.

The culmination of the initiating stage is when a project charter gets signed. A charter is tantamount to a contract between the sponsor (who represents senior management and any other customers) and the core team that will carry out the project. While charters vary in form, their purpose is to get all participants quickly on the same page. One can think of it as a very rough plan that everyone can understand and agree to in principle. One way to remember items frequently included in a charter is the three Ws, Hs, and Cs[16]:

Why is this project important?
What is included and what is not included?
When will the project be completed and how will it be evaluated?
How much money and other resources do we expect to need?
Hazards—what are the risks and assumptions?
How will the project team operate?
Communications plan—who needs to know what, when, and in what format?
Collection of knowledge—what lessons can be incorporated from previous projects?
Commitment—have all parties signed up for their respective responsibilities?

Sponsors will often write the rough draft of the why and what sections. These can be very brief—a sentence or two for the what and a short list or paragraph for the why. If the sponsor is really representing top management and any other customer, he or she should be able to get the project team started with this. The core team then often writes the rough draft of the other sections, sometimes with help from the sponsor. Once a draft is written, both parties get together to discuss every detail in the charter for both understanding and agreement. Finally, the charter is signed and each person treats it as a contract and tries very hard to live by it. One caveat is that everyone knows the estimates in the charter (schedule, budget, resources, scope of work) are based upon the best knowledge at the time—but not based upon detailed planning. Therefore, some of the specifics are likely to vary when the detailed plan is completed. This does not give either party the right to try to change the intent later. Everyone should be firmly committed to the project.

Commitment is also the culmination of the project leader's responsibilities for the planning stage. The final commitment is to secure approval of everyone for the detailed project plan. If the project leaders have taken an inclusive approach (including all interested parties) in accomplishing their other responsibilities during the planning, few people should be unpleasantly surprised when it comes time to approve the project plan. The approval process can vary considerably depending on the size and type of project. On a large project, it is common to have the core team coordinate much of the planning and other interested parties to help plan the portion of the project they are involved in. In such a case, a wise project leader will have one meeting with the core team to ensure they all agree with the entire project plan, and then have a more public kickoff meeting for all project stakeholders. At a typical kickoff meeting:

- The sponsor and project manager will describe how important the project is.
- Everyone will introduce himself or herself.
- The project manager and the core team will describe work expectations.
- The project manager will describe the project goals.
- The customer will describe their satisfaction standards.
- The project manager will describe the project plan and current status.
- The core team will describe the communications and quality plans.
- Everyone will have the opportunity to ask questions.
- The project manager will make any changes to the project plan.
- Everyone will agree to the plan and to his or her individual action items.[17]

Commitment during the project-executing stage is twofold: ongoing commitment on everyone's part to continue the project work as long as needed and acceptance by the customer of the project deliverables when they are complete. Some projects take longer than expected or are very difficult to accomplish. Ongoing commitment is required. We all need to find ways to recommit during the difficult times on our projects. As project leaders, we need to find ways to help the other people on our projects recommit.

The end-of-execution stage commitment occurs when the customer formally accepts the project deliverables. This can happen all at once or in stages. Generally, the customer wants some sort of guarantee or demonstration that they are getting what they signed up for. This demonstration should have been agreed upon in the project plan. If not, to get the customer really to commit to accepting the project deliverables, a wise project leader should agree to this. Often a customer will provisionally accept the deliverables—they need them quickly, but the deliverables are not complete or perfect yet. In this case a ''punch list'' of remaining work is created and agreed to. A responsible project leader will take this punch list very seriously and insist that each item be completed to the customer's satisfaction.

Commitment in the final project stage—closing—is ensuring that all the administrative details are complete. This is far from the most exciting project work; it is finishing all the details that are left hanging. It can include finishing the last work packages, satisfying the last punch list items, closing out the budget, completing and distributing the final reports, paying all vendors, etc. One additional challenge frequently is presented during closing: some of the most energetic participants have been assigned to new projects. The final project leadership challenge is to ensure that all the administrative closing details are satisfactorily completed. This final challenge presents the project leader once again with the dilemma of when only to oversee and when to intervene. If the leader has done a good job of empowering others on the project team and has insisted that all responsibilities be accomplished, this should go smoothly; otherwise it can be a nightmare. The project leader has the power, by how he or she behaves throughout the project, to have either a fairy tale or a nightmare ending.

Summary

This chapter has discussed the need to utilize the learnings in the fields of project management and leadership to understand and implement project leadership.

The framework used delineates seven key tasks of project leadership and discusses each of the tasks during the four phases of project leadership: initiating, planning, executing, and closing. This model (or any other representation of the challenges) requires that everyone involved understand each task and complete it in a manner that reflects skill in both managing and leading. Suggestions are given that apply to each of the 28 cells. The needs of various stakeholders, the project itself, and the people involved directly in the project all have to be balanced by applying appropriate project leadership principles.

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Chapter

16

Making Optimal Use of the Matrix Organization

Charles J. Teplitz

Biographical Sketch . . .

Charles J. Teplitz is the Clarence L. Steber Professor of Project Management in the School of Business Administration at the University of San Diego. He was the founding Director of the University's Certificate in Project Management program, one of the first such programs in the country. Dr. Teplitz has been a certified Project Management Professional (PMP) by the Project Management Institute (PMI) for over a decade. He currently serves as a member of PMI's Publications Advisory Board and is on the Editorial Review Board of *PM Network* and the *Project Management Journal.* Dr. Teplitz is a frequent speaker, trainer, and consultant in the United States and Europe and has published numerous articles on project management.

A love-hate relationship explains management's attitude toward the matrix organization. For over 30 years, organizations have vacillated between utilizing the matrix structure in managing their firms and opting for the traditional functional organizational design. Literature reviews over this period of time indicate total indecisiveness by organizational experts as to the superiority of the matrix structure over alternative organizational structures. Although project managers have little influence over the design of the corporate organization, they do have to operate optimally in a variety of situations. Project managers can use the nuances of the matrix organization to their advantage when managing projects.

What Is the Matrix Structure?

The organizational design of a matrix structure represents the hybrid of a functional organization and a pure-project organization. The functional structure is perhaps the most familiar. As seen in Figure 16–1, this hierarchical form demonstrates the type of command structure seen in a military environment, with each subordinate reporting to a singular superior. Each parallel structure represents a significant function within the organization, such as marketing, accounting, production, logistics, and finance. The pure-project structure looks quite similar to the functional structure as can be seen in Figure 16–2. The only difference is that whereas the diagram describing the functional structure represents the entire company, the diagram describing the pure-project structure only represents those functions used by the specific large-scale project depicted. In other words, the project is shown as a miniature organization, which is that of the project. This format is used when a project is of sufficient size and duration to warrant an entire organization of its own.

The matrix organization chart appears similar to the functional chart. The difference is that there is a project manager (usually reporting to a director) whose responsibilities cut laterally across many of the functions. The result is a matrix of superior and subordinate relationships as shown in Figure 16–3. It is a hybrid of the functional and pure-project organization in that functional personnel report to the project manager, even though the functional personnel belong to an existing department with its own manager.

Niche Filled by the Matrix Structure

As a hybrid, the matrix structure takes advantage of the fluidity of the hierarchically aligned organization while being flexible enough to fulfill the objectives of distinctively different projects. With this form, the functional departments are maintained as repositories of specialized resources and each project is provided a manager accountable for project success who reports directly to top management. This arrangement places the project manager on the same level of hierarchy as the functional managers, providing the project manager with legitimate power in negotiating for needed resources. Thus, although project and functional components are interdependent with regard to the performance of the project, they remain administratively independent. This division of responsibility can create conflict. Despite the potential problems, the matrix structure attempts to preserve the strong points of both the functional and the pure-project structures while avoiding the inconveniences of each. Organizations find that the matrix structure is the most economical for a project environment.

Economics of Organizational Design

Each organizational design option, such as functional, pure-project, and matrix, has its unique cost consequences. The functional structure is the most cost-effective. Economies of scale are obtained within each department by

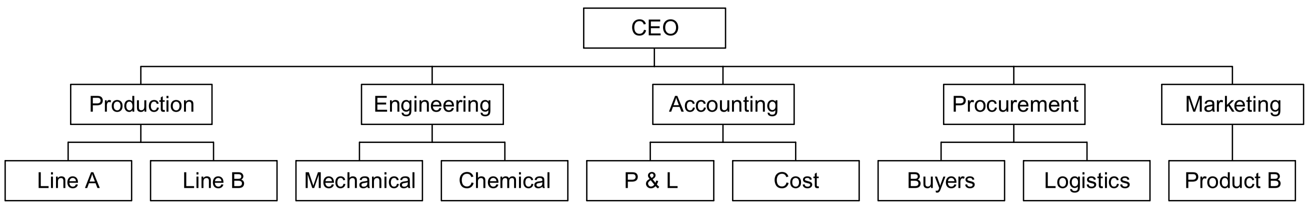

Figure 16–1 Functional Organization Structure

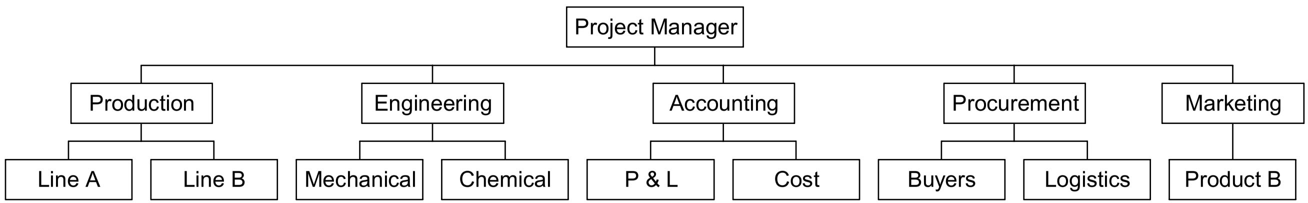

Figure 16–2 Pure-Project Organization Structure

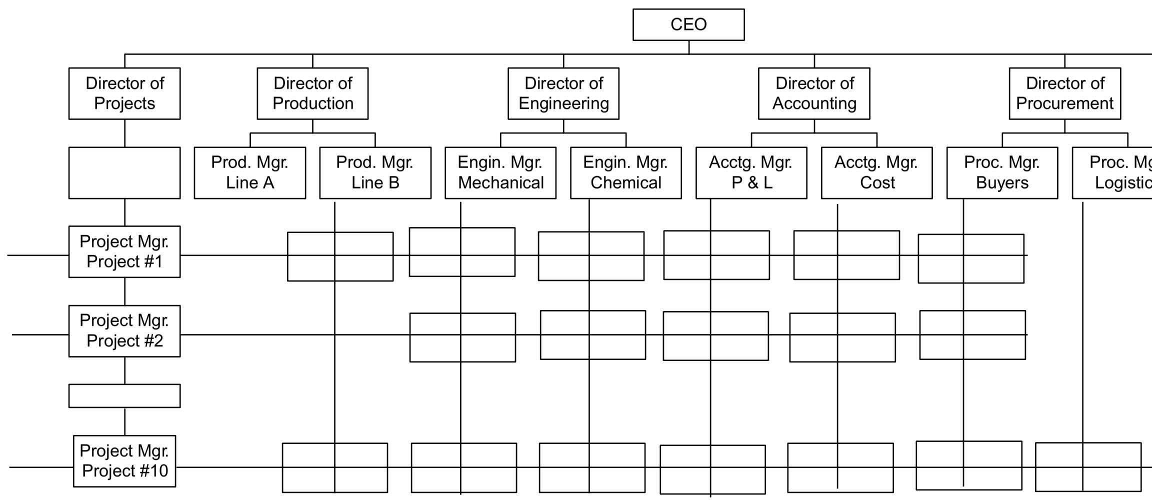

Figure 16–3 Matrix Organization Structure

staffing to efficient levels with well-trained and qualified individuals. The departments can focus on training and technological improvements that will lead to enhanced departmental abilities as well as additional cost efficiencies.

Under the pure-project organization, each ''mini-organization'' must contain sufficient departments and personnel to fulfill the demands of the project. There are as many mini-organizations in the company as there are projects. The problem is that not all projects require an entire department or even a whole person dedicated to a particular function. This exposes the company to cost inefficiencies because of redundancies in resources. For example, one company using the pure-project structure found that one of its projects would require the services of a mechanical engineer. Under the pure-project design, they would need to establish a mechanical engineering department for this project and staff it with the appropriate number of mechanical engineers. Unfortunately, this was a small project requiring approximately three hours a day of mechanical engineering. The structure required them to hire a ''whole'' mechanical engineer even though the workload was only three hours per day. This example is certainly not unique to this project or this company. The possibility of such a scenario repeated many times throughout an organization leads most companies to avoid this structure. The company in this example decided to cross-train the engineer to perform other functions during the day, thus reducing their cost per hour of mechanical engineering for this project.

The matrix structure, being a hybrid, is economically somewhere between the other two designs. By maintaining departments of resources to be *shared* by all projects, resource costs are much lower than under the pure-project method of organization. It is true that under the matrix structure departments have to contain more people than under the functional structure to ensure adequate resource availability for all projects. But the lack of efficiency is offset by the possibilities for synergy and improved methodologies within the departments. Thus, the matrix structure is often found to be the most economical for a company performing much project-oriented work.

The Matrix Continuum

Firms employ the matrix structure to varying degrees depending on the significance of work performed as projects. It would not be appropriate for a firm that only occasionally performs projects to restructure the entire organization into a matrix format. Likewise, a company obtaining most of its revenue from one major project would be well advised to take a pure-project approach to organizing this megaproject. With project managers and functional managers having a different set of objectives, the appropriate organizational structure will depend upon the weight that top management gives to each objective. Therefore, the matrix structure employed by a firm may more closely resemble a functional structure or a pure-project structure, depending upon the company's needs.

Functional Matrix

The functional matrix, also known as a weak matrix, is appropriate when overall quality or technical expertise is more important on the project than low cost or schedule maintenance. In this environment, the balance of power between the project managers and the functional managers is definitely in the functional managers' favor. That is, the functional managers have a greater degree of decision-making influence than do the project managers. Under this structure, when push comes to shove, the project managers will likely have to bow to the demands of the various functional managers with whom they are negotiating.

Project Matrix

The project matrix, also known as a strong matrix, is appropriate when project cost and schedule are more important than overall quality. Here, the project manager possesses the greater degree of decision-making influence because the project is deemed significant to the company. It is also not unusual to see project-team members removed from their functional departments and physically located together for the duration of this important project. The extreme in relocation is referred to as ''skunk works.'' This has been used very successfully by companies such as Apple and IBM for the development of a whole new product line. Physically moved to a location off-site, the project-development team bonds as a unit and is freed from the home organization's bureaucracy, policies, and procedures.

Balanced Matrix

The balanced matrix exhibits a balance of decision-making influence between the project manager and the functional managers. In this environment, it is believed that cost, schedule and quality are equally important. It is here that the project manager possesses the same degree of decision-making influence as the functional managers. Because of the apparent equality of the managers, this structure results in the need for continuous negotiations and tradeoffs between the managers. Such interactions often result in considerable conflict between the project managers and functional managers. This issue will be addressed in greater detail later.

Critical Look at the Matrix

As a hybrid, or more accurately, a compromise, the matrix does indeed possess some of the positive as well as negative features of other organizational designs. Project managers trying to complete projects successfully in this environment must understand the conditions under which they are attempting to operate.

Responsibilities of the Project Manager

Project managers are responsible for planning what has to be done for the project, when it has to be done, and how much can be spent to do it. Then project managers are for making sure the plan is met. Thus, the project manager is a very busy person. Most of the project manager's time will be spent developing sound relationships with the customer, functional departments, and team members, to name a few. The purpose is to ensure that what needs to be done is being done in a timely fashion and within budget.

Under the matrix structure, the project managers have no direct subordinates. Project managers can only get work done through functional managers' subordinates. To do this, project managers must not only negotiate with functional managers for the use of their subordinates, but must also convince functional managers of the importance of timing the subordinate's availability properly. Depending upon the matrix structure (weak to strong), project managers may be facing quite a challenge. Project managers must negotiate with all the functional managers for all their needed workers. Also, project managers are likely to require the same resources at the same time. Therefore, negotiating and communicating skills are essential for the successful completion of the project. After all, a project manager's job is to integrate and coordinate the various resources to meet the goals of the project.

Responsibilities of the Functional Manager

Functional managers are responsible for determining how the tasks of the project are to be accomplished and who will accomplish them. They are the ones responsible for maintaining the high level of competence in their organizations and for ensuring that the work done on the project is of the highest quality. One reason for leaving the functional departments in place under a matrix organization is to provide an atmosphere in which professionals can enhance their skills and the knowledge base of the organization. Functional managers *own* the resources. Project managers are simply borrowing these resources.

The functional manager's priorities are to improve continually the technical competence of the department's resources and to provide project managers with skilled staff to perform the project's scheduled work. These goals are in conflict. Goal number one is negatively affected if the subordinates are unavailable to the functional manager while assigned to a project, which is goal number two. Unfortunately, the priorities of the department manager rarely match the priorities of the projects and the project manager. Therefore, it is to the project manager's advantage to be aware of the inherent conflicts of the matrix organizational structure and to take action to mitigate these conflicts.

The greatest source of conflict between the project and functional managers is the fact that the functional managers own the resources whereas the project managers own the work. Both are dependent on the other for their own survival and yet resent this dependency. It is this ego problem that must be watched. If an organization recently shifted to the matrix, the project manager will also experience the hostility of the functional manager, who believes that his or her role as a manager has been reduced by the reorganization and by the project manager.

Perhaps the most recognized drawback to the matrix structure is that personnel are expected to report to two superiors, their functional manager and the project manager to whom they have been assigned. This dual-reporting scheme goes against all management theory for successful employee relations. The project personnel are put in a bind: At any point in time they might be requested (required) to perform two very different tasks for their two very different superiors. Which do they obey? Unfortunately for the project manager, even in the matrix environment, the functional manager tends to possess the power over the subordinates. The worker comes from the functional manager's department and is only temporarily assigned to the project manager.

A major cause of conflict can be attributed to a lack of clearly defined roles, responsibilities, and authorities. These roles need to be defined by top management. If they are not, project managers need to persuade top management to describe in writing the jurisdictions of the project manager and functional manager. This documentation will reduce much jockeying for position by these two. If both parties clearly understand each other's goals, life will be a lot better for all involved. It is vital for each to understand what makes the other tick, what things are important to the other, and what things are not.

These conflicts tend to come to a head when the project manager is given a functional staff person to work on the project. Although the functional manager's first priority is the quality of work by his or her subordinates, the project schedule often takes precedence over the availability of qualified and available department personnel. Typically, the project manager demands someone *now*. So the functional manager sends over the only person available at that time. This person could be newly hired from another company, or straight out of school with no experience, or a long-time employee who is somewhat incapable, or an old-timer who hates everyone and is just waiting to retire. Any of these scenarios can leave the project manager with a major problem, especially if, as is usually the case, the project manager has no input into the worker's annual review. When top management defines the roles of the project manager and functional manager, they should also define the project manager's role in performance appraisals, merit raises, and dismissal decisions for all personnel assigned to the project. This action will greatly reduce conflicts between project and functional manager, and will also reduce much of the anxiety experienced by project managers on personnel issues.

Another issue is power. In the matrix, there seems to be a constant power struggle between the project manager and the functional managers. Part of this occurs when top management does not document policies for this problem area. In some cases, top management may be oblivious to the potential for conflict or may have been in such a hurry to reorganize into the matrix that they failed to consider it. Regardless of the reason, power struggles are a fact of life in the matrix organization. Project managers need to keep in mind that even when power is given, it can just as easily be taken away.

In a 1974 study of project managers' sources of power, a survey of 66 project personnel revealed that they believed their project managers derived power from the formal authority given the project manager from top management.[1] Over the last 20 years, the project-management atmosphere has changed considerably. A similar study performed in 1992 reported that project personnel believed that their project manager derived power based upon the manager's technical expertise.[2] In the new study, formal authority was rated as the fourth most likely source of power behind expertise, reputation, and work challenge (the manager's ability to assign challenging assignments). Any source of power project managers can muster will be beneficial to them. Undoubtedly, project managers' professionalism, knowledge, and expertise will all help provide them with greater power in managing projects.

A third issue, in addition to conflict and power, is administration. The number and cost of administrative personnel are excessive under a matrix organization compared to the traditional functional design. Because each project operates independently, there is considerable duplication of effort under the matrix. In addition, the matrix structure, by its very nature, is much more complicated to monitor and control than are the other organizational designs. It becomes extremely important that all projects and their resource requirements be monitored by top management as a set, rather than as individual projects. This requires additional administrative staff to coordinate all of the ongoing activities. It also requires that a set of universal policies and procedures be established so all projects are managed in similar fashion using similar reporting methods and utilizing established forms and formats. Because each project has different goals, objectives, and payoffs, the strategy described can assist in establishing priorities between projects.

Benefits of the Matrix Structure

At the corporate level, it becomes obvious that the matrix structure provides maximum efficiency in the utilization of scarce resources as compared with other structures within a project environment. This shows up immediately in the corporation's bottom line. Also, from the lofty perspective of the head office, it is apparent that a properly functioning matrix facilitates more effective dissemination of information both vertically as well as horizontally. Such information flow reduces conflict and enhances the working relationships across functions and between managers (including project managers).

Project

The true beneficiary of the matrix is the project itself. In a matrix, the project gets respect—it has an identity. Under the functional structure, with no project manager assigned, the project is tossed over the wall from one department to another with the hope that it will be completed miraculously on time, within budget, and as designed. Unfortunately, projects can often fall through the cracks while moving from department to department in the functional structure. The functional managers may be overseeing many projects simultaneously and cannot be expected to control the progress of the projects through the organization. When this happens, projects can often lie dormant for some time because no one has been assigned responsibility for them. In the matrix, however, the project becomes highly visible and its objectives are made known to all relevant parties with responsibilities well delegated. When the project is assigned a project manager, it tends to get better support from the functional departments than it would get under the traditional structure.

Another benefit of the matrix structure is that the customer (client, project owner) receives rapid response to inquiries about project progress or modifications. Because the project has a dedicated manager, there is a contact person available to the project owner. Under the traditional structure, it would be extremely difficult for the owner to find someone to talk with who could speak knowledgeably about the status of the project or who had authority to modify the project objectives.

Project Manager

Project managers do not only exist in matrix environments. There are project managers in organizations designed under the functional structure and certainly in organizations designed under the pure-project structure. In fact, in the latter, project managers possess the most authority, power, and control of all project managers. However, in comparing the opportunities for success for the project manager, the matrix structure certainly provides a better chance for success than does the functional design. Under the matrix, the project manager enjoys greater control over resources used on the project. The project manager is in a better position to respond to problems or changes that come along. This affords the project manager more opportunity for balancing project time, cost, and performance. That translates into more opportunity to manage the project to a successful conclusion.

Functional Units

As compared with a pure-project environment, the matrix preserves the functional units at cost-effective levels. This facilitates the development and control of high-quality craftsmanship performed by department personnel without incurring corporate-wide expenses because of redundancies. It permits the continuous improvement of methods and quality of work utilized on all projects, not just one. The strong technical base also allows for the maintenance of a powerful corporate memory. Functional personnel will be able to recall examples of prior projects that perhaps exhibited similar characteristics and problems to the current project. A problem solved once can be more easily solved the second time it is observed.

Personnel

The matrix structure affects personnel in many ways. First, functional personnel stay with a project only as long as they are needed. They are not assigned for the duration of the project. This allows the workers many opportunities to experience different types of projects as well as project managers. Second, the workers are exposed to other departments than their own while working on a project. This is an excellent way for them to see what others do, and perhaps for them to move to other departments. Third, in rotating from project to project and project manager to project manager, the functional personnel are broadening their perspectives and experiences. This training is the best means of developing future project managers. Fourth, unlike those in the pure-project environment, these functional personnel know they have a home when the project is terminated. They know that when they are no longer needed for this project their jobs will not be terminated and they will be able to return to their own departments to await the next assignment. All of these factors lead to improved employee morale. After all, job enrichment and job enlargement are what the management experts agree provide stimulation for the employee and success for the project.

To Matrix or Not to Matrix

Since its conception, the value of using the matrix organization in corporate governance has been hotly debated. Advocates have stressed its efficient use of resources, improved information flows, and focus on project requirements. Detractors have stressed the power struggles, excessive overhead, and unwieldy structure. Recent studies have tried to settle this debate with the hope of offering definitive recommendations on the subject.

A 1997 study of project managers employed by government contractors, all using the matrix structure, attempted to discern the main strengths and weaknesses of the matrix.[3] They found that the project manager within the matrix structure successfully acted as a point of contact between functional groups and as a liaison between management levels. But they also found that the structure led to conflicts between the goals of the functional departments and those of the project. The authors of the study suggest that if the balance of power within a matrix structure is shifted in favor of the project managers, strong and effective management is possible. These results were confirmed in a 2001 study.[4] In this study, several hundred project managers working in matrix-type organizations were surveyed about the relationships between functional and project managers. Again, it was found that worker satisfaction and project success were improved when the project manager was afforded more responsibility and authority than is normally observed in a nonmatrix environment.

These results are subject to one caveat discovered in another study.[5] The success of the matrix depends upon the perceived effectiveness of the working relationship between project team members. In a matrix structure, team members must identify with and be *more* committed to the project team than to other constituencies in the organization (e.g., their functional department). This concept is paramount to the success of the matrix since individuals have dual responsibilities between their project team and their functional department.

Despite increased research into the pros and cons of the matrix, literature continues to report organizations shifting to or from the matrix structure. Recent headlines have announced that AOL Time Warner Inc. has eliminated the matrix structure in order to improve accountability of employees.[6] Likewise, SunCorp-Metway Ltd. has restructured away from the matrix in an attempt to improve financial performance and customer satisfaction.[7] On the other hand, Honeywell Control Systems Ltd. has experienced much success with the matrix structure by incorporating continuous self-assessment by all of management.[8] Likewise, the City of Los Angeles Bureau of Engineering boasts considerable improvement in performance after reorganizing into a matrix structure.[9]

Conclusion

Obviously, there is no one right organizational structure for all companies at all times. Companies do reorganize periodically, sometimes looking for improved operations, sometimes simply looking for change. Although the matrix structure might currently work well for a company, in a few years it might not be appropriate. Therefore, if a company is not organized around the matrix structure, there may be a good reason. One should not believe that the only way the company can operate efficiently is to reorganize to the matrix. Likewise, if your company *is* a matrix organization, one should not assume it should stay in this configuration. It is important to understand the pros and cons of the different structures. Even in a functionally structured organization, it is often possible to implement certain aspects of the matrix to improve the relationships within the company and the efficiency with which your projects can be managed.

It appears that every aspect of business is being performed under the definition of the project, including operations to mine raw materials, construction of manufacturing facilities, procurement of parts, product manufacturing distribution through marketing channels, and sales and service. As customers demand more rapid improvements in technology and quality while insisting on price cuts and shortened lead times, firms are forced away from traditional functional organizations and procedures. They are adopting project-management methods, as evidenced by the exponential growth of project-management literature, books, professional societies, and certifications. This movement will likely result in more firms reorganizing into the matrix structure as its advantages become more evident.

ENDNOTES

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Chapter

17

How to Motivate All Stakeholders to Work Together

R. Max Wideman

Biographical Sketch . . .

R. Max Wideman is a retired engineer and professional project manager with experience in systems, software, social, and environmental projects, as well as design and engineering projects, from hydroelectric, river, and marine work to commercial and residential construction. He is a Fellow, Institution of Civil Engineers (U.K.), as well as Fellow of three Canadian engineering societies. He developed the 1987 version of the Project Management Body of Knowledge (PMBOK) and wrote two supporting books. He has presented papers and seminars in many countries, and his project management work can be seen at http://www.maxwideman.com. He was president of the Project Management Institute in 1987 and Chairman in 1988.

Who are the stakeholders and why should we worry about them? The answer is that project management is about running a successful project and the degree of that success is ultimately measured by the success of the product that is delivered. The problem is that such success is often a matter of perception and that perception is in the eyes of the stakeholders. So anything that can be done within the scope of the project to influence stakeholders to take a positive view also will help in managing the project. This is good reason to worry about the stakeholders and their expectations.

In the following sections, we will look at some issues around success, the stakeholders involved, and how to energize them.

 Field Guide to Project Management, Second Edition. Edited by David I. Cleland

Achieving Success Can Vary with the Type of Project

The classic measure of project-management success is ''On time, and on budget and meeting specifications.'' Important though these criteria are, the real measure of project success is the level of customer satisfaction in the final product. How this is achieved depends very much on the type of product, and this has a direct bearing on the best way to manage that particular project. Thus, there are several significantly different types of projects, and the following are some examples:[1]

- A project that results in a tangible product and is the result of craftwork, such as traditional building construction
- A project to develop a new physical artifact resulting from intensive intellectual work, such as a new invention
- A project in which the value of the product is in its intangible and intellectual property, such as the development of new software
- A project in which the value of the product is really intangible but nonetheless is the result primarily of craftwork such as updating and editing a procedures manual

These kinds of projects are very different and need different project-management approaches because of the people involved. It is a good idea, then, to identify these project stakeholders, especially during early project planning, and develop a list of related key success indicators (KSIs) that reflect their reasonable expectations.

KSIs are project-management indicators that should be identified at the beginning of the project, listed in order of priority, reflect directly on the perception of the project's product; and provide the basis for tradeoff decisions during the execution phases of the project. Needless to say, KSIs should be measurable in some way, on some scale, and after a relevant period of product time-in-use. Note, however, that KSIs should not be confused with so-called critical success factors (CSFs).

CSFs are generally those factors in the project and organizational environment that contribute towards project success, or otherwise militate against it. They are typically an integral part of the project's environment and generally beyond the control of the project team. Certainly, they have a significant impact on the way some of the stakeholders think, and positive examples include active management or public support, favorable labor or economic conditions, and sufficient time and/or budget to complete the work. In contrast, KSIs are essentially proactive and within the planning and control of the project team. They measure the way people think about the results of the project.

For example, a major objective on a particular public engineering project could be a political one to create local employment. However, the real value of the project is in the facility's cost-effectiveness over many years in service. For this project, the use of labor would be preferable to the use of plant, especially where the total real costs are about the same. Given established and prioritized KSIs, it should be possible to observe if the success focus changes and shift direction accordingly. For instance, market conditions or ownership may change during the project, leading to a new vision. Attention to relevant KSIs avoids a short-term project success becoming a white elephant in the long term.

Who Are the Stakeholders?

Stakeholders can be many and various and called by different names. For example:

- Project owner, client, customer, or financial source
- Project sponsor or director
- Program manager, project manager, leader, or coordinator
- Project team, group, or workforce
- The project's users
- Authorities having jurisdiction
- Professional and business groups
- The public, taxpayers
- The media
- Special-interest groups

Networking with these stakeholders occurs under two very different types of conditions. The first condition is if the project is undertaken entirely within the sponsoring organization, i.e., internally, usually for its own internal purposes. The second is if the project is undertaken for an outside client and involves some form of legal contract or agreement. We will discuss each in turn.

INTERNAL PROJECTS

Many organizations undertake projects entirely in-house for their own benefit. Typical projects include information systems and technology changes, organizational changes, or even the addition to physical plant. Whatever the project, it is vital to ensure that the project's stakeholders are all identified and brought into the network of contacts. If the project is to be successful, all must be fully committed and behind the project for its duration, even at the expense of some disruption to their own ongoing work.

The project manager is obviously an important stakeholder, and from his or her perspective the most important stakeholders are the project's owner or sponsor, possibly a departmental or division head. These are the project manager's clients. Note, however, that the owner and the sponsor of a project are not necessarily the same people. The first may provide the money while the second provides the overall direction usually in the interests of the users. Hopefully, both have the same goals in mind.

Nevertheless, the project owner is the ultimate beneficiary of the fruits of the project. The project owner is the one who will pay the bill, though the money to support it may be borrowed from someone else. Therefore, the project manager must ensure that:

- Project objectives are clearly spelled out
- Project concepts are effectively developed and planned
- The project itself is efficiently executed
- The project is properly transferred back to care, custody, and control of the owner on completion

The problem with this scenario is that many project owners are represented by a group and not one individual. That is, the project owner may be an executive committee, company board, or even the company's shareholders, and this does not make for the easy and rapid communication that the project manager needs to run a project efficiently. That is why the position of project sponsor, or project director, is an invaluable one, holding, as it should, a more focused, liaison position. Indeed, if the project does not have a specific sponsor, it is a good idea for the project manager to lobby to have one as soon as possible. This is true no matter how brief or small the project is. The project manager should ask, ''Who is my direct contact person?'' The answer to that question is the de facto project sponsor.

From the corporate perspective, the project sponsor or director is the individual employee who holds the authority and responsibility to act for the corporation on the project. At first glance, it may appear that a project sponsor duplicates the efforts of the project manager, but even on a small, short project, a well-briefed project sponsor can improve communication without any overlap of responsibilities. This is because the project sponsor's job is to:

- Participate in senior management's overall project prioritization and resource allocation
- Establish the project's level of priority and maintain that level of management's interest in the project
- Alert the project manager if circumstances, economics, or the environment changes and, if necessary, arrange to accelerate, slow down, redirect, or even abort the project
- Have oversight responsibility for the project's progress, control, and successful delivery
- Report progress to upper management

This is a vital role and one that can greatly relieve the burden on the project manager, whose primary responsibility is to manage the work of the project.

Hidden Stakeholders

It is rare for a complete list of stakeholders to be identified at first pass. Unsuspected stakeholders have a habit of popping out of the woodwork at inconvenient times, often with very negative attitudes because they were somehow overlooked. A checklist of stakeholders of internal projects will typically include:

- People recruited directly to work on the project team
- People seconded to the project, full time or intermittently, who normally work for other departments
- Managers of those other departments who will be contributing human resources or services to the project, sometimes reluctantly at first
- People who represent other departments because the project will affect those departments. These people may be the users or operators
- Representatives from other remote-location divisions, subsidiary companies, or even overseas branches, who will be affected by the project or required to conform to it
- Other project managers and their teams working on different projects within the organization but who may be competing for the same resources

In each case, it is the project manager's job to get these individuals enthusiastic about the project and contributing their best. It is a question of motivation. The project manager can greatly improve working relationships with these stakeholders through several personal strategies. The following are some suggestions:

- Invite people to join the project team, with the option of turning down the offer without fear of retribution. A person, who joins the team voluntarily, as a privilege or opportunity, will do so with a positive attitude and will offer his or her best.
- Interview every team member, preferably individually, to ensure everyone's support for the project. If support is lacking, bring out and resolve obstructing issues.
- Sell managers of the functional departments, who will be contributing people or services to the project, on the project importance and relative priority within the enterprise.
- Have users form their own users' group, particularly if the users will be many and various. The group can then have a designated spokesperson formally representing them on the project team. This tactic may or may not be successful, depending on the following:
  - The perception of isolation
  - The extended line of communication
  - The potential lack of discipline in conforming to the project timetable

This issue of discipline may require the intervention of the project sponsor. If other project managers are competing for the same resources, form a project managers' coordinating-committee. If this group is unable to agree, then call on the project sponsor to resolve the issue with senior management. While these recommendations require the project manager's personal and individual attention and can be very time-consuming, they are well worth the effort.

Keeping Internal Stakeholders on Your Side

Having recruited members to the project team, the next step is to form a viable working group. It is a question of team building covered in detail in this book in Section V, Team Management. However, a few pointers are worth mentioning here in the context of motivating stakeholders:

- Make sure that the project is in alignment with the enterprise's strategic objectives. An excellent approach to this end is the hierarchy of objectives tool, described by Robert Youker.[2]
- Decide on and maintain an appropriate level of stakeholder involvement, particularly for those who are not directly involved in the project team.
- Start the team-building process by holding a project start-up workshop including both the principal stakeholders and those who will be doing the actual work. A checklist for this workshop should include:
  - Description of existing situation
  - Goals and objectives of the project, or problems the project is designed to solve
  - Consequent assumptions, benefits, risks, and constraints
  - Tentative overall schedule and work plan or operating mode
  - Allocation or delegation of responsibilities
  - How communication will be conducted, formally and informally
  - Technical interactivity expectations
- Working as a team, develop the project intent into a viable scope-of-work that obtains buy-in to the project's objectives
- Similarly, list the project's KSIs, such as:
  - Reduced customer complaints as measured by the number of entries in the complaints log
  - Improved processing of accounting as measured by time to invoice
  - Improved product quality as measured by reduced mean time between failure
  - Better public image as measured by increased positive publicity and reduced negative publicity
  - Improved profitability as measured by reduced processing costs
  - Better market penetration as measured by increased market share
- Encourage full- and part-time team members to continue doing their best by maintaining a positive project culture. This requires the following:
  - Maintaining visible, clear, and consistent objectives that are understood and well worthwhile
  - Ensuring open, honest, accurate, and continuing communication
  - Demonstrating evident benefit to individual team members by way of experience and/or enjoyable effort
  - Rapid removal of obstacles to performance
  - Visible recognition and reward for excellence

EXTERNAL PROJECTS

External projects are those undertaken by the organization for an independent client or, alternatively, by an external project-management company for the sponsoring organization. Either way, the project is the subject of a legal agreement and, since the parties are otherwise independent of one another, are said to be at arm's length. The presence of a legal agreement tends to put project management's emphasis on the external stakeholders. However, the internal stakeholders should not be overlooked and should still be treated as described in the previous section.

The following recommendations are written for a public construction project, but it is not difficult to apply the principles to other types of project with appropriate changes in wording.

Why External Project Stakeholders Are Different

There is a big difference in external project stakeholders. This is because all communications in an external project are subject to the terms of the legal agreements involved and external projects characteristically include many public stakeholders.

Jack Lemley, formerly chief executive of Transmanche-Link (TML), had this to say about image versus reality in managing the immense English Channel tunnel project:[3]

> Today, managing the public image of major civil engineering projects is at least as important as managing their physical creation. Poor public perception can damage or stop a project as surely as bad ground or shortage of labor and materials. The Channel Tunnel is a classic example: for much of its formative period it existed in an often-destructive climate of adverse public opinion. Most of this was avoidable but it resulted in the project team spending much of its time fighting a rearguard action rather than simply getting on with the job.

Therefore, it is quite wrong for the project manager to think that the client is the only real stakeholder to worry about. For example, on a construction project there are many stakeholders involved.[4] They may include the following:

- Prime contractor
- Subcontractors
- Competitors
- Suppliers
- Financial institutions and bonding companies
- Government agencies and commissions; judicial, legislative, and executive bodies.

Of course, not all these turn up on every construction project, but many of them do. Figure 17–1 shows the potential complexity of this type of project.[5]

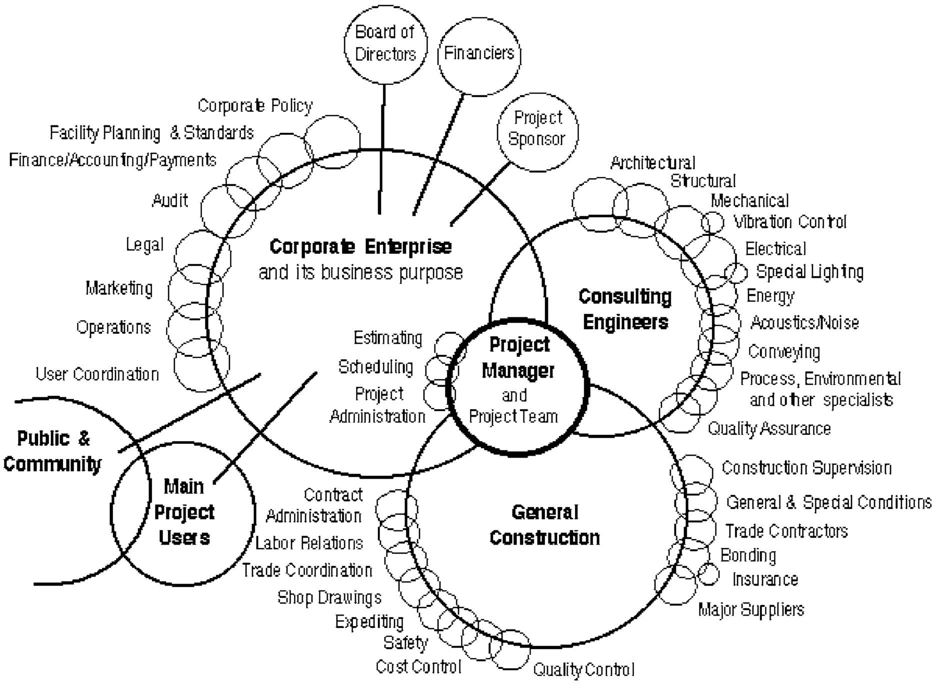

Figure 17–1 Stakeholders in a Construction Project

Just as important are the members of the public, some of whom can have a significant influence over the course of the project and the project-management process. They include the following:

- The local community that is affected by the project
- The general public, often represented by advocacy groups, such as consumer, environmental, social, political, and others

These people are not stakeholders in the sense that they have an invested stake in the project and expect to get money out of it. Rather, they have a stake in the project because they are affected by its results and/or can have varying degrees of influence over its conduct. In this case, perhaps *constituent* is a better label than *stakeholder* for describing such people.

Through various legislations, members of the public can have the power to stop the project entirely if their concerns are not heeded and given appropriate consideration. Therefore, even on medium-sized projects, project managers should give some attention to the project's public.

How to Identify Public Stakeholders

The following are recommended steps to identify a project's public stakeholders or constituents.

EXAMINE THE ENVIRONMENT

The first step is to examine the public environment surrounding the project. Identify any individual or group, who may be affected by the project, or even have an influential opinion about it. An excellent starting point is to hold a project team brainstorming session for this purpose. This has several benefits:

- It enables people to contribute ideas and suggestions from their knowledge and experience of local conditions and politics.
- It may be one of the first opportunities for members of the project team to show they can make a positive contribution.
- The process starts the feeling of community of interest in the project.
- The process is fun and the project manager can put the results to good use.

If the project is significant, the project manager might seek expert advice after the brainstorming exercise.

DETERMINE THE TYPE OF INFLUENCE

The second step is to sort the findings into groups according to the type of influence each may have. These can be described as:

- Those who come into direct contact as suppliers of inputs or consumers of outputs
- Those who have influence over the physical, infrastructural, technological, commercial, financial, socioeconomic, or political and legal conditions
- Those who have a hierarchical relationship to the project, such as government authorities at local, regional, and national levels
- Those individuals, groups, and associations who have vested interests that are sometimes quite unrelated to the project, yet who see the project as an opportunity to pursue their own ends.

CATEGORIZE THE LEVEL OF INFLUENCE

The third step is to categorize each group according to the level of influence it may have over the project. The following are examples:

- Those over whom it may be possible to exercise some degree of control by way of compensation
- Those who can be influenced by some form of communication
- Those who need to be appreciated and, if necessary, planned for

GATHER INFORMATION

This fourth step can be systematized. The following questions should be asked when developing stakeholder information:[6]

- What do you need to know about each stakeholder?
- Where and how can you obtain the information?
- Who will have responsibility for gathering, analyzing, and interpreting the information?
- How and to whom will you distribute the information?
- Who will use the information to make decisions?
- How can you protect the information from misuse?

It is quite possible that some of the information collected will be sensitive material. Also, do not assume that all stakeholders and constituents operate ethically. Therefore, treat all information as if it were sensitive and possibly questionable. This poses a problem for some government operations, which may be subject to the requirements of the Freedom of Information Act (FOIA). In any case, project managers should observe strict security over the information to avoid undermining the integrity of the effort.

The following is a summary of typical sources of stakeholder information:[7]

a. Internal
- Project team members
- Key managers
- Customers and users
- Suppliers
- The professional associations of members of the team
- Articles and papers presented at professional meetings
- Trade associations of those directly involved

b. External
- Local press
- Trade press
- Annual corporate reports
- Public meetings
- Government sources
- Business periodicals such as *The Wall Street Journal, Business Week,* and *Forbes*
- Business reference services such as *Moody's Industrial Manual* and Value Line Investment Survey

USE THE INFORMATION GATHERED

The final step after gathering the information is to do something with it. This is probably the biggest challenge of all. If the project is small, project managers can share the communication workload among members of the project team. Each team member can assume responsibility for specific areas and groups. By maintaining stakeholder and constituent linkages in this way, the project has the best chance for ultimate success. The project manager should see that respective responsibilities are documented in a project communication plan.

If, however, the project is not so small, then a more elaborate approach is necessary. This is discussed in the following sections.

Mounting a Project Public Relations Program

In the following text, the term *stakeholder* is used to refer to stakeholders and constituents collectively. If the project is large, significant, or critical, it will be necessary to mount a formal program that establishes and maintains constant stakeholder linkages. Often called a *project public-relations program* (PPRP), it is designed to deal with the public and the media and requires expert staff to undertake this work.

Public relations may be defined as a set of activities calculated to improve the environment in which the enterprise operates, and hence improves its performance. The same principle applies to a project microcosm. Dynamic managers have long recognized that opening communications in both directions—for top management and employees—is a powerful motivator. Providing that information of high quality is exchanged, whether verbal or in written form, or better still in graphical form, project managers should expect a remarkable improvement in team performance and in the progress of the project.

To a surprising extent, the project team's ability to exercise positive communications can have a significantly favorable impact on the team's ability to control the project's schedule and cost. If the project is a major one, especially if it is publicly funded, establishing such a program is essential.

BEWARE OF NEGATIVE ATTITUDES

On some sensitive projects, the term *project publications relations program* may be viewed as vague and self-serving. The image of a smooth, fast-talking individual, replete with well-worn clichés, is not a desirable one and the term may therefore be unacceptable. A possible alternative is *public participation program*. Unfortunately, this too has negative connotations. For some, it may conjure up a perception of interference with project objectives, escalating costs and schedule delays. Nevertheless, whatever the activity may be called, the purpose is the same: to obtain people's understanding and positive, active support.

Every project team should bear in mind that projects have a tendency to become the target of negative criticism. Those with conflicting interests may circulate this negative information. Special-interest groups may seek to have the project delayed, canceled to preserve the status quo, or otherwise ''held to ransom'' to serve their own political ends. Like bees to the honey pot, the news media are much more attracted to controversy, finding it more newsworthy than any official project press releases.

The cries of the critics often include:

- The technology is untried.
- Safety is at stake.
- The environment will be destroyed.
- The community will incur additional indirect costs.
- Taxes will increase.
- Some group or other has not been considered or is hard done by.

There may well be individual hardship cases that will attract political and media attention. In the short term, construction may result in noise, dirt, trucking, road restrictions, and congestion. If property has to be acquired, some people's homes, businesses, or lifestyles could be affected. For example, a shift in the balance of the economy in the area could affect real estate values so that some win and some lose.

All these require immediate and effective response, and the only effective response is that which is strictly factual. The project manager needs to foresee these issues, recognize them as part of the project responsibility, deal with them honestly and fairly, and deliver the message with complete sincerity. He or she should also keep in mind that the public that stands to gain from a public project is not necessarily the public that is most affected by it. Therefore, vocal minorities may create difficulties while the silent majorities sit on the sidelines, leaving others to resolve the issues.

ESTABLISHING A POSITIVE ATTITUDE

It is important to understand that everyone who works on the project contributes to its image, and all contributions must be positive, yet without exaggeration. An effective PPRP requires a strong identity setup within the project, its own concrete goals, and a well-planned strategy to achieve those goals. It must also recognize, reinforce, and actively promote the objectives of the project. Therefore, the PPRP must be evident at all levels of the project organization and should aim at improving the credibility of the project team and therefore the team's ability to perform.

Whether the project is publicly or privately funded, the primary benefits will undoubtedly go to the project's owners. Nevertheless, there will be secondary benefits for the public, so the PPRP should be designed to promote them. Such benefits could include:

- Increased employment
- Improved services
- Increased demand for local goods and services
- A trickle-down effect of related commercial activities
- Increased primary and secondary contributions to taxes

A PPRP has all the characteristics of a project in its own right, but it is conducted within the main project. It requires a leader who is outgoing and positive about the project, yet able and willing to listen. Such a leader must be capable of preparing carefully constructed text and presentations; of responding to media questions rapidly and honestly; and of working through a PPRP steadily and systematically.

There are eight steps in developing a PPRP plan:[8]

1. Know the enterprise and its objectives thoroughly.
2. Identify the interested public stakeholders and the characteristics of each.
3. Establish stakeholders' relative importance to the project. In particular, determine the high-risk areas.
4. Assess the current reputation of the sponsoring organization as it is perceived by each of the public stakeholders.
5. Decide appropriate action in each case.
6. Develop an integrated strategy that includes resource requirements, priorities, and schedule consistent with the project for which the PPRP is being developed.
7. Carry out the plan.
8. Continuously monitor the effectiveness of the program during its application and adjust as necessary for optimum results.

A typical philosophy behind a PPRP would include the following goals:

- To maintain internal project communications that promote a good understanding of the project by the workforce and members of the project team
- To keep the public up to date on the progress and performance of the project
- To be open with public information
- To promote and effectively respond to any misleading information that may be circulating about the project or its people
- To develop audio and visual aids and information sources that give substance to the above

The PPRP leader must design visual presentations to create confidence, trust, and pride in the project. Presentations should not be more than four to six minutes. If there is a technical story to tell, tell it in terms that an eighth-grade student can understand. The technical story should be in keeping with the short TV commercials to which we have become so accustomed. Too much detail must be avoided, but the presenter should be ready with such details for the time when a so-called expert comes along to question the project. A scale model, whether of the physical entity or one that shows the underlying concept, is an excellent demonstration tool and well worth considering.

TARGET AUDIENCES FOR A PPRP CAMPAIGN

The primary target audiences for a PPRP on most major projects will likely include:[9]

- The project workforce
- The eventual users
- The local community
- The community at large
- Special-interest groups
- Elected representatives and government administrators
- The news media

Secondary target audiences may include:

- Business and professional groups
- Business media
- Labor groups
- Educators and school groups
- Taxpayers
- The industrial sector of the project

Those responsible for the PPRP on a high-profile project must be prepared for some typical issues and concerns that will inevitably be raised by the various target groups. These will depend on a variety of factors:

- The critical project assumptions
- Real and imagined situations
- Trends based on various public indicators
- Experience with similar projects
- The latest fashionable issues currently being pursued by the media
- Irresponsible news reports
- Fallout from any disputes or litigation on the project

Project managers should develop responses that are in tune with the current political climate. A sampling of typical issues encountered in the past includes:[10]

- Will the project cause safety risks?
- What happens in an emergency?
- How many jobs will be lost through automation?
- How reliable is this latest technology?
- Will there be dislocation because of land expropriated for the project?
- How much congestion and noise will there be in local neighborhoods during construction?
- What is the real cost to the taxpayer, including subsidies and the costs of budget and schedule overruns?
- Will the project become an issue in an election campaign and, if so, will the winning party terminate it?

Careful and constructive attention to these kinds of details is of enormous value in enabling the project to proceed in a smooth and orderly way. However, the PPRP should not become an end in itself, and therefore itself a target for public outcry.

THE PPRP WORK BREAKDOWN

With a PPRP plan prepared in outline, the PPRP leader must obtain approval from the project's management. The PPRP should be part of the project's work-breakdown structure (WBS) (see Figure 17–2), with its own line item in the project budget. It is wrong for the PPRP to be left to an existing department in the enterprise as an added workload, lest it get overlooked or become secondary in importance to ongoing operations.

The PPRP plan must be complete with detailed objectives, target dates to match the progress of the project, the resources required, detailed costing, and identification of performance measures. For example, a detailed set of PPRP objectives might look like the following:[10]

1. Develop and maintain a PPRP that ensures that timely, accurate, consistent, and relevant information is presented to the project's primary audiences.
2. Develop internal project procedures that ensure the availability of accurate and consistent information that emphasizes the team approach.
3. Establish a resource facility that monitors, researches, collects, and collates information as it relates to the project.

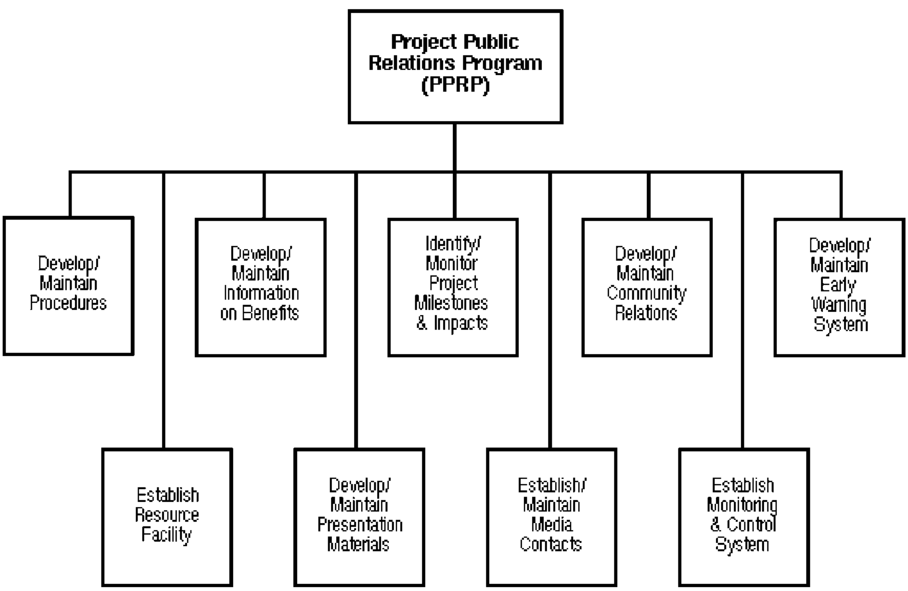

Figure 17–2 PPRP Work-Breakdown Structure

4. Develop material that clearly explains the economic benefits of the project to business, labor, and others.
5. Develop and maintain information packages, presentations, and events, including safety on the project, that show pertinent information to community groups, educators, professionals, school groups, and others.
6. Identify and monitor milestones during the project and their impact on, or opportunities for, the PPRP.
7. Establish news media contacts that keep key writers and editors fully informed, especially those who appear sympathetic toward the projects.
8. Develop a community-relations program that responds to public issues and concerns relating to the project.
9. Monitor and control the PPRP to ensure optimum benefit to the project.
10. Develop a system of review and contacts that can provide an early warning about activities by outsiders that may adversely affect the project.

Each of these objectives is elaborated into a detailed task list. For example, item 7, which suggests establishing and maintaining media contact, may require completion of the following tasks:[11]

- Develop a telephone listing of local television stations, radio stations, news wire services, newspapers, local politicians, and other frequently called numbers.
- Develop and maintain news media mailing lists suitable for the circulation of project news releases, articles, or features intended for the audiences in the primary and secondary target areas.
- List names and addresses of elected representatives, administrators, and others who will receive project news releases.
- Schedule a series of contact meetings with key media representatives who have appropriate spheres of influence.
- Notify key project personnel who will attend such meetings.
- Hold a seminar to discuss the advantages of the latest technology incorporated into the project.
- Arrange to hold an open house when work on the project is sufficiently well advanced.
- See that notices go out in good time for maximum impact.

A PPRP effort is significant, especially for a large project with public involvement and sensitive issues. At critical times or at specific locations, a weekly newsletter can be very helpful to inform local people of unavoidable temporary disruption. People are willing to put up with a lot more, if they know what is going on and that it is only for a limited time.

Key to the success of a PPRP is the constant garnering of opinion and adjustment of the program details accordingly.

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Chapter

18

Political Strategies for Projects and Project Managers

Bud Baker

Biographical Sketch . . .

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Introduction

Pick up just about any book on project management and you'll see the three components that comprise a typical project: cost, schedule, and technical performance. These three elements receive so much attention, in fact, that a student of project management might reasonably conclude that they alone determine the degree to which a project is successful.

But the world of project management is far more complex than that. In fact, history shows us a number of projects where ultimate success or failure cannot be traced to the traditional triad of cost, schedule, and technical issues. In at some projects, the final outcome seems dependent on a fourth dimension of project management: politics.

Astute project managers understand and accept the importance of politics as a key success factor in their efforts. Further, they are able to develop and implement political strategies that enhance the likelihood of their project's success.

Field Guide to Project Management, Second Edition. Edited by David I. Cleland

Politics Defined

For the purposes of this chapter, we will consider ''politics'' to be synonymous with effective stakeholder management. One way to begin is with a process called community mapping. That is, the project manager must first identify who the project's key stakeholders are. Some are easy to identify: a client, an end-user, the providers of financial backing are obvious, and unlikely to be overlooked. Others are more subtle: suppliers, competitors, community groups, environmental activists, and the media are just some examples.

Once the stakeholders are identified, the project manager's attention must turn to the identification of those stakeholders' interests. There is little to be gained in attempting to judge the legitimacy of those interests, for two reasons. First, legitimacy is one of those things seen best through the eye of the beholder: an idea which to one person seems on the radical fringe may have a status approaching that of religious doctrine to another. Second, in our ever-more litigious society, the objective merits of a stakeholder's position matter less than the fact that such stakeholders have ready access to the legal system. A project may be vindicated in the end, but such victories are often pyrrhic, won only after mega-dollar legal fees and damaging schedule delays.

Only after identifying stakeholders and their agendas can the project manager effectively develop political strategies. Those strategies will vary based on a variety of factors, including the phase of the particular project in question. In the project-design phase, for example, gaining community input can prevent huge difficulties downstream. Later in the project, through, when changes are less readily made, political strategies of forcing and resistance may be more suitable.

Political Management in the Project-Planning Phase

Aristotle said, ''Well begun is half done,'' and it is generally accepted that a project's success or failure is often determined in the planning phase. Even brilliant execution often cannot save a poorly conceived project.

The same holds true for managing the political dimension of a project. The planning phase is where basic, fundamental political strategies must be set. These will carry over, in large measure, to the execution phase of the project.

There are at least six aspects of politics to be considered when planning a project. These apply to all projects, not just those that are large or publicly visible. However, each of these takes on particular meaning based on the individual project at hand. The six aspects are:

- ***Active listening.*** What do stakeholders really want? What needs must the project address? Are those needs real? Where do stakeholders' needs coincide, and where do they conflict?

- ***Project structure.*** Only after the needs of stakeholders are thoroughly understood can the project be successfully structured. Subcontracting, for example, may need to be spread out geographically to ensure broad legislative support. If risk is believed to be unacceptable, then risk reduction can be pursued through strategies such as joint ventures, partnerships, and teaming arrangements. An uncertain funding future may cause a long-term project to be planned in discrete chunks so that inevitable changes of business or government leadership are more likely to mean project slowdown and less likely to mean project termination.
- ***Coalition-building.*** Where stakeholder interests converge, joint action is possible. We live in a world where such long-time antagonists as the United States and Russia can join forces to make possible a project like the International Space Station. If that coalition can work successfully, it certainly supports the idea that other diverse project stakeholders can find enough agreement to join forces in common cause.
- ***Dealing with government.*** This goes beyond such obvious and widely practiced activities as lobbying and targeted campaign contributions. The less reachable executive branch of government, from local all the way to federal levels, must be addressed. Such issues as zoning, environmental restrictions, and regulatory limits all have the potential to stop a project in its tracks. Ideally, such constraints can be shaped by a proactive effort. But before that can even be a possibility, the governmental environment must be thoroughly understood.
- ***Setting expectations.*** Clement Studebaker, the American automaker, lived by the motto ''Always *under*promise, and *over*deliver.'' We tend to forget that sometimes. In the zeal that so often characterizes the start of a project, when all things are possible and the laws of physics and economics are but distant clouds on the horizon, we tend toward overoptimism. Sometimes our optimism is calculated to gain support. If all the project's potential catastrophes were known up front, we might be unable to get the political support necessary to begin. Further, if *we* don't believe in our own project, who will? But whatever the cause, overly rosy expectations will come back to haunt the project later, when—to twist Mr. Studebaker's words around—the project is seen to have *over*promised, and *under*delivered.
- ***Communicating with all stakeholders.*** This can take the form of town meetings, media appearances, press releases, and advertising. Key messages must be developed and promulgated, and stakeholder contact maintained. Many projects fail here, often because project leadership, especially in contentious situations, forgets that the *op*ponents of a project are at least as important as its *pro*ponents. It's human nature to want to maximize time with our friends and minimize it with our foes. This desire may be understandable, but that doesn't make it correct.

In the rest of this chapter, we will explore the political environment of project management using three case studies. The first project was a multibillion-dollar science effort, which suffered from all sorts of problems. Those difficulties might have been overcome, though, had the project's managers developed a more feasible political strategy. The second involves a project that, by conventional standards, should have been a success. Yet it proved to be one of the great failures of American business history. The third case is perhaps more complex, and it shows something different altogether: a project monumentally over cost and behind schedule that went on to become a symbol of successful project management.

CASE STUDY
THE SUPERCONDUCTING SUPERCOLLIDER

The Superconducting SuperCollider (SSC), located near Dallas, Texas, was designed to conduct experiments within a 54-mile underground circular chamber, accelerating subatomic particles to 99.9999 percent of the speed of light and smashing them together at combined energies of 40 trillion electron volts. The thought was that this would provide answers to fundamental questions about the formation of the universe. Many believed that the benefits of such research could be enormous. In their view, such pure science research was comparable to the first atom-splitting, which led to the discovery of nuclear energy, quantum theory, and most of the electrical and computer technology we take for granted today.

But all that will remain forever as mere speculation. In 1993, Congress, after spending more than $2 billion on the SSC project, unceremoniously pulled the plug, ending eleven years of effort and putting thousands out of work. Certainly there were problems with the SSC. Cost had ballooned, largely due to increasing technical requirements, and schedule was slipping correspondingly. But the real problem facing SSC management was not technical, or budgetary, or schedule-related. The real problem was politics.

One political problem facing the SSC was the lack of support from the Clinton administration. The SSC had begun under a Republican administration. There was never more than a lukewarm acceptance of the SSC from the Clinton White House, and when the going got tough there was only concern for the budget deficit.

The SSC became, in fact, a symbol of fiscal irresponsibility. For all the billions spent, the truth was that the SSC produced very few jobs, at very high cost, most in a very limited geographical area. With limited economic importance beyond Texas, the SSC had few backers in Congress. And when the respected Texas senator Lloyd Bentsen left the Senate for President Clinton's cabinet, the SSC became a prime target of Congressional budget cutters, concerned with a $4 trillion deficit and unmoved by the SSC's limited appeal as a "Texas project."

The project's negative press wasn't helped by news of millions of taxpayer dollars spent on ritzy hotels, liquor, decorative plants, and artwork. The widespread dislike of the senior SSC officials in the Clinton administration didn't help either. Top SSC officials were perceived as self-important and arrogant, and they denied access to confidential information requested by auditors from federal agencies. Other scientists—perhaps jealous of the SSC budget—claimed that the SSC was undermining the credibility of all science. Worse still, the SSC's wastefulness was singled out from a list of hundreds of government projects.

One last difficulty probably sealed the SSC's fate. As opposition to the project grew, leaders of the effort persisted in their tendency to speak primarily to pro-science groups at universities around the country. At the same time, they avoided hotbeds of opposition, including Capitol Hill. In fact, project leaders had so little regard for Congress that after legislators finally killed the project, one senior project leader reportedly referred to the cancellation as "the revenge of the 'C' students."

CASE STUDY
THE DEATH OF THE TIGERSHARK

In the mid-1970s, things seemed to be coming together for the Northrop Corporation. Long a power in the business of selling fighter aircraft to foreign governments, Northrop had sold thousands of its F-5 Freedom Fighters to countries around the world. And now they had developed the newest version of the line, the F-5G Tigershark.

At the same time, the Carter Administration was expressing concern about selling more advanced American fighter aircraft to foreign governments. There were at least two reasons for the concern. First, such weaponry had a way of later being used against U.S. interests, as was then threatening to become the case with Ayatollah Khomeini's Iran. Second, there was genuine concern about fueling arms races between unstable third-world governments.

So the stage seemed set. Northrop had a good, affordable design, arguably less capable and thus less threatening than other, more sophisticated fighters. Further, the Tigershark meshed with the political desires of the Carter Administration. At this point, Northrop began to pour its own money into the Tigershark's development.

It didn't take long for trouble to develop. President Carter—the very man who had encouraged the plane's development—vetoed a proposed sale to Taiwan, for fear of offending the People's Republic of China.

Soon after that, the election of Ronald Reagan in 1980 marked the beginning of the end for the Tigershark. The Tigershark was seen as a "Carter airplane," and the Reagan administration seemed happy to sell the top-of-the line fighters to pretty much anyone who could pay the bills, including South Korea, Pakistan, and a host of other less stable nations. Added to the fact that the U.S. Air Force had never ordered any Tigersharks, the overall image of the Northrop fighter began to decline.

The crashes of two of the three prototypes—neither attributable to aircraft failure—merely provided the coup de grace to an already staggering program. Northrop threw in the towel in 1986, after investing 1.2 billion dollars. A project with impressive technical qualities, one that hadn't cost the taxpayers a cent, became one of the great product failures in history, largely because of political considerations. The Tigershark was dead.

Where had it all gone wrong? If Northrop, a politically astute firm in many ways, had listened adequately at the beginning, could the Tigershark debacle have been prevented? Certainly they would have realized that the genesis of the project was not a real military need, but rather an artificial political one. And those sorts of needs can, and do, change rapidly. Certainly the military stakeholders, both within the United States and outside, had no desire for the Tigershark. Hindsight is always 20-20, of course, but it is clear in retrospect that an unsound political strategy was at the core of the Tigershark's failure.

Managing Politics in the Project-Execution Phase

As a project moves from planning to execution, most of the same elements that were previously important remain, but the approach changes in subtle ways. Listening to stakeholders remains important, but not for the purpose of planning and structuring the project: it's too late for that. Rather, listening forms the basis for mid-course corrections in the project, so that the ''unknown unknowns'' from the planning phase can be addressed as they arise. Coalitions built earlier need to be maintained and even repaired, as the pressure of the project causes fissures to develop among coalition members.

Government liaison must be maintained. As seen in the Tigershark case, changing administrations, whether in Washington or a local village council, cause paradigm shifts that can quickly undermine all the project manager's previous efforts.

Expectations set in the planning phase need to be managed carefully so that surprises are kept to a minimum. Few things corrode working relationships in a project as badly as the unexpected bombshell, when one project constituent is perceived as springing a surprise on the others.

Communications channels built in the planning phase need to be fertilized and even expanded during project execution. This is extraordinarily difficult, for many reasons. First, the pace of the project typically picks up, and firefighting efforts tend to take precedence over longer-term issues. Further, the interests of stakeholders can diverge in this phase. The project team wants to tell its *good* news to the world, using press releases and other tools. The world, on the other hand, finds such good-news stories uninteresting at best, self-serving at worst. But when *bad* news is involved, positions reverse: media and other outside stakeholders are passionately interested, while the project team circles the wagons, just as the Superconducting SuperCollider team did when under attack.

Another political strategy rises in importance during the execution phase. It can take many forms—litigation, stonewalling, outright noncompliance are examples—but we can call this strategy ''resistance.'' Take a hypothetical power plant project, for example: six years into the project, a new interest group emerges, dedicated Luddites opposed to any form of power generation. Their obstructionist tactics can include lawsuits, blockades, threats, even sabotage.

Most of the strategies cited earlier—listening, coalitions, and the like—are useless here. Rather than accommodation and appeasement, a more appropriate strategy is resistance. Defensive legal postures, offensive litigation, counterattack, and delaying tactics are all more feasible when the project is well underway or when dealing with constituencies unalterably opposed to the project.

The American interstate highway system demonstrates some of these ideas. Poor planning got it off to a shaky start, but well-conceived political strategies allowed it to recover.

CASE STUDY
THE INTERSTATE HIGHWAY SYSTEM

Nearly 50 years ago, President Eisenhower proposed a massive road-building plan, one that would bring a host of benefits to the American public. Among these benefits, Eisenhower mentioned increased productivity, enhanced highway safety, and a strengthened national defense. Additionally, Eisenhower believed that the thousands of jobs created would help lift the United States out of the post-Korean War doldrums. He estimated the cost of the highway system at $50 billion.

Despite Eisenhower's personal support, the project was quickly swamped with political problems, largely related to finances. Within just four months, the cost estimates had grown to $76 billion, and they further ballooned to over $100 billion just two months after that.

But it wasn't the projected cost overrun that sidelined Eisenhower's first plan—it was politics. Truckers objected to increased taxes on tires and fuel. Western states, faced with vast expanses of highways but few drivers, objected to tolls as a financing source. Eisenhower's Democratic opponents objected to the proposed financing methods as well. In the summer of 1955, Congress killed Eisenhower's plan and adjourned.

The setback was only temporary. Early in 1956, Eisenhower adopted a more politically astute approach. He identified the key stakeholders and their demands. The result was the Interstate Highway Act of 1956. The key principles behind the Act were these:

- Tax increases on the trucking industry would be limited.
- In return for federal design control, 90 percent of cost would be borne by the federal government.
- Urban areas—where the votes were—would receive most of the construction dollars.
- Contentious issues—e.g., the use of tolls as a financing tool—were intentionally avoided. Both sides agreed to postpone any decisions until the project was underway; not a sound concept for most projects, certainly, but necessary here.

In sum, then, the Act offered something to everyone and aroused the anger of almost no one. And therein lies one secret of political success. Certainly some tactics, such as the intentional postponement of critical decisions, aren't applicable to every project. But politics is, as they say, "the art of the possible," and the rules are, of necessity, different.

Conclusion

Politics matters. And effective project leaders know that politics—the effective management of project stakeholders—can spell the difference between ultimate success or failure. Early attention to stakeholder issues during the project-planning phase is a start, but it is not enough. The plans laid out and the channels opened at that time need to be maintained and enhanced throughout the life of the project. Only by those actions can project managers put politics to work for them, rather than against them.

Chapter

19

The Role of Senior Management on Projects

Kenneth O. Hartley

Biographical Sketch . . .

Kenneth O. Hartley has spent over 37 years in the project-management field. He is currently a Principal Project Manager with Parsons Brinckerhoff Ltd. in London. Mr. Hartley holds a B.S. and M.S. in civil engineering from the University of Missouri. He is a Fellow of the Project Management Institute, having served as its International President and Chair. He was recognized by the University of Missouri in 1988 for his Distinguished Contribution to Engineering and is a member of the College of Civil Engineering's Academy of Distinguished Alumni.

Introduction

CIO magazine and the Project Management Institute (PMI) recently conducted a survey of some 300 representatives from companies that have a project management office (PMO). The results indicated that ''Executive sponsorship/Support from senior management'' was one of the top five most common practices. It contributed to the success of these units with the PMO ''projects having direct links to the company's strategic and operating plans.'' This was in addition to providing other key indicators with respect to project success, including direct financial impact.[1]

Similarly, two recent ''Hot Button'' reader polls from *PM Network* indicate that senior management plays an important, if not critical, role in successful project management. In the first poll (March 2003), in response to the question ''What is the most important factor in promoting organizational project management buy-in?,'' an overwhelming 64 percent said, ''executive champions.'' This overshadowed the 27 percent who indicated that business alignment/strategic synergy was the key factor.[2] In the other poll (May 2003), in response to the question ''Which factor most severely impacts your ability to deliver projects on time and on budget?,'' 29 percent indicated that this

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factor was ''lack of executive support.'' This lagged behind the 42 percent who indicated that ''unrealistic estimates/milestones'' was the determining factor.[3]

Recognizing that the composition of PMI membership has shifted significantly over the years to a current heavy preponderance of computer/software/data processing, information technology, telecommunications, business management services, and financial services from the earlier predominance of engineering and construction focus, there may be some bias in these responses. This is partially due to the large number of project managers working on smaller and internally focused projects in these industries and the advent of the PMO as opposed to large dedicated project and program management teams on large capital works for external customers.

Obviously, while the degree of involvement of senior management, under the guise of various titles, including project sponsor, project executive, and manager of project managers/management, may vary, the need for this involvement exists. The choice of title and exact description for this assigned role varies between organizations, but we will use the term *corporate sponsor* herein to describe this senior management role on the project.

Although the specifics of the given corporation may differ, the person filling this role provides a vital function for the corporation, the project, and the ultimate customer, regardless of whether the project is being executed for an internal or external customer. As evidenced from the *CIO* magazine and PMI survey, it is also important to note that this role is critical, even when a project management office is used by the organization. Further, the corporate sponsor role is equally important in a corporate environment, whether the core business has only an occasional project or whether the corporation is essentially a project-driven enterprise.

It is conceivable that a seasoned project manager might prefer that the organization assign the responsibility and provide requisite authority to him or her and then leave him or her alone to manage and accomplish the work in accordance with agreed scope, budget, and schedule and to established quality, safety, and environmental standards. However, this is wholly unrealistic in today's world of complex issues and changing conditions in response to internal and external stimuli.

Therefore, the corporate sponsor has several important corporate functions to apply to the project or program in support of its unique strategies and objectives. Some of these are general and overarching, while others deal specifically with the various project phases—conceptual/planning, execution, and closeout. All are intended to be practical and applicable to the vast majority of projects as experienced over many years in the profession.

General Senior Management Overarching Roles

Since projects are essentially mechanisms for change, the corporate sponsor must see himself or herself as a combination of champion, enabler, and overseer of the project. The main focus must be to ensure that the project is an integral supporting component of the corporate strategy and its objectives. The project must fit within the strategy and produce results that will be instrumental in moving the corporation toward achieving its objectives.

The corporate sponsor must champion and promote the value of the project at the corporate level to ensure both initial and continuing support for the project by other senior management. The corporate sponsor must ensure that the project scope, schedule, budget, implementation plan, and risk management plan are well defined and in place for the work. Also, all applicable quality, safety, and environmental standards must be addressed together with legal and environmental requirements.

In the corporate sponsor's enabling role, the provision of appropriate numbers of properly trained staff to accomplish the work is of critical importance, whether these resources are under the direction of the corporate sponsor proper or have to be provided by other functional senior management. The corporate sponsor must ensure that the project has in place, and fully complies with, monitoring and reporting tools so that senior management is provided with timely and accurate progress information and is apprised of status on a regular basis throughout the entire project duration.

Importantly, the corporate sponsor must not only ensure that the ultimate customer buys in to the original premise for the project, but also provide a mechanism for validating these premises and objectives throughout the project and ensure customer acceptance and sign-off at project closeout.

Suffice to say, the corporate sponsor must also be prepared to terminate the project if the corporate strategy changes, it is determined that the project will not contribute to attaining corporate objectives, customer requirements are deemed to be unattainable, or forecast schedule and costs are found to be out of line with corporate project management guidelines.

Key Senior Management Responsibilities to Projects

There are several key contributions that the corporate sponsor must bring to the project. The corporate sponsor must:

- Work together with the assigned project manager to ensure that both parties understand their roles and responsibilities for the project. There should be no gaps and no overlaps within accountabilities such that management directions become blurred. The corporate sponsor must ensure that he or she does not start functioning as the project manager by making decisions and providing directions that are more appropriately within the remit of the project manager. The corporate sponsor must ensure that the project manager is held accountable for adherence to both his or her personal performance objectives and those of the project team.

- Establish a relationship of trust and openness with the project manager and his or her team, such that problems and risks and potential solutions and mitigating measures are identified, quantified if possible, and discussed and agreed upon in a timely manner and at an appropriate management level. Expectations of all parties should be voiced, agreed upon, and recorded at the outset.
- Have a clear understanding of the corporate strategy so that all project actions are supportive of objectives driven by this strategy. He or she must also be alert to any changes so that the project can be responsive to needs derived from these changes.
- Ensure that the project manager develops and implements a comprehensive risk management plan to identify, assess, and address risks to the project from both internal and external sources. Further, the corporate sponsor must ensure that appropriate corporate support is provided to assist in the ongoing review and management of these risks throughout the project duration.
- Facilitate project performance by ensuring that all necessary skilled resources are available to the project when needed and in sufficient quantities to accomplish the works in a timely, cost-effective manner.
- Be fully aware of outside influences on the project and be proactive in managing these interfaces. In this way, the project manager can focus his or her attention on those project activities over which he or she has control and structure the project work program to accommodate the needs of third parties, whether they be for approvals, permits, or simply information.
- Be astute about corporate politics at senior management level so that he or she can obtain commitment for needed resources and support for the project well before they are required. The corporate sponsor must also continuously validate resource availability and ongoing support when either corporate or project conditions change.
- Ensure that sound project management and other business practices are used on the project so that there is consistency in approach with the other corporate projects. However, at the same time, the corporate sponsor must encourage continuous improvement in the processes and procedures used to enable improvements in efficiency and effectiveness wherever possible, not only for the project, but also to encourage their application to other projects.

Conceptual/Planning Phase Activities

Senior management sets the stage for successful project execution before the project gets fully underway. This is a crucial and active period for the corporate sponsor. Planning done and decisions made during this phase are fundamental to the ultimate success of the project. During this phase, the critical senior management activities include the following:

1. ***Select the right project.*** With the renewed emphasis on ensuring that projects are undertaken only when they support the defined corporate strategy, this activity has become the primary criterion. It is imperative that senior management evaluate each prospective project to ensure that it fits within overall corporate strategy and that the successful execution of the project will contribute to both the short-term and long-term corporate objectives. This step must be taken whether the proposed corporate project is conducted for internal purposes (e.g., installing new computer systems, changing procedures, or modifying a production facility) or where the corporation is proposing to execute a project for another firm. The project must be examined to ensure that the scope can be accomplished, that the schedule and budget are realistic, and that it will deliver the desired results for the corporation. If the project is one that requires a formal proposal and financial bid for an external customer, then the market conditions, competition, and resource requirements also have to be addressed. The proposed technical approach and corporate capacity to perform the work must be examined as well in order to determine if the project should be considered.
2. ***Commit the corporation.*** Each project must have a corporate champion, herein termed the corporate sponsor. This is a senior management level person who believes implicitly in the project and is committed to its success. The corporate sponsor is ultimately responsible to the other members of the senior management team for the success or failure of the project throughout all its phases. It is the responsibility of this individual to convey clearly the corporate commitment to the success of the project—not only to the other senior managers and shareholders, but also to the project team, customer, outside agencies, and the general public as well. The corporate sponsor must also be willing to provide direct support to the project in acquiring the resources required to perform the work and provide the corporate level interface with other functional corporate executives. On projects performed for external customers, the corporate sponsor must serve as the corporate level contact between the parties.
2. ***Select the right project manager.*** Senior management must carefully examine its candidates for the project manager position before selecting the individual to fill this important role. The right candidate must possess a combination of technical expertise, management experience, and interpersonal skills to be able to manage the specific project type, size, and complexity. This is the individual whom the corporation will hold accountable for directing the project's day-to-day activities as well as communicating daily with the customer and others involved in the project. The ability of the corporate sponsor and the project manager to communicate and work together is another key consideration. Therefore, the importance of selecting the right person for the right job cannot be overemphasized.

3. ***Provide the right technical and management expertise.*** Senior management must evaluate its own corporate resources to determine if they are sufficient to complete the project. If resources are lacking, the corporation must arrange for the timely recruitment of appropriate resources. It may be necessary to establish contractual arrangements in a joint venture, partnering, or contractor mode so that these resources are available, as they are needed. In the case of teaming arrangements with other organizations, the corporate sponsor must ensure that the roles, responsibilities, and contractual and financial obligations of the parties are clearly understood and documented at the outset. Typically, the corporate sponsor will take an active role in the negotiations for these services. The corporate sponsor must ensure that all internal corporate approvals are obtained and in place to support the project activities.
4. ***Provide sufficient support systems.*** Senior management should ensure that the functional support systems are in place for access by the project team as needed during performance of the work. These support systems include management systems, policies, procedures, and standards. However, unique project requirements may demand that adjustments be made to these corporate systems in order for them to be entirely applicable to the specific project, especially for external customers. Equally important is the need to have support staff in place who are experienced in using these systems so that assistance can be made available to the project as required. Another critical corporate sponsor role is to ensure that all applicable health, safety, environmental, and quality standards are available to and implemented by the project from the outset.
5. ***Establish effective incentives.*** Projects are often disruptive to corporate operations, functional activities, employee relations, and personal lives. Prior to the commencement of each project, senior management should examine potential incentive systems in the context of the particular project to determine their applicability to the work and create the appropriate reward structure for successful project completion. The project incentive program may be established for either the entire project team or key personnel only, with the former recommended for ensuring full commitment of the project team. Regardless, the corporate sponsor must clearly establish the parameters at the project outset.
6. ***Participate in project kickoff meeting.*** Senior management should participate in the project kickoff meeting to stress project importance, discuss integration of the project with the corporate strategy and objectives, demonstrate corporate support, and reinforce roles and interrelationships of the corporate sponsor with other corporate functional managers in executing the work.

Execution Phase Activities

The project-execution phase is the phase in which most practitioners see senior management as having an enabling and facilitating relationship to the project team. That is, the corporate sponsor enables the project manager to focus attention on the specifics of the project and facilitates access of the project manager to all required resources for successful project execution. The project manager and team are now in place with full responsibility for day-to-day execution of work. Therefore, the corporate sponsor's role in this phase is to support the project manager by fulfilling several essential responsibilities, including the following:

1. ***Let the project manager manage the project.*** It is essential that the corporate sponsor and the project manager jointly establish their specific roles and responsibilities at the start of the project. It must be clearly understood that the project manager is responsible for the hands-on management of the work by directing the day-to-day efforts of the project team and ensuring that the project objectives defined in the project mission statement are met. The corporate sponsor is responsible for providing support to the project manager to accomplish the work. It is also important that the corporate sponsor refrain from becoming so involved in the project details that the project manager's responsibility for project execution is diluted.
2. ***Provide the project oversight and feedback.*** Even though the project manager has been assigned responsibility for performing the work, regular management reporting is required to provide the corporate sponsor, and through him or her the corporation, with sufficient information to demonstrate that the project objectives are being met. These may relate to scope, changes, cost, schedule, quality, safety, affirmative action, disadvantaged business enterprise (DBE) participation, environmental concerns, and productivity. The corporate sponsor represents the corporate interests in analyzing this management information and evaluating corrective actions, as applicable. Providing senior management feedback to the project team is essential, because typically the corporate sponsor has had previous experience in managing similar projects. Furthermore, the corporate sponsor may offer a broader perspective to implications of the actions.
3. ***Conduct regularly scheduled management reviews.*** The corporate sponsor should visit the project team site and chair formal reviews of the project status on a regular basis. This management review should focus on the project status against schedule and cost plans, evolving technical issues, major risk identification and mitigation, safety, environmental, quality, and customer interface issues. Throughout the review cycle, the corporate sponsor must be alert to,

and insist that the project manager take action with respect to, potential scope creep and unauthorized changes. This review often precedes a meeting between the corporate sponsor and the customer's executive contact for the project. The corporate sponsor should also insist on regularly scheduled peer reviews by corporate technical experts at critical junctures in the project development and execution cycle.

4. ***Ensure corporate systems are in place and used.*** The corporate sponsor must ensure that corporate systems, processes, and procedures are used on the project in accordance with corporate technical and business standards and practices for consistency and to attain expected results. Of particular importance is the development of a project implementation plan including a management review and reporting regime, risk management approach, quality expectations, and document control process.
5. ***Provide senior management level client contact.*** The corporate sponsor provides an appropriate executive level contact with the customer's executive staff. This relationship serves as a conduit for ensuring a high level of customer satisfaction and involvement, addressing concerns about the project operations and obtaining customer reactions to the performance of the project team. With respect to external projects, it also provides an ongoing marketing opportunity for the corporation including maintenance of good market intelligence and possible prospects for further work. It is important that the project sponsor establish this critical communications link early in the project and maintain it throughout the duration. This will reinforce the stated corporate commitment to the project. This contact may take the form of regularly scheduled face-to-face reviews with the customer executives, supplemented with occasional telephone calls on a more informal basis. Although this contact is critical, care must be taken that it does not usurp the project manager's ability to work on issues with the customer's organization and that the customer does not use this conduit to circumvent the project manager's role.
6. ***Ensure technical and management support availability.*** The corporate sponsor should ensure not only that the corporate functional organizations are available to assist the project team on an as-requested basis by providing needed tools and resources to the project, but also that these organizations actively encourage contact with the project team. The corporate sponsor must facilitate this process, especially when corporate resources are at a premium, time constraints are critical, and near-term results are required. This is particularly true when multiple and geographically spread offices are used to execute portions of the project work. The corporate sponsor should also insist on periodic audits of critical issues by appropriate

functional managers to ensure that the proper corporate systems and procedures are being used and are delivering the expected results.

7. ***Promote initiative solutions.*** During the course of the project, the project team will undoubtedly encounter situations identical, or at least similar, to those encountered on other projects. These projects may be the corporation's own endeavours, or they may be ones highlighted in technical publications as having developed unique and innovative approaches to solving project problems. The corporate sponsor should serve as the conduit to the project for transferring innovative or unique solutions to problem areas. The corporate sponsor should encourage the exchange of lessons learned among project managers and their project teams on a continual basis while projects are ongoing. The corporate sponsor should also encourage and facilitate specialized workshops and engage technical consultants as deemed applicable to any project issues that present risks to the project delivery.
8. ***Keep the project shielded from corporate politics.*** The corporate sponsor must ensure that the project team is protected from ongoing corporate politics and competing corporate organizations to minimize disruptions and ensure that the focus is on the project goals. There will undoubtedly be situations in which various members of senior management will have differing objectives and approaches, but these should not be allowed to affect accomplishment of the project's stated and agreed-upon objectives. The corporate sponsor should ensure that the project team is made aware of organizational changes and events that may have an impact on the staff; for example, by having the corporate sponsor address a project team meeting on a planned project visit and providing access to all current corporate literature.
9. ***Promote project staff continuity.*** Although assigned project team members may be expected to remain on the project throughout its duration, this is not always the case. The corporate sponsor must be cognizant of the needs and desires of the project team members concerning career objectives, personal growth, and project burnout. While it is usually considered desirable that the project staff, and especially the project manager, remain on the project from initiation through project closeout, the corporate sponsor must recognize and accommodate the unique skills of certain project managers who are particularly adept in one of the project phases and use these skills appropriately. Regardless, it is highly desirable that the corporate sponsor remain actively involved and accountable to the other corporate executives throughout the project duration.
10. ***Provide growth opportunities to project staff.*** The corporate sponsor must also be aware of staffing needs on other projects and the opportunities for placement or exchange of personnel between proj-

ects. Whenever possible, these personnel changes should be encouraged to develop corporate resources and enhance the ability of the corporation to execute additional projects and perform more complex ones. The corporate sponsor should also be available to meet one-on-one with project team members to discuss career objectives and life-after-the-project opportunities.

Project-Closeout Phase

The role of senior management continues after conclusion of the project execution phase when the physical aspects are complete and the project is delivered. At a minimum, the corporate sponsor must ensure that the following activities are performed:

1. ***Document the project.*** An essential management tool that is sometimes overlooked in the rush to get a project completed is the need to compile a project history. This includes an analysis of the project successes and opportunities for improvement and must include both technical and business aspects of the work performed. Although this document needs to be started early in the project, it often languishes until near the end. This typically results in the need for expenditure of corporate resources to complete the documentation after project turnover. Of significant importance in the document is the inclusion of lessons learned, as well as cost and schedule information for future projects. Because the project team will be dispersed and the project manager, who is responsible for providing the document, will likely be reassigned immediately, this document may become the only easily accessible record of the project for future reference. Therefore, it is important that the corporate sponsor ensure that the document is completed in a timely manner and in a format that is usable by other project managers.
2. ***Stop the work.*** Although this appears superfluous, it is an important issue for both the corporate sponsor and the project manager. Without proper attention, staff often continue to charge time and expenses against the project when it is already essentially complete. This incurs costs that are not legitimately part of the project and hinders use of the resources on other projects. When the project is complete, the corporate sponsor must notify all corporate entities that charges will no longer be accepted and that assigned resources are no longer needed.
3. ***Obtain customer acceptance.*** The corporate sponsor should obtain formal customer acceptance and signoff on the project deliverables as soon as the project is deemed to be complete. It is critical to ensure that the deliverables meet the customer's needs and that additional product improvements will not be requested on an ongoing basis,

thus delaying release of project staff and incurring continued costs. This is also essential to ensure release of final payments. Additionally, when product warranties with limited duration apply, it is important that these take effect as soon as testing and operation commence.

4. ***Follow up with the customer.*** Senior management should maintain contact with the customer after acceptance of the project deliverables to determine the degree of general customer satisfaction, ensure that the deliverables have met and continue to meet the customer's expectations, explore other project and follow-on opportunities for the corporation, and identify areas of better-than-expected results as well as those areas where enhancements should or could be made in the future. Additionally, this follow-up should facilitate release of performance bond or post-warranty final payment, where applicable. Another key reason for this follow-up is to be able to use the customer as a positive reference for future project work with others.
5. ***Recognize the project team.*** It is very important that senior management properly recognize and reward the project team for successful completion of the project objectives. This recognition may take several forms, including publicizing the project success in corporate and public literature, relocating project personnel to other projects, promoting personnel who contributed significantly to the successful effort, reassigning personnel to functional organizational units, following through on the incentives established at the beginning of the project, and providing actual rewards, either monetary or commemorative, to celebrate the satisfactory conclusion of the work.
6. ***Build on the successful project.*** The primary purposes for undertaking any project include long-term benefits that will accrue to the corporation in the form of enhanced professional recognition of management and technical competence in the industry, a broader satisfied customer base, and development of staff skill levels. With the project objectives having been met, senior management has the opportunity to maximize these benefits to the corporation by using these seasoned project management personnel on other projects and making them available to other senior corporate managers who have requirements for similar expertise on their projects.

Conclusion

It is imperative that senior management take an active role in each project by assigning a corporate sponsor to champion and shepherd the project through to its desired completion and expected results. This process begins with a decision on an appropriate project within the corporate strategy, selection of a project manager, assignment of staff to a project, continues with a proactive role throughout the execution and delivery phase, and concludes with the project closeout. The pre-project steps must be taken to increase the probability of project success well before the project begins. Provision of technical and management support, as well as close attention to overall results compared with project goals during the project, is required to achieve the project objectives. Post-project activities are needed to maximize the benefits available to the corporation following completion of a successful project.

ENDNOTES

1 Santosus, M. *Office discipline: why you need a project management office. CIO* 16(18):82–88

2 Hot button. *PM Network* 17(5):12, May 2003

3 Hot button. *PM Network* 17(7):15, July 2003

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Chapter

20

Building a High-Performance Project Team

Warren Opfer

Biographical Sketch . . .

Warren Opfer is a principal and the Chief Operating Officer of The Dayton Group, Inc. He is a practitioner, consultant, and instructor in program/project management and information technology with over 25 years of industry and government experience. He has presented research papers at Project Management Institute (PMI) Symposiums and the PMI Research Conferences in 2000, 2002, and is a scheduled presenter in 2004. Mr. Opfer has been a contributing author for several books and coauthored an article published in the *Project Management Journal.* He is actively involved with PMI and has served as a member of the Research Member Advisory Group. Mr. Opfer holds an M.B.A., CCP, PMP, and is a Ph.D. candidate at the University of Strathclyde, Glasgow, Scotland.

The Origin of Teams and Team Culture

Eons ago, our ancestors are said to have come together informally in groups to hunt and gather food and defend themselves from predators. They determined all that time ago that it is more effective to work together toward a common goal than to do it as individuals. A culture, or doing things in certain ways, evolved over time and the propagation of that ''team approach'' to many activities developed and flourished. *Webster's Third New International Dictionary* defines a team as ''a number of persons associated together in work or activity.'' It is not the team, however, that is important, but what the team accomplishes. If our ancestors had not been effective as a team, we might well have not survived to be reflecting on this. *Webster's* goes on to define teamwork as ''work done by a number of associates with usually each doing a clearly defined portion, but all subordinating personal prominence to the efficiency of the whole.'' In these

Field Guide to Project Management, Second Edition. Edited by David I. Cleland

fundamental definitions lies the basis for what really differentiates between a team and a high-performance team. The focus of this chapter will be on the people aspects of teams and how ''usually each doing a clearly defined portion'' and ''subordinating personal prominence'' strongly influence team performance and effectiveness.

Effective Teams

Effectiveness is a measure of outcome or results. Vijay Verma wrote, ''An effective team is composed of a group of people who work interdependently, who are flexible, committed to achieving common objectives, work well together, produce high quality results and enjoy it.''[1] This is a very thorough definition because it focuses on the people working together on a common cause, as well as the results. The key points are:

- ***People who are willing to work and depend on one another.*** People are the assets that make the team. The level of competence, commitment, trust, and willingness to depend on the other team members to do their part and support the team as a whole determines the quality of the results.
- ***They are flexible in what they contribute personally, to changing requirements and conditions, and in how they interact and support the other team members.*** This goes back to the ''usually each doing a clearly defined portion'' section of the definition. To be highly effective, team members need to be able to adapt and rise to the occasion and overcome conflict or crisis, or simply pitch in when someone needs some help.
- ***They have a common set of goals and objectives.*** It is vitally important to align the goals of the team members, the team, and the organization so that all efforts are focused together to derive the required synergy of a high-performance team. Communication, which is addressed later in this chapter, is key to this.
- ***They need to work together well.*** The team members need to appreciate the contributions of others, appreciate the likenesses and differences in people, and be willing to make the necessary effort to get along with their fellow teammates in a positive spirit. This may seem a little corny, but how many times have you seen politics and personalities get in the way of getting the job done? This directly relates to ''subordinating personal prominence'' in the definition. The team leader and the team members must have a common set of goals and objectives so that the issue of personal prominence is no longer important. In a true high-performance team, there are no superstars and no losers.
- ***They produce high-quality results.*** Results of less than high quality are not representative of high-performance teams. Leadership and the cohesiveness of the team in accomplishing the objectives are the key.

- ***They enjoy their work.*** This speaks volumes on how people perceive themselves and the work they do. People who have passion for their work generally also enjoy it and are good at what they do. This is reflected in the results of their efforts in quality, timeliness, and other measures of success. In a team environment, this bar has to be raised so that the team realizes a harmony of effort, enjoyment of what they do, the team members they are working with, and what they are accomplishing.

All too often today, we focus on the results and not the people who get us the results. This lack of humanistic focus impacts on how people perceive their roles and responsibilities in a team and whether or not they enjoy it.

Performance is also impacted by a failure to consider the humanistic side. Performance relates to the process by which something is accomplished. It is also a measure of progress toward the desired results. Process, hence performance, is influenced in part by culture, the personality preferences of the team members, and the formal and informal leadership within the team. We tend to measure performance the same way we measure results such as time, cost, and quality. Often on projects we use the earned-value method to determine the level of performance. However, sometimes we fail to consider other aspects of performance. How well did we apply ourselves? Did the team members grow professionally and learn? Did we learn from our mistakes? Part of performance is understanding and benefiting from lessons learned. Are we making the same mistakes twice? Not in a high-performance team! Other important performance factors include new technical knowledge or capabilities gained and the ability to take on larger and more complex projects.

Teams and Projects

Teams and projects are inexorably intertwined. Most projects are not individual efforts. They require a group of people, often with specialized skills and experience, to accomplish the objective. Moreover, the team must work in concert with one another to be effective, much as the musicians in an orchestra must play together to develop the music we enjoy. The essential elements of a project team are as follows:

1. People with common goals and objectives
2. People who are committed to the goals and objectives of the project and the team
3. People with the right mix of skills and competencies
4. People who lead formally and informally
5. People who trust and collaborate with each other
6. People who know their roles and responsibilities and are willing to be accountable

7. People who want to be affiliated with accomplishment and the power and prestige that go with it

The emerging trend here is obvious. The true assets of an organization and a project team are the people. "They are not just an asset, they are the asset, and they deserve to be treated well—not just because it is the right thing to do, but because it is the only smart and fiscally responsible thing to do."[2]

The strengths and weaknesses emerge from an analysis of the team. The identification of project risks and opportunities is also partially derived from this activity.

- Is the team the right size?
- Do we have the right skills and competencies?
- Are we collocated or geographically dispersed?
- Are our goals and objectives within current technical knowledge and capabilities?
- Do we have active support and communication with executive sponsors?
- How, when, and to whom will we communicate?
- What do we need to learn to be successful?
- Do we have a clear end—a definition of "done"?

The answers to these and other questions and others frame the understanding of the team personality and challenges that will need to be overcome.

What Is Team Culture?

Team culture relates to the transmitting of knowledge, social experience, and discipline within the team. David Cleland describes culture as a "refined set of behaviors" that frame a way of life.[3] This way of doing things relates to the earlier discussion that suggested that there exists a team approach. Culture influences both individual behavior and team actions. These actions relate directly to performance or how we do things to achieve results. Culture in teams, therefore, is partially influenced by the corporate culture and environment, and it is heavily influenced by the personality preferences of the team members and leadership. It is also a dynamic structure that can be influenced by events both internal and external to the team. Some examples of this could have to do with changes in behavior by team members due to stress such as an illness in the family, technological or schedule constraints, or corporate pressures caused by market or financial instability. When people react to stresses and influences outside of their regular behavior patterns, it has an effect on the whole team, not just the individual. Thus, culture is a form of standardization, but it is not inflexible and it evolves over time. One example is how employees are viewed regarding work hours. In the industrial revolution, there was no thought of flextime, 40-hour work weeks, job sharing, or cafeteria-style benefits. Most employees were lucky to get benefits at all. Today in corporate cultures, these privileges have become commonplace.

Team cultures are determined by a mix of the corporate environment they operate within, the project objectives, the style of leadership chosen, and the personality preferences of the leader and team members. The leader can influence all of these factors to some degree, but the leadership style chosen and how the leader interacts with the team members can have a profound effect. Many have researched leadership styles and their effect on project management and project teams. Thamhain and Wilemon[4] worked to develop new insights into possible differences in the effectiveness of leadership styles depending on various task complexities and organizational climates. They suggest that there is a continuum of possibilities that must be considered in selecting a leadership style and that the leader has a strong influence over the organizational climate. Martin and Wysocki identifies three elements contributing to the overall project team success:[5]

- Environmental elements affecting the project-management team
- The leadership style of the project manager
- The motivation of team members

This suggests that the leader must select the appropriate leadership style for the situation from many possible styles so that project success will be realized, not just hypothesized.

Trust and Interdependence

Trust and interdependence relate to the importance of team integration and integrity. In a high-performance team, there are no superstars and no losers. The team members must pull together, watch out for each other, and be able to count on one another. Military personnel in battle have to be able to depend on the members of their unit to do their part and cover each other's backs. The team is only as strong as its weakest link, and so the team members must assist one another to gain the desired results.

In addition to the needs of the team, there are individual needs that must be satisfied. David McClelland categorizes individuals' needs into achievement, affiliation, and power.[6] In a team environment, the strength of these needs influences the behavior of the team members and the performance of the team. It is in achieving a balance that true effectiveness can be realized.

Trust and communication are inseparable. "Collaboration flourishes in a climate of trust."[7] The absence of trust diverts and diminishes the concentration and drive of the team and focuses it on nonproductive pursuits. In a problem-solving environment such as a project team, this is clearly undesirable and can lead to political polarization and disharmony. Trust promotes more efficient communication and coordination and improves both the results and the quality of the results.

Communication

To be effective, the team must maintain a high level of communication and coordination on a frequent, if not daily, basis. People naturally want to know what is going on. Team members want and need to know what the straight story is and how it will affect them as individuals and as a team. If this need is not met, team members will find out what they can through the grapevine or make assumptions about what is happening. This is counterproductive and not conducive to building and maintaining a high-performance team. Communication between all team members, and especially between the team leader and the rest of the team, is the foundation for the trust and interdependence needed to build a high-performance team. Team members, including the leader, need to develop an appreciation for the contributions and the value of each member. This is one of the critical success factors for high-performance teams. To gain the required level of performance and results, the team must synergize. This collaboration of effort and reliance on the team as a whole is what differentiates a team. The foundation is communication, which is the most important of the seven critical success factors for high-performance teams.

Team leaders must take an active role in this communications process. They must act as a conduit for information to and from higher levels of management and the rest of the organization, and must also be the facilitators for communication between the team members. The leader must act not only as visionary and champion for the project, but as coach and cheerleader to encourage and motivate the team. This is vital to high-performance team performance and sustained successful results.

One of the first steps in developing a project plan is to produce a complete and well-defined statement of the scope of the work, which the project is to accomplish. This is sometimes referred to as the ''*Definition of Done.*'' This is frequently not communicated effectively to the team members. It is one of the critical success factors that each team member clearly understand the project goals and objectives. It is also a critical success factor that each team member understand his or her roles and responsibilities in accomplishing those goals and objectives. Frequent and open communication among all of the team members, including the leader, is essential.

Team Building—How Teams Form, Develop, and Interact

We discussed in the previous section the importance of communication. It is the foundation of team building. Building a high-performance team requires a careful balancing of goals and objectives, technical requirements, skills and competencies, personality traits, and leadership style. The key to it all, however, is communication.

It is very important for the team leader to remember that he or she is a team member, too. Leadership needs to be a shared responsibility in the team, and both a formal leader and informal leaders will emerge.

When building a team, it is essential to establish a team identity. This is why military units select nicknames and why military fighter pilots have call signs. It helps to build *esprit de corps*. For project teams, selecting a name helps to build a sense of belonging for the team members. Things like project team baseball caps and tee-shirts also contribute to building this all-important team spirit. Having team social events is another common way to let the team members get to know each other better and establish a rapport. This is particularly important for virtual teams and teams that are geographically dispersed. Another important factor is recognition of success. As milestones are met, it is important to recognize the contributors and celebrate the accomplishment. This is a very powerful team-building tool.

The classical and most referenced model regarding team building is the four-stage model of forming, storming, norming, and performing. Tuchman and Jenson have revised this model and added adjourning as the fifth stage.[8] The model lays out team formation in five stages, which correspond to phases of maturity in the team.

In the forming stage, the team is just coming together. Ground rules are set forth, but discipline in the team has not yet been established. Lines of communication are formed, and the seeds of team identity are sowed. Risk planning and management begins and continues to be carefully monitored through the remaining stages. During this stage, the project kickoff meeting or meetings take place and project organization and documentation are also established. This is the time when objectives, goals and metrics, and the roles and responsibilities of the team members are communicated to the team.

The storming stage is the time when the team really starts to congeal. Control issues emerge as the informal leaders and other team members begin to establish their influence. Team culture and practices begin to develop. The team members start to deal with internal politics and personalities, and conflicts arise. This is a critical time for the team leader. A certain amount of conflict is inevitable and needed to pull the team together into a cohesive unit. At this stage, the necessity of some changes in team membership may become evident to the leader, who must take decisive action quickly. The use of sound leadership and conflict-management techniques is needed to bring the team to the next stage in development.

In the norming stage, the team begins to take ownership of the goals and objectives. The team's culture is now fully established. Roles and responsibilities have now been set and the team members are focusing on achievement. All team members want to be accepted and affiliated with a successful team. The issues surrounding power have been largely resolved, and thus team cohesion is realized. Communications are frequent and open. Subteams have now formed and leadership is shared. The focus of the team is now on performing and generating results.

The performing stage is the project-execution phase, when the bulk of the work is accomplished. Team leadership is focused on timely resolution of issues and problems, monitoring risk, and determining progress against objectives. Collaboration is now at its highest level and the team now tends to think and act as a cohesive unit. The risk of ''group think'' needs to be watched for and avoided. Team and team-member accountability are now at their highest levels. Both leadership and success are now shared responsibilities. Rewards and recognition for accomplishment are now occurring on a regular basis. Issue and problem resolution are a shared team effort. The focus of the team is on performing, generating results, and project completion.

The adjourning stage addresses the fact that projects and teams are temporary. They exist to complete the goals and objectives and then they disband frequently to reform for another project. This closely relates to the closing phase of the five project-management processes in the *PMBOK Guide*.

Group Dynamics—"Group Think" and Other Phenomena

Teams as groups are a living, evolving, dynamic entity. Change and growth in a team is necessary to the team's development, but sometimes that change is not for the better. Group think is a common trap teams can fall into when team conformity becomes excessive. This phenomenon occurs when the team members begin to think too much alike, to a point where creativity and individual thinking are stifled. Teams in this mode will sometimes feel a sense of invulnerability, and pressure to be a team player can arise when objections are raised to a proposed course of action. Decision-making in this situation can lead to tragic results.

Some other pitfalls that affect teams are analysis paralysis, the conflict gridlock, and waning commitment, which is a diminishing of interest and focus by team members as the project is nearing completion. These are all leadership issues that must be addressed quickly in a high-performance environment.

The Importance of Leadership

The quality and effectiveness of team leadership is a critical success factor for high-performance teams. Whether formal or informal, the leadership sets the vision and direction for the group. High-Performance Teams are defined by their leaders. Leaders need to be flexible and adaptable and use different styles of leadership as called for by the situation. They must overcome the many disruptive factors that influence teams and their effectiveness. Leadership is both an art and a science. There is no perfect recipe for how to be an effective leader. The reason is that no two sets of organizational environments and project team circumstances are ever exactly alike.

Douglas McGregor said it best:

> There are at least four major variables now known to be involved in leadership: (1) the characteristics of the leader; (2) the attitudes, needs, and other personal characteristics of the followers; (3) characteristics of the organization, such as its purpose, its structure, the nature of the tasks to be performed; and (4) the social, economic, and political milieu. The personal characteristics required for effective performance as a leader vary, depending on the other factors.[9]

Leadership by following can be an effective technique when appropriate, and leaders should not necessarily be focused on themselves, but be willing to share credit with the team.[10] It is important that both leadership and success be a shared team responsibility.

Communication and Team Size

Team size has a major influence on performance and effectiveness. Obviously, too many resources or too few of the right resources with the right skills can be a problem. An important and sometimes overlooked factor, however, is the effect of team size on communication. Communication is a key determinant for high-performance teams. It is important that all team members be able to communicate with one another freely and that the communication channels always be open. Bigger is not always better.

The number of communications channels is a function of team size. Take, for instance, the case of a small team of just 2 people. Only one communication channel is necessary. Increase the team size to 4 and you have 6 channels. Now increase the team to 10 team members and the number of channels increases to 45. Double the team size to 20 members and you now have a whopping 190 communication channels to maintain. The problem becomes obvious that as team size increases, the challenges to effective communications grow substantially. Add geographic dispersion to the team mix or working in a virtual team environment and you have complicated communication even further. So how do we deal with this issue for high-performance teams? The use of a core team and subteams is an effective technique when the total project team is large or dispersed in geographic clusters. Building subteams on functional lines or based on natural task groups can also be effective. When working with a virtual team, however, time and other resources for communication must be increased to account for this condition. This, of course, should be clearly defined and explained in the project communications plan and identified as a risk in the risk management plan.

Personality Preferences and Contribution—Teams Are People, Too!

It has been previously established that people are important assets—many would argue, the most important assets. From a team perspective, this is most certainly true. Understanding and appreciating the likenesses and differences in people is extremely valuable information for evaluating team strengths and weaknesses. The team leader must learn how to utilize these traits to maximize the team's effectiveness. In this case, knowledge is truly power. This topic deserves a chapter to itself, but we will focus on at least a few key aspects that relate most directly to teams.

Starting with the sixteen Jungian personality types, Katherine Cook Briggs and Isabel Briggs Myers developed the Myers-Briggs Type Indicator®, or MBTI®.[11] The four MBTI scales are continuums based on psychological theory holding that people have natural preferences and that when working within that framework they are at their best and at least somewhat predictable. Conversely, if they are outside their comfort zone, their behavior becomes more unpredictable, stress levels increase, and performance may decline. That is not to say people never utilize the opposites of their preferences or stray from their comfort zones. In fact, straying from your natural preferences can be used effectively in the right circumstances to get specific desired results. This tool is extremely well suited to help determine the personality preferences, traits, and predicted behaviors for the team members and how the team is likely to interact and perform.

Aligning Goals, Objectives, and Preferences

The alignment of goals, objectives, and personality preferences is vitally important to effective team building. Earlier in the chapter, we addressed the importance of the alignment of organizational, team, and individual goals and objectives. Another factor to consider for the team leader is how to blend and best utilize the personality preferences, traits, and behaviors of the individuals to yield the greatest positive results. This is by no means an easy task.

Passion and Enjoyment

Bill Gates said it best: ''I think that the key point is you've got to enjoy what you do.''[12] One of my partners in The Dayton Group opens every course and workshop with a discussion about passion—passion, that is, in project management, in his life's pursuits, and in his personal preferences. It is important for people to have passions in their life, know what they are, and act upon them. It has been suggested that as many as 70 percent of people don't know what their passions are. Hating your job and having to go to work every day dreading it is not conducive to high performance. Unfortunately, the statistics on this are sad, because approximately 5–20 percent of people hate what they are doing, 60–70 percent tolerate it, and only 20–25 percent say they love what they do and enjoy it.[13] Hopefully, you are in that last group. High-performance team members are usually functioning in the top 20–25 percent zone.

Likenesses and Differences

Understanding the likenesses and differences of the team members will reveal the strengths and weaknesses of the team. Among other things, it will also help in determining who to assign to certain tasks or subteams because of their abilities based on preferences. In Table 20–1 are some of these team traits based on the MBTI® Team Type Lens.[14]

Strength from Diversity

In a high-performance team, it is important to select team members who have diverse preferences. This is necessary to get a balanced team that will present different points of view and approach issues and problems from different perspectives. Differences will also lead to conflict; but if controlled and constructively molded, this can lead to very positive outcomes. Many new and great ideas arise from conflict and even failure. Failure to balance the team, however, can lead to very negative consequences. Project leaders must understand conflict and use it when it is constructive, but avoid or mitigate conflict when it is destructive.

Seeking the "Truth"

It is necessary to say a few words on ethics and communication. High-performance teams must be based on trust, and trust is based on communication. Team leaders must be truthful and honest in their communications both to the team members and to the project sponsor and executive management. This cannot be overstated.

Appreciation—Goals, Roles, and Souls

Team leaders need to be stewards of the company's assets, especially the people, whose abilities should be enhanced through the project work and

Table 20–1 MBTI® Team Type Lens

Extroverted types Remain aware of the environment, maintain their networks, and take action	***Introverted types*** Pay attention to the infrastructure, conceptualize the problem, and look deeply into issues
Sensing types Know the facts, understand the planning stages, and work out implementation details	***Intuitive types*** See the big picture, forge into new areas, and develop new possibilities
Thinking types Discuss issues in a logical way, consider the pros and cons of various alternatives, and spot the inconsistencies in a plan	***Feeling types*** Understand what is important to people, acknowledge the human side of decision-making, and help others accept decisions
Judging types Generate systems, provide organization, and act with decisiveness	***Perceiving types*** Are open to new ideas, provide insight, and react with flexibility if the system breaks down

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mentoring.[15] There is no doubt that people like to be appreciated. It is necessary for the team members to be recognized for their roles and contributions in achieving the project goals and objectives and to do this in a very public way. Achievement and success need to be celebrated, and everyone in the organization needs to know about it. Acknowledgment at company functions, especially social ones, and in company newsletters or press releases is very effective. Recognition, rewards, and a simple thank you go a long way.

How Do I Recognize a High-Performance Team?

Teams that are performing at high levels are easy to spot. In Table 20–2 David Cleland identifies the qualities of high-performing teams from a task and a people-related orientation.[16]

Hans Thamhain[17] identifies a list of drivers and barriers to team performance. The positive drivers for performance are:

- Professionally interesting and stimulating work
- Recognition of accomplishment
- Good interpersonal relations
- Proper technical direction and team leadership

Table 20–2 Characteristics of High-Performing Project Teams

Task-Related Qualities	People-Related Qualities
• Committed to the project	• High involvement, work, interest, and energy
• Innovativeness and creativity	• Capacity to solve conflict
• Willingness to change	• Good communication
• Concern for quality	• High need for achievement
• Ability to predict trends	• Good team spirit
• Ability to integrate	• Mutual trust
• Ability to anticipate problems and react early	• Self-development of team members
• Synergism	• Effective organizational interfacing

Source: Cleland, D. I. *Project Management: Strategic Design and Implementation,* 2nd Edition. Boston: McGraw-Hill, 1994. Reproduced with permission of the McGraw-Hill Companies

- Qualified project team personnel
- Professional growth potential

The barriers to high team performance are:

- Unclear project objectives
- Insufficient resources
- Power struggle and conflict
- Uninvolved, disintegrated upper management
- Poor job security
- Shifting goals and priorities

I would add one more item to these lists as both a potential positive, if done well, and a potential negative, if done poorly: communication.

Eleven Characteristics of High-Performance Teams

Many authors have developed lists of characteristic associated with effective teams. Here is another in Table 20–3, which focuses on eleven key characteristics of effective teams. Leadership is a crucial element in the effectiveness of teams. The leader is the driver for the actions necessary to ensure project success.

Leadership in High-Performance Teams

Team leadership is demanding at best, but even more so in a high-performance environment because the leader must define and mold the team, mentor the team members, and persevere to succeed. The leader has to champion the project or the necessary achievement will not occur. Some exceptional leaders are even said to possess an ‘‘evangelical leadership gene’’[18] because of their enthusiasm and zeal. Success and high-

Table 20–3 Eleven Key Characteristics of Effective Teams

Key Characteristics	Effective Teams
Goals	Goals are clear and accepted by all team members
Roles	Responsibilities are clear and change as needed
Conflict	Conflict is managed openly and accepted as a vital part of team development
Learning	Learning is valued and lessons learned are captured, documented, and distributed
Leadership	Leadership is seen as a shared responsibility and is demonstrated by example
Performance	Performance, satisfaction, and growth are valued and achieved
Communication	Communication is clear, open, and energetic
Processes	Team processes are ''invented'' that ensure alignment with team objectives
Risk	Risk is seen as a challenge and an opportunity
People	Individual goals are blended with team objectives and organizational objectives. Team members consider the team to be more than just coworkers and the job to be more than just a job
Power	Team members feel powerful—each team member's contribution is valued and sought
	W. A. Opfer ©2002 adapted from Mower and Wilemon ©1989

Source: Opfer, W. A. Presentation on building high performance teams at Abbott Laboratories. November 2002; Mower, J., and Wilemon, D. ''Team Building in a Technical Environment.'' In *Handbook of Technology Management.* Edited by D. Kocaoglu. New York: John Wiley & Sons, 1989

performance teams go together and are what really differentiates them. Hans Thamhain developed a list of specific recommendations for helping leaders cultivate productive environments and build high-performing teams.[19]

- ***Negotiate the work assignments with team members.*** Team members need to buy in to the objectives and plans.
- ***Communicate organizational goals and objectives.*** Communicate the relationship among organizational, team, and individual objectives and their contribution.
- ***Plan the project effectively.*** Involve the team early and set realistic objectives.
- ***Staff and organize the project team.*** Plan and staff based on requirements, not who is available.
- ***Define the project organization, interfaces, and reporting relations.*** Know your stakeholders well.
- ***Build a high-performance image.*** Market the team capabilities and success, but don't oversell.
- ***Define the work process and team structure.*** Utilize methodologies and processes. Develop cross-functional linkages.

- ***Build enthusiasm and excitement.*** Make the work more interesting and challenging. Strive for high commitment.
- ***Ensure senior management support.*** Sponsorship and a positive organizational environment are critical.
- ***Define effective communication channels and methods.*** Communications internal and external to the team.
- ***Build commitment.*** Collaboration in planning aids in team member commitment to plans.
- ***Conduct team-building sessions.*** Team-planning meetings, brainstorming sessions, social gatherings.
- ***Ensure project leadership.*** Requires credibility, trust, and respect.
- ***Create proper reward systems.*** Reward for creativity, achievement, and performance.
- ***Manage conflict and problems.*** Issues and problems should be avoided by alert action.
- ***Ensure personal drive and leadership.*** Lead by example. Leaders must be enthusiastic, competent, and committed.

Balance and the HPT—Personal, Social, Work

One thing project team members frequently don't do very well is maintain the balance among work, personal, and social activities. All too often, team members will move to the "dark side" and spend an inordinate amount of time on work, neglecting the personal and social aspects. People need a life outside of work. They need to do fun things and spend time with family and friends. They need to clear their minds and rest so they can refocus and be crisp. There is also a need to socialize with the team members. This is an essential element of team building, especially for high-performance teams. Just as selecting a name for the team gives it an identity, it is essential that the team members develop and identify with the team and form a bond with the other team members.

Accomplishment, Success, and the High-Performance Team

Many authors have defined project success, and like so many of them, this author does not feel there is a definitive answer. However, for this chapter we will define a series of success factors:

- On-time, on-cost results have been achieved.
- Quality work products have been produced.
- Technical success based on goals and objectives has been achieved.

Table 20–4 Seven Critical Success Factors for High-Performance Teams

1. Clear goals, objectives, and metrics
2. All team members understand their roles and responsibilities, their value to the team, and the value of others, and understand and appreciate each other
3. Communications are frequent and open
4. Leadership and success are shared responsibilities
5. No superstars and no losers
6. Learning and change are necessary
7. Conflict and risk are dealt with quickly and directly
W. A. Opfer ©2002

Source: Opfer, W. A. Presentation on building high-performance teams at Abbott Laboratories. November 2002

- Sponsors, stakeholders, and user community expectations have been met.
- Benefit to the organization has been derived.
- Team members have grown professionally and learning has taken place.
- Team coalescence has been achieved.
- Team has been able to stretch beyond perceived limitations.

High-performance teams must use whatever means are available to them to perform efficiently and produce successful results.

Seven Critical Success Factors for High-Performance Teams

In conclusion, Table 20–4 identifies seven critical factors that need to be addressed for all successful teams. Success and high-performance teams are not synonymous, but they are close.

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Chapter

21

Motivation in the Project Environment

Robert J. Yourzak

Biographical Sketch. . .

Robert J. Yourzak, P.E., P.M.P., C.M.C., is President of Robert Yourzak & Associates, Inc., a Minneapolis management and engineering consulting company founded in 1982. The company's over 20 professionals serve clients in program, project, construction, and operations management and planning for facilities, products, and training. He has taught over 20 project management courses for over ten years at the University of Minnesota, and is a worldwide speaker and author. He is a Past Chairman of the Board and President of the Project Management Institute (PMI). He also served as Minnesota Chapter President for PMI, American Society of Civil Engineers (ASCE), and Institute of Industrial Engineers (IIE). Mr. Yourzak has been honored as a Fellow in PMI, ASCE, and IIE, and with recent listings in *Who's Who in the World, Who's Who in America,* and *Who's Who in Science and Engineering.*

Often the difference between a good and excellent project is the ability of the project manager to develop a motivated team. The challenge for project managers is to motivate multidisciplinary individuals to work together effectively toward a common goal as a team. The interpersonal style of the project manager can have an impact on the project throughout its life cycle.[1] The following are the classic leadership behavioral profile patterns:

- ***Analytical.*** Project managers with this behavioral style depend on their own technical knowledge and ability, and often make the technical decisions for the project, which they communicate to their teams. One-way communication may result. Project managers will often ask questions to get the facts.

- ***Driver.*** Project managers having a dominant driver style are extremely self-motivated and control their teams by constantly giving directions. Their competitive attitudes drive the teams to win.
- ***Supportive.*** Project managers with this behavioral style establish formal project reporting channels linked to their organizations' structure. These project managers understand the broad company perspective. When unsure of an issue requiring subjective judgment, they ask questions to find answers before making decisions.
- ***Influencing.*** Project managers using the influencing style emphasize teamwork, team building, and team decision-making. They work with their teams to influence project implementation.

Each project manager has a mix of these styles. The mix can vary depending on experience level and the project environment. The most important skill is knowing when to apply one style (or a mix of styles) to handle a specific situation.

Research Studies

The author led the following four research studies:

1. In 1985, students in the author's project-management courses interviewed 128 executives/managers and 59 employees near the University of Minnesota's Institute of Technology.
2. In 1996, the same 1985 questionnaire was sent to 400 Midwestern executives/managers in manufacturing, utilities, government, consulting, and construction. However, only 36, or 9 percent, of the executives/managers sent back the questionnaire in the enclosed self-addressed, stamped envelope.
3. In 2003, the same five 1985 questions that form the basis for the five tables in this chapter were sent to 1000 Minnesota executives/managers in industrial and commercial organizations. However, only 113, or 11.3 percent, of the executives/managers sent back the questionnaire in the enclosed self-addressed, stamped envelope.
4. The author conducted a study on behavioral styles by summarizing profile-instrument results from participants in company training programs since 1982.

Executives/managers in the 1985, 1996, and 2003 survey questionnaires were asked to rank the project manager's behavioral style that would best service their organizations. Table 21–1 shows that in 1985, executives/managers ranked influencing style as the most desired, followed by supportive, analytical, and driver. In 1996, executives/managers ranked influencing style as the most desired, followed by analytical, driver and supportive. In 2003, executives/managers ranked influencing style as the most desired, followed by supportive, driver, and analytical.

Table 21–1 Project Managers' Desired Behavioral Style

Project Managers' Desired Behavioral Style	1985 Executive/ Manager (128)	1996 Executive/ Manager (36)	2003 Executive/ Manager (113)
Analytical	3 23.7%	2 24.2%	4 18.3%
Driver	4 21.6%	3 21.7%	3 22.4%
Supportive	2 25.0%	4 19.2%	2 28.6%
Influencing	1 29.7%	1 34.9%	1 30.7%

( ) Denotes sample size.

After nearly two decades of desiring their project managers to develop a greater influencing style, the 2003 executives/managers surveyed reported a 1.5 percent drop overall in project managers having an existing influencing behavioral style (see Table 21–2).

Results from the study on participants in the author's company-training programs since 1982 differ from the other studies. The dominant behavioral styles of existing or aspiring project managers taking the training programs are the following: supportive style (29 percent), analytical style (28 percent), driver style (25 percent), and influencing style (18 percent).

Developing Leadership Skills

Project managers will change the balance of the four behavioral styles as they get more experience and as the project environment changes. In 1996, the functional organization was the most common structure, with 69 percent of organizations using this structure. (See Chapter 16 for more on organi-

Table 21–2 Project Managers' Existing Behavioral Style

Project Managers' Existing Behavioral Style	1985 Executive/ Manager (128)	1996 Executive/ Manager (36)	2003 Executive/ Manager (113)
Analytical	2 26.6%	1 31.6%	3 25.3%
Driver	4 20.7%	2 27.4%	4 23.1%
Supportive	3 25.3%	4 16.9%	2 25.7%
Influencing	1 27.4%	3 24.1%	1 25.9%

( ) Denotes sample size.

zational structures.) The matrix organization was the next most popular, with 17 percent using this structure. Project and one-owner organizations each had 7 percent. Projects had an average of eleven team members and a duration of thirteen months. Many of these organizational factors will have an influence on how project managers lead their teams and interact with other stakeholders.

A project manager working on a technical project may start with a dominant analytical style. At this stage, the project manager may have a small, single-discipline project where he or she also does the technical aspects.

As the project manager gets more assistance and directs project teams for small- and medium-sized projects, he or she may develop a dominant driver style. As the project manager gets medium- and large-sized, multidisciplinary projects, he or she may develop a dominant supportive style. This stage often includes repeat, noncontroversial projects.

As more new, controversial, difficult, large, and multidisciplinary projects are successfully completed, the project manager may develop a dominant influencing style. At this stage, the project manager especially recognizes the need to motivate and lead the team.

Project managers who desire to strengthen their influencing style to achieve greater balance among the four behavioral styles should do the following:

Table 21–3 Most Effective Motivators

	1985		1996	2003
Motivator	Executive/ Manager (128)	Employee (59)	Executive/ Manager (36)	Executive/ Manager (113)
Recognition*	1	1	2	2
Responsibility*	2	3	3	3
Achievement*	3	2	1	1
Advancement*	4	9	5	9
Growth*	5	10	8	4
Salary	6	5	10	7
PM's Leadership	7	7	7	8
Work Itself*	8	8	6	5
Relation with PM	9	6	9	10
Team Peer Relations	10	4	4	6
Work Conditions	11	11	13	11
Team Subordinate Relations	12	12	12	14
Organization's Policy	13	15	14	16
Title/Status	14	14	15	15
Security	15	13	11	12
Personal Time	16	16	16	13

*Six intrinsic factors (other ten are extrinsic factors).
( ) Denotes sample size.

Table 21–4 Rank of Extrinsic Demotivating Factors

Demotivator	1985 Executive/ Manager (128)	1985 Employee (59)	1996 Executive/ Manager (36)	2003 Executive/ Manager (113)
PM's Leadership	1	4	1	2 tie
Team Peer Relations	2	2	6	1
Relation with PM	3	1	2	4
Salary	4	3	3	5
Organization's Policy	5	7	7	9
Team Subordinate Relations	6	8	8	7
Work Conditions	7	6	5	2 tie
Security	8	5	4	8
Title/Status	9	10	10	10
Personal Time	10	9	9	6

( ) Denotes sample size.

- Observe and understand effective influencing leaders in their organization, professional society, or civic organization. In particular, observe decision-making, controlling, motivation, communication, and planning styles.
- Gain influencing experience as a committee chair or officer in professional societies or civic organizations.
- Take courses in organization and management, human relations in organizations, psychology in management, fundamentals in management, team building, and leadership.

Motivation Factors

An improper behavioral style can lessen the impact of effective motivators. According to the surveys, some motivational factors have not changed much

Table 21–5 Rank of Intrinsic Motivating Factors

Motivator	1985 Executive/ Manager (128)	1985 Employee (59)	1996 Executive/ Manager (36)	2003 Executive/ Manager (113)
Recognition	1	1	1	2
Achievement	2	2	2	1
Responsibility	3	3	3	3
Work Itself	4	4	4	4
Advancement	5	5	6	6
Growth	6	6	5	5

( ) Denotes sample size.

Table 21–6 Recognition Motivators

• Recognize team as the key component of the organization in the company newsletter or on the bulletin board. • Write an article or articles on the project in external publications and include team-member names. • Send the team to seminars and conferences, especially to present successful project-team results. • Give team awards, performance certificates, plaques or gifts, "project of the month," "team of the month," annual awards day, traveling team trophy, 5-10-15-etc.-year service pins, watches, clocks, or pens. • Give special parking spaces next to the building for the month; or use of the company resort condominium. • Identify and associate with successful results; provide positive reinforcement by management, peers, and customers for being under budget and ahead of schedule with high project quality. • Create a "company wall of project teams."	• Hold team dinners or lunches, picnics, social or sporting events, fishing or hunting trips; invite customers and top management. • Give extra time off at project completion as a reward for a job well done. • Participate in major decisions on project. • Give additional responsibility or special assignments. • Include in key project teams working on important issues. • Sign reports or drawings. • Make client or top management presentations. • Receive praise or feedback from management for a job well done; get an in-person thank you from the boss and/or the president. • Obtain customer or client thank-you letter to the team. • Provide profit-sharing, stock purchase, bonus, merit or benefit increases—tangible proof of the value of the team accomplishment.

Table 21–7 Achievement Motivators

• Meet or beat project schedule, budget, technical requirement, quality, or goals while working together as a team. • Obtain satisfied customer. • Receive sense of accomplishment seeing your project completed and working as planned. • Solve difficult problem, find innovative process, or get new patent. • Market project to potential customer and win, beat out competitors for a new business account. • Become an industry leader.	• Develop leading-edge product that works, that customers need or want, and with a good financial return. • Create publicly needed structures or services. • Complete a new and difficult project. • Complete additional education or degree. • Feel a sense of being important or belonging to the team and organization. • Get payoff for entrepreneurship. • Reach or exceed team goals that are greater than the goals of individuals working alone.

Table 21–8 Responsibility Motivators

• Be accountable for project schedule, budget, technical work, or quality. • Plan scheduling, budgeting, and staffing on your project. • Set one's own work goals and be accountable for achieving them. • Take control of team direction and project approach. • Select one's own work method. • Receive commensurate authority to act, along with responsibility for the project.	• Provide customer needs or wants. • Develop a good working relationship with the customer. • Participate in decisions affecting your project. • Keep informed on issues affecting the project. • Take new risks. • Get larger and more complex projects or project-team role. • Be trusted to perform responsibilities and achieve desired results.

since 1985. Table 21–3 shows that executives/managers and employees ranked recognition, achievement, and responsibility as the top motivators over nearly two decades.

In 1985, the four most demotivating factors were inadequate project manager's leadership, inadequate team peer relations, inadequate relations with the project manager, and inadequate salary (see Table 21–4). In 1996, inadequate team peer relations dropped significantly as a demotivator. Inadequate security increased to a top four demotivator in 1996, along with inadequate project manager's leadership, inadequate relations with the project manager, and inadequate salary. In 2003, executives/managers significantly increased the rankings for inadequate team peer relations and

Table 21–9 Work Itself Motivators

• Have interesting, varied, challenging, and important projects and work. • Know one's work is needed and helps society; see physical results of meaningful contributions. • Create innovative, worthwhile, necessary, and/or tangible product with high quality for satisfied customers. • Develop good team spirit and peer relationships and work with knowledgeable professionals. • Have a choice of projects. • Make one's own decisions and have greater team and individual independence. • Be allowed to take a risk. • Work for one's own customers and obtain new customers. • Have meaningful impact and ownership of work.	• Feel competent, so that one is not underemployed or pigeonholed. • Handle job-related problems that customers care about. • Receive clear direction and leadership. • Have realistic goals and objectives. • Work in a proper, positive company work environment. • Be satisfied with the accomplishments that can be achieved in a 40-hour work week. • Like the job and go to work with a smile. • Adjust hours to meet personal and business demands. • Convince customers to be environmentally supportive. • Have work specialty(ies). • Contribute to financial business goals.

Table 21–10 Advancement Motivators

- Receive job promotions for new and broader opportunities.
- Obtain more responsibility, authority, and accountability.
- Get new, more complex tasks and larger projects.
- Recommend team members on the project for promotion, and share in their satisfaction when they earn it.
- Obtain opportunities to advance by receiving reimbursement for seminars, workshops, classes, or conventions.
- Certify and approve projects.
- Get an increase in salary, obtain a bonus, a larger office, a company car, or other added benefits.
- Meet with clients or top management on the project.
- Participate in job rotational development; obtain varied experience to become well-rounded.
- Have a dual-ladder system; promote both on the managerial and on the technical sides.
- Receive one's first project to manage.
- Earn professional registration or specialty certification.
- Have a company policy of advancing from within.
- Relocate to more a desired company location.
- Be named to a corporate committee.

Table 21–11 Growth Motivators

- Increase or develop new technical, multidisciplinary, or managerial skills.
- Become more competent on the job through on-the-job learning and from projects that develop the individual.
- Attend company-paid seminars, courses, trade shows, conventions, or professional-society programs to help prepare for future changes.
- Promote life-long learning in a comprehensive career-development program.
- Diversify one's knowledge base; learn other skills in nontechnical areas and a wide variety of work tasks.
- Increase interpersonal skills.
- Meet more people, both inside and outside the company.
- Become more marketable for other tasks, positions, and new challenges.
- Earn an opportunity to teach, become a leader and mentor within the company.
- Contribute to one's professional society, including service as an officer and committee chair.
- Research a new area for publication on company-paid time.
- Interact with other industry professionals.
- Read or use up-to-date industry publications or books.
- Participate in a rotational development program (broadening assignments).
- Obtain more challenging and varied work assignments.
- Develop a respected reputation.
- Use new, company-paid equipment.
- Be part of a growing organization that is expanding in new areas, adding new staff, and having efficiency gains and office improvements.

inadequate work conditions as top four demotivators along with inadequate relations with the project manager and inadequate project manager's leadership.

When asked to separately rank the six intrinsic motivators, as shown in Table 21–5, the 1985 executives/managers and employees had identical rankings. The 1996 executives/managers had the same rankings as in 1985, except that they reversed the last two factors. The 2003 executives/managers had the same rankings as in 1996, except that they reversed the first two factors. In all surveys, either recognition or achievement ranked as the best motivator, followed by responsibility.

Dr. Frederick Herzberg's two-factor theory was used as the basis for the motivator and demotivator factors listed.[2]

The lists in Tables 21–6 through 21–11 include a host of practical motivating tips for everyday project-team use. It is recommended that organizations first place their effort in fixing the problems causing their most demotivating factors. Then, and only then, should they work on improving the motivating factors for project-team members. Some of the practical motivators listed in this chapter should be implemented as they best fit the specific situation.

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Chapter 22

How to Get the Right Message Across

Francis M. Webster, Jr. and Stephen D. Owens

Biographical Sketch . . .

Francis M. Webster, Jr. is retired after 8 years as editor-in-chief of the Project Management Institute (PMI), 21 years of teaching at the university level, and 14 years of industrial experience. He joined PMI in 1978 and has received all three of PMI's highest individual awards. He has authored a number of articles and papers and conducted several workshops on project management. He was responsible for the PMI Software Survey for 8 years and for creating PMINETwork. He earned a B.S. degree from Carnegie-Mellon University and a Ph.D. from Michigan State University. He has had work experience with Phillips Petroleum Company, Chrysler Corporation, and H.B. Maynard and Company.

Stephen D. Owens attended Lamar University and the University of Texas and received his Ph.D. in Industrial Relations from the University of North Texas. Dr. Owens has over 20 years of teaching and consulting experience. He has taught human resource management, organizational behavior, and labor relations both in and outside the United States. He has also led workshops and seminars to improve managerial skills for supervisory and midlevel managers in both the private and public sector.

Dr. Owens has taught and delivered lectures at the University of North Texas, Louisiana State University, and central Michigan University. His principal areas of research and consulting interest include a variety of topics related to the field of project management, industrial relations, and human resource management. Dr. Owens has presented research papers at various professional organizations. Dr. Owens serves as a labor arbitrator and is listed on the panel for the United States Postal Service and the Federal Mediation and Conciliation Service.

Field Guide to Project Management, Second Edition. Edited by David I. Cleland

Even the most experienced project manager is probably not competent over the entire range of variables involved in communicating. For example, most of us are only slightly conscious of the extent to which we communicate through body language. Often spoken language and body language are in conflict; for example, when a person says, ''I am listening to you,'' but is looking around the room or out the window.

Spoken language and written communication are the most obvious ways to get a message across. How those messages are delivered are important for the effective project manager. For instance, some voices are in ranges with a timbre that is pleasing to hear. Varying the tone of voice and speed of speaking adds interest to the spoken words. Combining these with clear, crisp diction conveys the image of an educated and often sophisticated person. Adapting such characteristics to the situation can help bridge the gap between the speaker and the listener. Aspiring project managers should not hesitate to seek counsel on their voice and, if appropriate, get training.

Another important communication element is the use of plain language that everyone can understand. Typically, a project team develops its own specialized language. This may be a coded matrix that identifies locations in physical space or words that describe unique business processes. This specialized language increases the efficiency and accuracy of communicating within the team but may create significant problems in communicating with peripheral project participants or outside stakeholders. Sometimes project participants may use unfamiliar words to impress or obfuscate. Repeated insistence on speaking or writing in plain language will probably resolve the problem.

Putting It in Writing

The formal written document is a must in any organization to convey instructions, restate understandings, convey a sense of importance of the message, or cover your tracks. The competent project manager ensures that all decisions and actions are properly documented so there is a complete audit trail. Too often legal action requires proof that the project manager behaved in a prudent and rational manner.

Although e-mail is a fast method of written communication, it has its disadvantages. E-mail can get you in trouble faster and with more people. E-mail can invite you to express feelings at the wrong time or send what would otherwise be considered a draft to people who matter. The probability that you will say the wrong thing or the right thing the wrong way is greater. Always assume there is an electronic copy of a message recorded somewhere in the system that can haunt you. You cannot deny having said it. On the other hand, when using a formal written letter or memo, it is relatively easy to carry it around in one's briefcase for a day or two and then revise it.

Show and Tell

''A picture is worth a thousand words'' is still a relevant admonition. Data portrayed in graphic form, and the message conveyed by that data, is far more likely to be understood. However, failure to portray the data properly is more likely to lead to confusion and frustration. Probably the greatest error is trying to cram too much into the graphic. Even if the graphic must be replicated several times, it is wise to make one key point per graphic.

Communicating Well Means Career Advancement

Regardless of the communication form, good communications skills go hand-in-hand with a project manager's ability to handle more complex projects effectively. It has been posited that project managers are developed ''one zero at a time.'' A person's first experience upon joining an organization is likely to be an assignment as a contributor on a project. That assignment may be valued at $1,000. If that person handles the job well, the next assignment may have a value of $10,000, and suddenly you are a project manager. And so it goes. If a person flubs an assignment, that person may go back down a notch or two. If a person truly shows promise, that person may skip a few steps.

The Neophyte Project Manager

An aspiring project manager has some important lessons to learn about communicating. To attract management's attention as a potential project manager, you need to demonstrate that you will be a good ambassador for the organization. The following suggestions should help the zeroes grow for your assignments. What you communicate to others and what others communicate to you, the potential project manager, are important. How you behave as a manager and how you provide visibility for what you are doing are also important.

DRESS FOR THE DESIRED ROLE

If you are to represent your organization, either internally or externally, you must present an image that is consistent with the organization's image. If you are playing in Boston, you need to be very proper. If you are in Tombstone, Arizona, you need to look like one of the outstanding leaders there. IBM once had a very rigorous dress code because it sold to executives. All who represented IBM looked like executives. Is this communicating? Most assuredly. The first impression people have is that of your appearance. If clothes are garish or unkempt, they communicate an impression of someone with poor judgment or lacking in personal pride. The message is that those characteristics will dominate in your work.

DEVELOP A POSITIVE ATTITUDE

Typically, the second impression that people get is attitude. In part that is communicated by posture, both standing and sitting. A slouchy posture says you are already defeated, so you are not likely to put forth an outstanding work effort. Standing erect, no matter what your height, gets attention. Sitting erect says you are interested in what is being said. Follow posture with a ''can do, will do'' attitude and you will be given the opportunity to prove yourself. To these, add high self-expectations and high work standards, and you will be saying ''I'm ready, boss.''

The message goes further because high expectations will be communicated to peers and the best of those will be pleased to be on your team. It will be a strong message to all on the team that great things are expected from them. It will also communicate to management that if they give you, an aspiring project manager, an important assignment, you will ensure that excellent results are delivered in a timely manner.

AVOID FOOT-IN-MOUTH DISEASE

A major trap into which many young people fall is saying the wrong things or even saying the right things at the wrong time. This can brand a person as a loose cannon. If management cannot rely on you to be discreet in choice of words and issues, management will not put you into a position of representing them either internally or externally. Does this mean being super cautious to the point of silence? Certainly not. But it does suggest that you should think carefully before speaking and especially writing.

The first opportunity to be heard will be in one-on-one discussions. After that, most likely the first chances to be heard by a variety of people will be in a meeting. Do not express an opinion on something about which you have little understanding. This point will be made abundantly clear when your boss says, ''You haven't been around long enough to have an opinion on that!'' If you have the basis for speaking up, you should organize thoughts well. This means jotting down key words of the points to make. These may be in the form of notations in the margin of your notes on the meeting discussion. Those notes should be prioritized so the comments sound well thought out.

LEARN TO LISTEN

Communications is a two-sided coin. One side is transmitting a message. The other side is hearing a message. Listening is an active verb, but it seems to be practiced passively by most people. Too often project assignments are misunderstood because of a lack of listening. If aspiring project managers want others to listen to them when they are project managers, they must learn to listen to the current project managers. Listening to other's ideas and suggestions, whether or not the suggestions are used, will earn you a reputation for at least considering other people's ideas.

LEARN TO OBSERVE

Communications need not be verbal or intentional. We all learn much from what we observe. Observe the techniques that more senior people use to get the job done, to manage meetings, or to convey their attitudes and expectations. Take notes on these and on how you can adapt and adopt the best practices. Learn to observe what needs to be done, where to appropriately anticipate that your services will be needed, and either do them or prepare to do them. This will communicate to management that you have the capability and the initiative to handle such responsibilities on your own projects.

The Novice Project Manager

This phase of career development may come sooner than expected. You will actually be managing your first project. The project value will be in the range of four to five zeros. Skills to develop during this phase include meeting management, controlling requirements and specifications, document control, achieving visibility, obtaining commitment, showing an effective leadership style, resolving conflicts, and communicating with stakeholders.

MEETING MANAGEMENT

At this level you will have a project team, although members probably will not report directly to you administratively. You will have to preside at project meetings, making them productive and worth attending. You should assume the others in attendance are at least as busy as yourself and could do very well without having to attend another meeting. Thus, it is essential that an agenda be distributed sufficiently before the meeting to allow everyone to be prepared to participate. It will also serve as a reminder of the meeting.

Do not just list the subjects to be discussed but identify the decisions to be made. One residential subdivision meeting drew record attendance when the agenda included a decision item for banning snowmobiles on the lake in winter.

The team may want to participate in designing the meetings. For example, members may wish to meet for one hour, whether all items have been completed or not. If this approach is taken, care should be taken to keep the agenda focused tightly, well prioritized, and on track. Another group may opt for longer and fewer meetings. If the first option is chosen, it is desirable to separate schedule and performance discussions from specific problem-solving meetings. If the second option is chosen, these subjects may be combined.

You can be relaxed or hard-nosed in running the meeting. At the extreme, for example, the relaxed approach may result in starting the meeting sometime after the appointed hour and summarizing what has been accomplished as each additional person enters. This will surely invite late arrivals and probably absences from the meeting. On the other hand, the hard-nosed approach might mean starting the meetings exactly at the appointed hour, not summarizing until the end of the meeting, and not allowing someone who enters late to repeat something that has already been discussed. Somewhere in between, though probably closer to the hard-nosed approach, may be most effective. Also, steps should be taken to ensure that each person is prepared for the meeting. That is, each person should have read the distributed materials or obtained the required information beforehand.

Care should be taken to ensure that everyone present has the opportunity to speak on each issue. Indeed, the project manager should ask specific questions of those individuals who are reluctant to speak. This encourages them to become involved in the meeting. It also serves a good purpose by letting all participants know that they, too, may be called upon, so they better be listening carefully.

The meeting should be wrapped up with a summary of what was accomplished and what was agreed upon. As soon as the meeting is over, the project manager should prepare the minutes or a memo restating the accomplishments, agreements, action required by whom and by when, and the date and time of the next meeting.

CONTROLLING REQUIREMENTS AND SPECIFICATIONS

This may be one of the most important tasks for a project manager. First, it is the basis for confirming with the customer or sponsor exactly what the team has committed to deliver. The work-breakdown structure (WBS), accompanied by appropriate text to more clearly define and limit each item, is the best way of communicating these commitments. (See Chapter 8 for more on the work-breakdown structure.) The text should start to define the criteria for accepting each deliverable. These criteria should be amplified early in the project.

Second, the WBS is the best friend of the project manager in protecting against "scope creep": the gradual expansion of the work content. This can be driven by either the customer asking for a little bit more here and a little bit more there or by participants in the project getting intrigued by esoterics or other motivations and actually performing work that is not necessary.

It is also important to verify the budget and other resources to be provided. Consider the consequences to your career of committing to upper management to achieve certain objectives only to discover that management decided to provide half the resources one expected. If this should occur, you may wish to quickly revise, or renege on, the commitments. Avoid the "superman" complex. You may not be able to do the impossible, let alone the improbable.

DOCUMENT CONTROL

As the product of the project is progressively elaborated, work-to-date is communicated to others who are dependent on it to proceed. It sometimes becomes necessary to revise certain decisions or drawings that have been distributed to other project participants. This can lead to interesting consequences.

EXAMPLE. In building a house, it was necessary to provide the plumber with drawings to plan and estimate the work. Later, as the concrete was being poured in the garage floor of the house, a question was raised about the precise location of a sewer riser. The explanation was that it was to provide drainage for the sinks on the floor above and it was to go up inside the utility-room wall. The problem was that on a subsequent drawing, the utility-room wall had been moved out about eight inches. Realizing that it was too late to move the riser, the owner issued an ''expletive'' and work proceeded. Later, after the utility-room wall was roughed in, the plumber returned and installed a urinal and the ''expletive'' was in fact realized. Had adequate document control been in place, this error would not have occurred.

ACHIEVING VISIBILITY

One of the communication responsibilities of the project manager is to maintain support for the project. This includes support on the part of upper management to ensure that adequate resources are provided and on the part of functional managers, who control when specific resources are available.

Visibility can be achieved by displaying large-scale versions of project documents. Pictures and other messages convey the importance of the project to the organization. These are sometimes displayed in a war room but can be on the wall in a convenient hallway. By posting progress against plan on these documents, every participant on the project is aware that the world will know if they fail to perform according to the plan. The display also encourages members of upper management who happen to pass the display to ask questions about the status of the project. Thus, the project is on the minds of all these stakeholders.

One document to display is the time-scaled project network diagram. It clearly shows which activities are on, as well as behind, schedule. Another convenient tool is the WBS, with each item colored in to show planned and actual progress and planned and actual costs. These can be plotted in translucent colors on percentage scales. While the schedule information is shown on the time-scaled network diagram, the same information summarized by the WBS element communicates clearly what the impact of schedule slippages may be.

OBTAINING COMMITMENT

Novice project managers should avoid getting out on a limb. You need commitments from functional managers to provide certain resources. You also need commitments from those people that they will perform certain tasks according to time and cost constraints.

Obtaining an individual's commitment to a project can only be conducted by relating project objectives to needs, plans, and objectives of that individual. This can challenge your best skills in communicating, and it often takes considerable time. But it is worth it because the individual who is committed will need much less supervision and direction later. The following are two important ways to verify commitments: public declaration and written confirmation. The former is the strongest because when a person states before others—be they peers, superiors, or subordinates—that they will perform a specific task, the person will work very hard to accomplish that task. Such oral commitments should always be confirmed in writing, and, if feasible, distributed to relevant superiors.

SHARING AN EFFECTIVE LEADERSHIP STYLE

There are many leadership styles, such as laissez faire, participative, authoritarian, autocratic, and situational. Pure laissez faire is hardly consistent with the requirements for managing a project. Pure participative is inconsistent with timely completion of a project. The authoritarian will likely alienate the project team. The autocrat will bog the team down as members wait for decisions. The last style, situational, which is really using the other styles at appropriate times, is probably the best style for a project manager. It should be apparent that each pure style implies a different way of communicating. Some of these have unintended and unfortunate consequences.

EXAMPLE. The owner of a construction company was concerned that his employees would never tell him about a problem until it was too late for him to do anything about it. It was suggested to him that his favorite response to bad news was, ‘‘Where is the SOB? I'll give him a new [a part of the anatomy]!'' He turned away and thought for nearly a minute. Then he turned back and admitted that this suggestion was probably correct. ‘‘But I don't know if I know how to manage any other way,'' he said. The owner had failed to develop a broad repertoire of behaviors that he could employ as the situation really warranted.

How we communicate with people often determines what they tell us. If a project manager makes people uncomfortable when they deliver bad news, that manager can expect to get bad news only when it's too late. If a project manager reacts negatively toward anyone who suggests something other than what the project manager thought of, those manager will get a team of sycophants.

EXAMPLE. A new manager of a refinery examined the 24-hour control charts looking for aberrations. The aberrations began to disappear. Then the process engineers began having trouble getting a material balance for the refinery. It seems the pump-house operator got tired of explaining aberrations and saw to it that he did not produce anything but perfect circular charts. The moral of the story? Tell me what you want to hear, either explicitly or implicitly, and I'll see that you hear it, whether it is true or not.

It is very important that project managers develop a management style and a communication style that elicit the desired behavior. If project managers want to hear the bad news when there is still time to do something about it, they can't shoot the messenger. In fact, the most severe reprimand should be for the person who hides the bad news until it is too late. This is just one example of how important an appropriate leadership style is to the modern project manager.

RESOLVING CONFLICTS

Conflict is inherent in projects. Resolving conflict is therefore an essential skill of a project manager. The best solution to a conflict is one that is arrived at by mutual agreement of the concerned parties through discussion of the issues. (See Chapter 23 for more on negotiating skills.)

COMMUNICATING WITH STAKEHOLDERS

The typical project has several stakeholders. They will require project information of various types at different intervals. Learning to understand their needs, anticipate their questions, and provide the appropriate information in a timely manner is an interesting experience for the novice project manager. A careful analysis of the stakeholders' needs and desires plus the availability of versatile computer capabilities will go a long way toward achieving this.

The Developing Project Manager

Success on previous projects will lead to more zeros so that the project's value is probably in the range of six to seven zeros. A developing project manager will have a larger project team, more stakeholders, and likely some level of public interest in the project. In addition to the skills honed on prior projects, it will become important to develop the vision, maintain commitment, create a sense of urgency, report accurately, manage conflicts, manage stakeholders, communicate with the public, and learn to listen.

DEVELOPING THE VISION

On previous projects, the vision of the product of the project and the project itself will likely have been given to the novice project manager. As the project size increases, the ambiguity of the requirements will probably increase. Part of a developing project manager's job will be to work from the broadly stated requirements and define the project in more detail. It will require that the project manager develop a large part of the vision. This will probably be done with the help of the key members of the project team. The process will result in a common vision on the part of those involved, and they are likely the ones for which the vision is most relevant. Thus, the communications task is minimized in the beginning. However, the project manager must maintain a sharp and constant focus on that vision and draw others back to it as the project progresses. The price for failing to do so is the inevitable scope creep and deterioration of project performance.

MAINTAINING COMMITMENT

Larger projects require longer durations. As time passes, memories fade and commitments get lost. The effective project manager must continually reinforce the commitments made for and to the project. This means communicating the importance of the project to the capabilities and reputation of the organization as well as to the careers of the team members. Even the project sponsor must have the fire rekindled sometimes to ensure that resources are not drawn away to more recent crises.

CREATING A SENSE OF URGENCY

As the duration of the project increases, participants tend to see the target as being well into the future and lose the sense of urgency that often pervades the shorter project. Soon precious slack is being used up and, if not dealt with early enough, the result will be slipped activity completion dates and increasing overtime. Budgets may be overspent in expediting work that could have proceeded in an orderly manner.

There are a lot of ways to create a sense of urgency, ranging from cajoling to being a hard-nosed autocrat. Clearly, the approach selected will depend on the extent to which the problem has gotten out of hand. One good approach is to ensure accuracy and honesty in reporting.

REPORTING ACCURATELY

Few project managers would argue that percentage complete is an accurate measure of progress. All are familiar with the adage that "It takes 90 percent of the estimated duration to do the first 90 percent of the work and 90 percent of the estimated duration to finish the last 10 percent of the work." Yet percentage completion still seems to be the preferred measure for communicating progress. Some people argue that no progress should be shown for activities that are not 100 percent complete. Perhaps an intermediate position is more appropriate. This approach was used very successfully on the following example of a half-billion-dollar project.

EXAMPLE. For each reporting cycle, the person responsible for an activity had to select one of two answers, yes or no. If the activity was due to start, the question was, "Will this activity be started on time?" If the activity was started, then the question was, "Will the activity be completed on time?" It was clear that no one would be chastised for answering "no" prior to the date the action was scheduled to be taken. It was made even more clear that a series of "yeses" and then all of a sudden a "no" just as the activity was due to finish had to be accompanied by a very good excuse. So long as the activity was on schedule, the only answer required was ''yes.'' If a ''no'' was reported, a simple explanation had to provided, along with an indication of what help was required.

To improve on meeting management, activities were coded with numbers to indicate the following:

1. This should have been completed in the prior report period.
2. This was due to be completed in this report period.
3. This should have been started in the prior report period.
4. This was due to start in the current report period.

The name of the responsible person was at the top of the report. Participants on this project practically turned handsprings to avoid having a ''1'' on their report. Because the reports were sorted by these codes, schedule meetings focused on the ''1s,'' then on the ''2s'' for which the answer was ''no,'' then on the ''3s,'' and then on the ''4s'' for which the answer was ''no.'' Activities in process with a ''no'' were discussed as time permitted. After implementing this approach, the project-team meetings went from about five hours every Thursday to about two hours every other Thursday. There were some fifteen people involved in these meetings, so the savings were substantial, both in direct costs of the meeting and in the indirect costs of the productivity of the subordinates of those attending the meeting.

To further increase the effectiveness of this approach, consider providing an advanced activity forecast showing the activities for which each person is responsible along with the status of all activities that are immediate predecessors of the activity. Along with predecessor activities, show the names and phone numbers of those responsible for the predecessors activities. This way, there is no excuse for lack of communication between responsible parties.

Since report formats are not included in most project-management software packages, you will have to create the report formats for your projects. The honesty and accuracy engendered in the reports will make their creation well worthwhile. One problem in using this approach is that it can create an atmosphere in which people become overzealous about starting and completing activities per schedule to the point of burn-out and possible physical problems.

CONFLICT MANAGEMENT

Novice project managers learn how to resolve conflicts. The more adroit project managers learn how to anticipate conflict and manage problems before they become potential delaying factors for the project. One approach to this is to ''manage by walking around.'' Learning early of a potential conflict provides time to analyze the issues, talk one-on-one to the key parties, and often achieve agreement on a solution before the ''concrete begins to set.'' Often the seasoned project manager can anticipate the issues based on prior experience. By building up a credit balance of ''wooden nickels'' (i.e., favors) beforehand, many conflicts can be resolved by horse trading early on.

STAKEHOLDER MANAGEMENT

In a similar manner, the astute project manager analyzes the needs and desires of stakeholders early on and anticipates the issues. The evidence indicates that this was done very successfully on a recent rapid-transit project. Issues and constraints were made public early in the project, thus creating an environment in which all parties to conflict resolution knew they had to come to an agreement or the public would become very difficult to deal with. As a result, negotiations with several government bodies proceeded to very acceptable solutions in time to avoid delaying the project. The last issue was signed off on just hours before the first train was to run.

COMMUNICATING WITH THE PUBLIC

Key to the successful stakeholder management in the rapid-transit project was a very aggressive and carefully considered public-relations program. Representatives of the rapid-transit project attended public meetings and made themselves available to the public. They released regular announcements to the media, established local information offices, and had a booth at every possible fair, exposition, or other event where they could communicate with people. The project became a source of pride to members of the communities involved, to the point that "the project could not fail." This was combined with excellent execution of the project so that the product that was delivered fulfilled that sense of pride. There are many examples of both failure and success of this aspect of project management.

LEARN TO LISTEN, AGAIN

Project managers in the developing stage may have gained the impression that now it is time for others to listen to them. That is true, but it in no way implies that the project manager is relieved of responsibility for listening. Indeed, that responsibility has become even more important.

Project managers are the ones who must listen to clients to sense any dissatisfaction with the project or any changed or new expectations. Project managers must listen to management to sense any concerns with or slackening of support for the project. Project managers must listen to those whom they may consider to be peripheral stakeholders to the project to identify their concerns and resolve those concerns before they delay the project. Project managers must listen to potential vendors very carefully, because they will attempt to sell project managers the latest innovations with seemingly little concern for the successful completion of the project. In fact, vendors are often far more concerned about getting someone to adopt their technology to help them pay for further development and aid them in selling to other potential clients. This has been a major cause for difficulties in the implementation of management information system (MIS) projects.

Above all, project managers must listen to their teams. They must listen to those concerned with the technology of the project to ensure that planned approaches are feasible and that all risks are identified. Project managers must be the leaders of value engineering by listening for ideas on how the project can be done better, more economically, or more quickly. To maintain peak morale of team members, project managers must listen to all team members. They may not adopt every suggestion, but failure to listen will dry up the source of ideas.

In at least one organization, it is common for an ombudsman to be a part of the project team as advisor to the project manager with regard to listening as well as other behaviors.

Listening is a vital skill of the professional project manager. You can only manage those things of which you are aware.

An Experienced Project Manager

Clearly, only experienced project managers are going to be assigned the very large projects. These have very large project teams, many stakeholders, and considerable public involvement. Experienced project managers need to have strong skills in the areas of identifying conflict, selling the vision, and managing public interests.

IDENTIFYING CONFLICT

In large projects, opportunities abound for conflict to exist out of the project manager's sight. Again, managing by walking around is helpful, but using communication skills is more demanding. The project manager must understand the decisions that have to be made at various levels in the organization and recognize the potential for conflict when greater numbers of people, organizations, and issues are involved. One manager did this very effectively by arriving at the site at 7:30 a.m. and visiting a different area each day. He seldom arrived at his office until 8:30 or 9:00 a.m., but what he learned by walking around was more important than the extra hour in the office.

SELLING THE VISION

The large number of stakeholders increases the task of creating a vision that can be sold to all the parties. As this vision takes shape, it is often the task of the project manager to be the primary articulator of that vision. Often there will be multiple sponsors for such a project, all of whom will try to "help." If their perceptions of the vision stray, or if they have not accepted some aspect of the vision, they can actually do harm to the project.

In developing the vision, it may be useful to use market research tools such as surveys and focus groups. Having the results of these may be helpful in developing the vision, but the results must be shared if the vision is to be accepted by the stakeholders. The results must also be provided to the key stakeholders and sponsors in such a way as to be an authoritative source to which they refer when answering questions. The vision must be continually reinforced to ensure a constant and consistent portrayal. A briefing book is a useful way to accomplish this. It should contain, in easy-to-use format, the project charter, vision, issues and answers, progress and status information, discussion of benefits to the stakeholders, and any relevant caveats.

MANAGING PUBLIC INTERESTS

The first step in managing public interests may well be to agree to and proclaim a customer-service charter that states concisely the attitudes that are to prevail on the project concerning the customer. No matter how considerate the participants in a project, one surly individual can create a negative image of the project. There can be no misunderstanding of the project team's attitude toward the customer.

EXAMPLE. On a recent project several communities were involved, and there was no time in the schedule for disruption by court delays. The team established and advertised a complaint system to aid in identifying individuals with complaints as well as identifying issues of concern to the public. Community information bulletins dealing forthrightly with various issues reduced misunderstandings that could have arisen if the grapevine had been the primary source of information. Community information offices can provide face-to-face opportunities to answer questions and correct misunderstandings. This project's team members participated in public events and forums such as meetings and spoke at civic organizations and other clubs. Team members had booths at fairs and expositions to take the message to where the people were. The project team offered community education, outreach programs, and safety seminars. These seminars and programs were held at public schools, community colleges, senior-citizen centers, and other forums for opinion leaders. Radio talk shows and television interviews made the information available to mass audiences. All of these are ways to increase the public's understanding of the project and its product, reduce misunderstandings, and diffuse special-interest groups who could cause substantial delays in the project.

The Art of Communicating

There is much more that could be said about communicating in projects, such as maintaining honesty and integrity and developing trust. These are major underpinnings of successful communications. Perhaps it is fair to compare the communication competencies of a project manager with those of an artist. The neophyte artist may create a crude still-life painting. The novice artist may create something that is a pleasure to perceive. The developing artist may create a more complex painting. Eventually the artist's skills develop to the point of creating a large canvas conveying complex messages on a variety of subjects.

The project manager must develop communication skills in a similar manner. Those who learn to excel in communicating in a project environment will truly be rewarded.

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Chapter

23

Negotiating Skills for Project Managers

Stephen D. Owens and
Francis M. Webster, Jr.

Biographical Sketch . . .

Stephen D. Owens attended Lamar University and the University of Texas and received his Ph.D. in Industrial Relations from the University of North Texas. Dr. Owens has over 20 years of teaching and consulting experience. He has taught human resource management, organizational behavior, and labor relations both in and outside the United States. He has also led workshops and seminars to improve managerial skills for supervisory and mid-level managers in both the private and public sector.

Dr. Owens has taught and delivered lectures at the University of North Texas, Louisiana State University, and central Michigan University? His principal areas of research and consulting interest include a variety of topics related to the field of project management, industrial relations, and human resource management. Dr. Owens has presented research papers at various professional organizations. Dr. Owens serves as a labor arbitrator and is listed on the panel for the United States Postal Service and the Federal Mediation and Conciliation Service.

Francis M. Webster, Jr. is retired after 8 years as editor-in-chief of the Project Management Institute (PMI), 21 years of teaching at the university level, and 14 years of industrial experience. He joined PMI in 1978 and has received all three of PMI's highest individual awards. He has authored a number of articles and papers and conducted several workshops on project management. He was responsible for the PMI Software Survey for 8 years and for creating PMINETwork. He earned a B.S. degree from Carnegie-Mellon University and a Ph.D. from Michigan State University. He has had work experience with Phillips Petroleum Company, Chrysler Corporation, and H.B. Maynard and Company.

 Field Guide to Project Management, Second Edition. Edited by David I. Cleland

Rarely are project managers allocated all the resources needed. Thus, there is conflict on what and how many resources are going to be available to the project and on which aspects of the project they will be used.

Negotiating is one of the fundamental methods to resolve conflict. The dominant mode for negotiating has often resulted in a win-lose situation or outcome. This mode has often led to disputes. Negotiating within a win-lose framework often results in costly and protracted legal proceedings, the creation of ill will, increased financial costs, and even the demise of successful witnesses. Because conflict in projects is likely to occur, perhaps it would be better to have a means to resolve conflict that can lead to win-win solutions. Improved negotiation skills can make this possible.

Negotiations in Projects

Typically the negotiation skills needed in projects are applicable in two broad domains: interpersonal negotiations and contract negotiations.

INTERPERSONAL NEGOTIATIONS

Interpersonal relationships with various project stakeholders will influence negotiations. For example, it is common for project managers to attend innumerable meetings, direct and motivate project members, obtain information, delegate, resolve conflicts, acquire resources, and set goals. All these activities involve interpersonal contacts with the following stakeholders: other project managers, customers, team members, peers, superiors, functional managers, and representatives of government and regulatory agencies. For activities characterized by interpersonal relationships, the project manager must use a variety of negotiation skills. Because project managers often have more responsibility than authority, such skills are vital for successful project completion.

Interpersonal negotiations require a skill called partnering, which is typically used in *external projects*. Essentially, a partnering mind-set can replace the adversarial relationship that often exists between the project organization and subcontractors. The former wants the deliverable at the least cost, whereas the latter tries to create a profitable outcome. The suspicions and antagonisms in this relationship lead to conflict. Partnering, however, can replace that counterproductive atmosphere with one of cooperation or accommodation. How does a project manager obtain this mind-set of partnering? All the parties in the project—the client firm and selected subcontractors—must commit to the partnering relationship. Also, they must all participate in workshops (sometimes called alignment meetings) where they will accomplish the following:

- Learn general principles of partnering.
- Assess behavioral styles and personalities.

- Examine communications principles and conflict resolution.
- Discuss mutual interests, positions, and project needs.
- Determine the participants' expectations and needs.
- Jointly develop a mission statement and project charter.
- Agree on the indicators for continuous quality on the project.
- Develop a responsibility matrix for partnering actions.
- Develop a partnering agreement to formalize the relationship.

In developing the partnering agreement itself, the parties must engage in negotiation. However, because partnering is founded on mutual trust and openness, the negotiations must be nonadversarial.[1] Once the partnering agreement is negotiated, subsequent negotiations take on a different perspective, because the parties have placed all their cards face up on the table. Thus, a working relationship develops in which conflict is resolved through win-win negotiation techniques.

CONTRACT NEGOTIATIONS

Contract negotiations are generally more formal than interpersonal negotiations. They occur between a buyer who has a specific need and a seller who agrees to meet that need. Given the more formal atmosphere, the parties will exhibit different behaviors than would be apparent in the context of interpersonal negotiations.

Contract negotiations require the ability to develop a project charter. *Chartering* is the process that creates the project charter or mission statement. It is simply a written agreement between the project manager, senior management, and the functional managers who are committing resources and people to the project.[2]

Chartering is applicable to the *internal project* and includes statements about issues such as resources to be provided and reporting relationships. Negotiation occurs when developing the charter because the parties hammer out what is to be done, how it is to be done, what resources are to be used, and when resources are to be available.

The completed charter sets forth the expected project's deliverables, often including the project's schedule and budget.[3] The charter connotes that the parties have agreed upon what is expected of the various participants in the project. It also places obligations upon the parties not to make unilateral changes to the terms of the charter.

Conflict in Negotiations

Negotiations can permeate a project. The Project Management Institute's Project Management Body of Knowledge (PMBOK) outlines eight project-management functions, each of which can be sources of conflict.[4]

1. ***Scope.*** Negotiations over what is to be accomplished
2. ***Quality.*** Negotiations over the specific measures to be taken to ensure quality
3. ***Cost.*** Negotiations over the parties' financial outcomes
4. ***Time.*** Negotiations over deadlines and resources
5. ***Risk.*** Negotiations over who assumes what risks
6. ***Human resources.*** Negotiations over staffing
7. ***Contract/procurement.*** Negotiations over cost, delivery, and specifications
8. ***Communications.*** Negotiations are affected by appropriate communications of project status

Negotiation skills are needed to resolve conflicts in these areas, which can arise throughout the project's life cycle. (See Chapters 6 and 7 for discussions of life cycles.)

RESPONSES TO CONFLICT

How can a project team member respond to conflict? Responses can be placed on two dimensions: assertiveness and cooperativeness. There can be five approaches to conflict, each of which reflect different degrees of assertiveness and cooperativeness.[5] The five responses are the following:

1. ***Forcing response.*** Here the negotiator attempts to get all he can at the other's expense. Legitimate or coercive power may be used and negotiators try to manipulate the process to only their advantage. Overuse of this response will likely breed hostility and resentment in others.
2. ***Accommodating response.*** This results in others getting most, if not all, of their desired results. Negotiators who favor a friendly relationship over a tougher or more critical approach will not serve their constituencies very well over the course of negotiations.
3. ***Avoiding response.*** One's interests are subordinated or neglected outright to avoid conflict. Unresolved issues lead to frustration and a sense of powerlessness, and other project team members will likely seek to change the situation.
4. ***Compromising response.*** This represents a middle-of-the-road strategy for dealing with conflict. Resolving disputes is accomplished by reliance on "splitting the difference" between two positions; more concern is placed on expediency than on trying to seek out the best outcome.
5. ***Collaborating response.*** This is both cooperative and assertive and illustrates the parties' attempt to solve a problem for their mutual benefit. The focus is on the problem, not the personalities involved in the negotiations.

Which of the approaches a project manager uses will depend to a large extent on how the following questions are answered.

1. How important is the outcome to be gained?
2. How important is the past, present, and future relationship with the other party in the negotiation?[6]

Power in Negotiations

Power can give the project manager leverage over both the desired outcome and the ongoing relationship of the parties. Because the outcome of negotiations rests largely on the ability to influence another, and the ability to influence is a function of power, it is important to take a closer look at power.

SOURCES OF POWER

Power is described as the ''ability to get another party to do something they ordinarily would not do by controlling the options they perceive open to them.''[7] During negotiations it is important to consider how power can affect the other party, especially concerning the perception of options available to the participants. For example, an energetic and productive worker, once known as a slacker, was asked by an interviewer: ''How long have you been working here?'' His answer was, ''Since the day they threatened to fire me.'' The employee's turnaround in work performance demonstrates how the use of power can influence behavior.[8] This example illustrates the use of coercive power. Six major sources of power are the following:

1. Reward power. This refers to the ability or attempt to use rewards to gain compliance. To obtain the desired compliance, one must be perceived to hold rewards that are desirable to the other party and that can be administered to obtain the compliance. Such rewards don't have to be tangible. For example, intrinsic rewards such as praise, recognition, and encouragement can be used to change behavior. Also, rewarding team members with desired work assignments that have visibility can be used. Reward power can be useful in negotiations to influence behavior through positive incentives.

2. Coercive power. This is the reverse of reward power in that one can influence the other by using punishment or taking something away. For example, construction superintendents have been known to forget to turn in a request for payment for a subcontractor who has been less than cooperative. Using coercive power is probably not as likely to produce the desired results in project negotiations. Under such circumstances, an unfavorable climate for future negotiations will likely be created. Although the use of coercive power is often counterproductive, it does occur in negotiations when tempers take over and efforts at persuasion fail.

3. Legitimate power. This occurs when a group organizes itself into a social system and someone is elected, born, or appointed to a position of authority in that system.[9] Engineers have power in the functional area of operations, whereas accountants have legitimacy in financial matters. Moreover, individuals can dispense rewards and punishments to solidify their position. In negotiations, the project manager must establish legitimate authority to be recognized by others in that social context.

4. Informational power. This refers to the ability to obtain and present relevant information that will change another's position or point of view. The project manager is privy to a large amount of information that can be used advantageously. For example, certain test results can be withheld until the appropriate time. Thus, the amount of information, where it originates, and its persuasiveness are all factors affecting the perceived power of the information. Moreover, the entire process of information exchange serves to define the context of negotiations for the parties. Essentially, information exchange serves as the primary medium for justifying one's own and the other's position, and eventually the information exchange leads to making concessions.[10]

5. Expert power. This stems from mastery of a large amount of information; it is the power of knowledge. It comes when the project manager has demonstrated competence in prior assignments or can do something better than others. For example, the project manager who can find the bug that has eluded the systems people has bargaining power. When someone has knowledge others don't have or has control of needed information, that person is accorded deference and power. The project manager who has access to information or possession of knowledge can manipulate options and exert greater control in the negotiations process.

6. Referent power. This accrues to the project manager who has personal qualities that others admire or want to emulate. Such power can also spring from building long-term relationships with others who develop trust and share common interests with one another. A project manager who possesses referent power should take precautions not to abuse it in negotiations because such power is only obtained after a long period of relationship-building founded on trust and honesty.

The review of the six sources of power should help project managers understand how power can be acquired. However, project managers must use care in exerting power. Project managers may achieve short-term goals if power is misused, but long-term relationships may be jeopardized or ruined. With this caveat in mind, the following list sets forth some guidelines for the prudent use of power.[11]

- The illusion of power can be as effective as real power in negotiations.
- It is easy to overestimate the power of the other negotiator.
- Using power exposes one to risks and costs.
- Power is affected by time constraints.
- Decisive and assertive action can create power.

- Creation of options and alternatives enhances power.
- Negotiators should not lose sight of their objectives.
- Negotiators should discover the needs and wants of the other person.

The subject of power is an extremely complicated one. One must not only be aware of its sources, but also be prudent in its application. In the context of project negotiations, the use of power can affect a project's success and a project manager's personal relationships with the team and with others involved in the project. Research has shown that effective project managers use their personal sources of power more often than do less effective ones.[12]

More Key Factors in Negotiations

Although power and its prudent application is a critical element in negotiations, other important variables must also be examined. Awareness of all the factors in negotiations lead to a better perspective on the process.

SUPPORT OF OTHERS IN PROJECT ORGANIZATION

The project manager (negotiator) is not without support from various constituencies. These supporters will encourage and assist in the negotiations by providing resources and reinforcing the objectives to be gained. However, where constituencies are not close to the action, they may have unrealistic expectations that could cause problems. Project managers who come to the table with the support of a savvy constituency have a distinct advantage.

TIME PRESSURES AND DEADLINES

In labor-management negotiations it is quite common for the parties to reach an accord at 11:59 on the night the labor agreement is to expire. Parkinson's Law often applies to project negotiations: They will usually take as long as the time limits given.

There are advantages to self-imposed time limits. For example, deadlines can serve to energize the parties as they approach the time limit. Deadlines can also make the granting of concessions more palatable because they were made to beat the time limits.

INTERDEPENDENCE

It is extremely important in project negotiations that the parties not forget they need each other to reach agreement. Conflict over differing needs can cloud the need to work together. What is essential to keep in mind is that the project manager must work with and through others to succeed in negotiations.

PERSONAL ATTRIBUTES

Not only is it important for a project manager to have cultivated a high degree of self-awareness, but it is also essential that she or he be able to "read" the other party. That is, knowing the personality traits and negotiating style of another can affect the manager's behavior in negotiations. Three personal qualities—persuasiveness, persistence, and integrity—are especially potent attributes that can positively affect outcomes in negotiations.[13]

ENVIRONMENTAL FACTORS

These factors include the location of the negotiations, the type of problems facing the parties (i.e., a simple, single issue versus complex multiple issues), the parties' past relationship and negotiating record, the rules related to the agenda, and the negotiators' different approaches to negotiations.[14]

The Negotiating Process

To achieve success in negotiations, the project manager must be aware of the fundamental characteristics underpinning the process. Whether the negotiations involve informal circumstances or more formalized contractual exchanges, these characteristics are present. Essentially, the parties must not forget that one party cannot achieve their objectives without considering the needs of the other party.

Planning for negotiations can be divided into the following three types:

1. ***Strategic planning.*** This involves defining long-range goals in negotiations and taking a position that will lead to the goals.
2. ***Tactical planning.*** This is the use of steps in the short run to attain strategic goals.
3. ***Administrative planning.*** This is the actual administration of negotiations, which requires forming teams, designating resource persons, preparing for caucuses, and getting information germane to the negotiations.

All three types of planning are important, and all tend to overlap during the process.

TWO KEY NEGOTIATION STRATEGIES

Two key negotiating strategies are *distributive bargaining* and *integrative bargaining*. Distributive bargaining can be described as win–lose bargaining, whereas integrative bargaining is more a mutual problem-solving solution or a win-win approach. In both, the premise is that the parties' behavior in negotiations is predicated upon how they perceive the issue(s) to be negotiated.[15]

Distributive Bargaining

The basic condition for distributive bargaining is that the issues involve goals that are in conflict. That is, resources are limited, and each side wants to gain as much of the "fixed pie" as possible and leave a smaller amount for the other. In projects where managers are vying for staff whose special expertise is also needed by others, a distributive situation occurs. Because the pie is fixed, the bargainers are likely to become more adversarial. As a result, the parties are going to hold their cards close to their chests and are likely to engage in bluffing and padding their list of demands. The parties seek to camouflage their positions and deliberately misrepresent their position. It is easy to see how conflict can be exacerbated in projects when the parties engage in distributive bargaining.

Integrative Bargaining

Also known as *problem-solving bargaining,* the integrative approach is a much more preferable negotiation strategy for bargaining in projects. It has been defined as a set of activities that help attain objectives that are not in conflict with the other party, and, therefore, can be integrated to some degree.[16] If both parties can agree that they share a common problem calling for a negotiated solution that will result in mutual benefit, then different bargaining behaviors will be needed. When project managers are involved in integrative bargaining, the resolution of the problem requires the parties to be open, honest, and willing to share information about their preferences for solutions. How does a project manager recognize whether integrative bargaining behaviors are appropriate to solve project problems? The following preconditions are important.[17]

- Common goals that are shared jointly so all will benefit.
- Use of problem-solving ability.
- Commitment to work with the other party.
- Trust, which enables one to break down defensiveness.
- Clear communication of needs.
- Acceptance of others' positions as accurate and valid.

It is quite important that these six preconditions exist in the project environment so that integrative bargaining can occur. When the negotiating parties perceive that problems can be solved for mutual benefit, both parties will be much more likely to adopt collaborative and cooperative behaviors. These approaches are much more likely to lead to win-win outcomes.

HOW TO OVERCOME NEGOTIATION PITFALLS

In *positional negotiations,* the parties tend to do the following:

- Become wedded to inflexible positions.
- Take an inordinate amount of time to agree because initial positions are extreme.
- Perceive the process as a contest of wills.
- Have to deal with numerous constituencies.
- Choose between hard or soft styles, both of which can be counterproductive

The following *principled negotiation* strategies can be used to overcome the deficiencies found in positional negotiations:

- Separate the people from the problem.
- Focus on interests, not positions.
- Invent options for mutual gain—or find a way to divide a pie so that each side gets the biggest half.
- Insist on using objective criteria to overcome the harsh reality of conflicting interests.

It is hoped that by using the methods of principled negotiation, project managers will fashion a worthwhile, acceptable, and wise agreement. It is especially important to separate the other party from the problem to be solved through negotiation. This will allow project managers to deal directly and empathetically with the other negotiator as a human being, thus making possible an amicable settlement.

ENDNOTES

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Chapter 24

Integrating Project-Management Skills for the Future

Elvin Isgrig

Biographical Sketch . . .

Elvin Isgrig teaches project management and systems engineering (PM&SE) in the Industrial Engineering and Management, Digital Enterprise, and Software Engineering curricula at North Dakota State University in Fargo. He practiced PM&SE for two and half decades in the U.S. Air Force, and advanced to the grade of colonel while directing projects for the development and acquisition of high-technology equipment and large-scale systems: aircraft, missiles, spacecraft, reconnaissance, communications, transportation, logistics, test, and evaluation. He holds degrees in aeronautical engineering, mechanical engineering, and industrial engineering and management. He also studied astronautics and space vehicles in a formal Education-with-Industry program with The Boeing Company, Seattle, that was sponsored by the Air Force Institute of Technology (AFIT). He concluded his military career as Dean of Systems Acquisition Education at the Defense Systems Management College (DSMC), now a part of the Defense Acquisition University (DAU).

This chapter, ''*Integrating* Project Management Skills for the Future,'' is offered as a follow-on to ''*Developing* Project Management Skills for the Future'' in the first edition of this handbook. The earlier offering began with the assertion that ''Almost everyone works on projects in their personal and professional lives, but preparation . . . ranges from none for most, to haphazard for many, and formal for a relative few.'' Today, formal preparation has grown significantly across the profession. However, there are still few instances of project-management lessons in primary and secondary schools or the general education portion of higher education curricula.

Children are naturally talented project managers. They know what they want and how to influence others to help bring about those results. In contrast, adults often gum things up or can't see the forest for the trees. Some suggest that this deficiency stems from years of academia's concentration on narrowly focused preparation. Emphasis on cognitive ability and technical recall of specifics distorts priorities. Specifics are easier to remember and test, but integration competencies are harder to prove. Putting the specialties together is difficult to impossible if the need to integrate is ignored. Ernest Boyer, President of the Carnegie Foundation for Advancement of Teaching (CFAT), brought the academic spotlight to the ''Scholarship of Integration'' in 1990.[1]

This chapter is devoted to the learning and practice of integration. *De Bono's Thinking Course,* by Edward de Bono,[2] helped me warm students up to integration after I moved from the world of practice to academics. The material below begins with a review of the evolution of thinking that has led to new standards for integration in academia.

J. Douglas Brown states: ''Strive for the effectiveness of integrated structures. . . . [E]mphasis must be on the dynamics of interaction and not on capability alone . . . to be truly constructive . . . must coordinate the activity of the individuals acting as self-conscious and self determining persons.''[3] Writing years later, Stephen Finks, Stephen Jenks, and Robin Willits state: ''In every complex organization, it appears to be necessary to differentiate tasks, roles, relationships, and organization structure.''[4] (They credit Paul Lawrence and Jay Lorsch for this epiphany.) In practice, subdividing tasks is more efficient than having everyone trying to do the same thing, so differentiation is easy to sell for practice. A plethora of differentiative tools exists, and new ones are added with each edition of texts and procedures. Putting the differentiated pieces together—that is, integrating them—usually proves more difficult than differentiating. Somehow the priorities became reversed, so that the most emphasis is on the easiest task (differentiation) and tertiary treatment is given to the most difficult (integration). It takes time to recognize this as backwards because differentiation demands immediate attention to abundant details. It took me years of service on hundreds of project teams, and the contributions of thousands of students and practitioners, to make me aware of the proper priority. As a consequence, this practitioner of differentiation and integration gravitated to integration as life's work. In 1983,[5] I offered a thesis that I am updating now on the basis of surveys of hundreds of students over two decades.

Some of the most noteworthy advancements in the integrative skills of project management continue to come from the world of practice. The integrative disciplines of project management and systems engineering grew from practice through the joint efforts of practitioners and academics in the Project Management Institute (PMI) and International Conference of Systems Engineering (INCOSE). C. Gerry King, when President of Boeing Defense and Space, has stated unequivocally that those with the integrative capabilities were the most important in his company and he was looking for better ways to identify and develop them.

Dr. Lee Schulman, President of the Carnegie Foundation for Advancement of Teaching (CFAT), emphasized that new cultures of integration evolve slowly in Lamarckian fashion in both practice and academia.[7] Under the theme ''Scholarship Reconsidered: Reconsidered,'' he boldly led the review of ten years of progress toward the scholarship of ''integration'' with both academics and practice. Dr. Charles Glassick, Interim President of CFAT between Ernest Boyer and Lee Schulman, offered encouragement to the 200 attendees in his track presentation.[8] He recognized that the work at North Dakota State University was a good example of the direction CFAT and AAHE fostered regarding integration.

All academic levels offer a plethora of project opportunities for project-management learning and reinforcement. Curricula and extracurricular activities, assignments, and projects can be focused directly on results, work, time, cost, and quality. Those needs for every undertaking can be helped through teaching and using the project-management disciplines. Reinforcement from repetitive use can ensure the development of integration skills naturally. Administrators, teachers, and coaches can help instill ability to integrate. But those skills need to be added to the toolkit of secondary school educators. Most likely the magnitude of the task is too great even to consider seriously, in light of numerous social engineering topics that are given so much emphasis. If it isn't given in secondary schools, formal attention to project and integration learning will continue to be delayed until college, or worse yet, to the beginning of practice, after degrees are earned and careers begun.

While the growth of project management in the upper levels of academia is happening, students should examine those opportunities closely before committing to particular programs of study. Some programs seem like tailored add-ons for the elite, the assumption being that people with proven cognitive ability and sharp technical recall can learn something new like integration in only one or two more courses. Those entering masters and doctorate programs that have newly added courses in project management and systems engineering should look carefully at learning integrating skills by doing integration. Much is missed if project management and systems engineering are included as discrete courses as additional cognitive and technical recall topics of the day.

Whichever level of academia undertakes the teaching of integration, students will need to pull together a breadth of other knowledge and skills areas. Memorize, pass, and forget won't do. Learn, retain, apply, and integrate are the watchwords. When learning to fly, for example, students are required to learn phenomena, systems, procedures, and rules. Pilots and regulators know that that is not enough, and that actual, practiced, integrated flight is essential. Learning to integrate for projects and systems presents similar challenges.

Dynamic handling of labyrinthine layers of perspective is essential to project success. Edward O. Wilson gives a useful description of the formidable task ahead.[9] He reviews the history and character of the natural sciences and the social sciences. The natural sciences deals with precise results, while the social sciences deal with, at best, ambiguous ones. The natural sciences rest on physics and mathematics, while the social sciences work through values, trends, diverse views, and real ambiguity. A similar dichotomy exists in project management.

Each of us can probably recall working with people who couldn't get the right balance among those skills. Routine surveys of seniors and graduate students, as an introduction to integrative thinking lessons, reveal much untapped ability, but little real experience. They do well in discussions on topics such as ''Why do some engineers make such bad managers?'' or ''Think about the best manager you have ever known and list the qualities you would use to describe them to others, and repeat the exercise for the worst managers you have known.'' Their answers come out first as individual input but their shared and mixed mental pictures of the people they wanted to work for or to avoid. Exercises that helped participants learn to integrate are worth collecting.[10]

Dr. Ken Cooper of the University of Minnesota asked about 40 adults at Purdue, ''What causes us to act the way we do?'' He drew a circle on the board and asked for input. After a respectful pause, during which with no one ventured an answer, he wrote ''behavior'' next to the upper edge of the circle and drew a smaller circle centered on the first. He then asked, ''What makes us behave the way we do?'' Again there were no answers. He wrote ''think'' next to the top of that circle. Behavior, he said, is influenced by our thinking! Then he drew a bull's-eye in the center and asked, ''What makes us think the way we do?'' Each of those questions begged for thoughtful answers. None of the participants was willing to risk a public answer among strangers. Dr. Cooper again supplied the answer, ''What we *believe*.'' His next question was, ''Who has a *written belief statement*?'' Again no one raised a hand. He gave us all an assignment to write our own belief statement. (Mine emerged a few months later.) Subsequently, this lesson helped bring hundreds of students into focus on this lesson of thought collection. That is an essential aspect of integration. Bernard Baruch, financier and statesman, declared that thought collection was the most difficult thing he had ever had to do. He also said that his most embarrassing moments were when he acted without thinking. Successful integration demands careful thought collection.

After years of integration efforts without much specific preparation, Ernest Boyer's book, *Scholarship Reconsidered: Priorities for the Professorate* (1990), came as an answer to a prayer. Boyer squarely challenged academia to integrate.[11]

In 1996, the Project Management Institute (PMI) updated its Project Management Body of Knowledge (PMBOK).[12] While the earlier editions were the work of a few people who accepted some, and rejected much, based on a limited range of input, this edition collected input from hundreds of practitioners from virtually every industrial group, as well as from academics. The PMBOK has a chapter on the processes of integration. It has been recognized by many specialty associations, IEEE, ANSI, and ISO. Acceptance by ANSI and ISO made it the national and international standards, respectively. Special-interest groups of some associations have developed extensions to PMBOK.

In the same year, a few seminars offered at the annual PMI conference in Boston were developed specifically for integration. ''Integrated Curricula'' and the ''Practice of Integration'' were offered for the first time. Charles Glassick, then Interim President of CFAT, and Forrest Gale and Owen Gadiken, Professors of Management, Defense Systems Management College (DSMC), collaborated on the integrated curricula seminar. Glassick, co-author of *Scholarship Assessed,* had contributed to *Scholarship Reconsider* with Dr. Ernest Boyer. Gale and Gadiken had been key contributors in the evolution of a more integrated curriculum at DSMC. The ''Practice of Integration'' seminar was led by Joseph Madden of Boeing, who had a long history of project-manager roles for programs such as EC-135 AWACS (for the U.S. and NATO), 747 Airborne Command Post, and 767 AWACS (for Japan). He also led the publication of Boeing's *Subcontracting Manual,* which put the challenge of integrating networks of contributing contracts into development, procurement, and legal frameworks. The design and development of the Boeing 777 and the Northrop B-2 Bomber used a new concept of ''zone design'' that integrated all physical elements that were to occupy assigned zone space. With the power of integrated design tools, it was possible to shorten the development cycle and gain certification without building a full-scale model to ensure function, space, and strength optimization. Their first airplane was used for flight tests instead of static fit tests.

In 2000, ten years after the publication of *Scholarship Reconsidered,* the American Association of Higher Education (AAHE) chose as its conference theme ''Scholarship Reconsidered Reconsidered.''[13] Their goal was the review of progress toward the scholarship of integration. Many schools had moved forward with pilot programs to integrated disciplines. Dr. Charles Glassick, in a presentation with Dr. Mary Huber on their new book from CFAT, *Scholarship Assessed,* stated that what North Dakota State University

- New pathways to teaching and learning
- Moving from inquiry to practice
  - Scholarship of discovery (research and publish)
  - Scholarship of teaching (inform and examine)
  - Scholarship of engagement (action and collaboration)
  - Scholarship of integration (and synthesis)
- Integration is most important
- It dissolves barriers
- The very best future will be integrative

Figure 24–1

was doing in industrial engineering and management went a long way toward what they had hoped for from *Scholarship Reconsidered.* (The NDSU and DSMC programs that integrate will be discussed below.) Dr. Lee Schulman, then president of CFAT and the keynote speaker at that AAHE conference, made the above points convincingly. He confirmed that progress toward integrative curricula was occurring and that it was what academia really needed to do.

When continuing education, certification, capstones, and advanced degree courses observe *Scholarship Reconsidered* and PMBOK standards, the integrative cultures of practice can be expected to continue emerging. The PMI education and certification programs have become credentials for employment and promotion. In parallel, the Department of Defense made the DSMC program management course a requirement for advancement in systems-acquisition career fields. They too use its sections: scope, time, cost, quality, procurement, human resources, communications, risk, and integration. However, the recognized bodies of knowledge for more technical, engineering, and scientific endeavors that have evolved have been slow to include project management and systems engineering in their curricula. Coincidentally, PMI and DSMC were founded in the same year, 1969, with complementary missions that later would facilitate serious collaboration and the publication of a defense extension to PMBOK.

The other integrative discipline that complements project management so well is systems engineering. The International Council of Systems Engineering (INCOSE), a relatively new association, is working vigorously to develop a Systems Engineering Body of Knowledge. The association was founded to address such needs. INCOSE is now hammering out more inclusive technical and scientific standards that specialty associations missed in their comprehensive treatment. The narrower focus most associations address relies upon others for the coverage of integration. INCOSE posts Air Force Manual 375-5, "Systems Engineering Management," as one of its starting points. General Bernard Schriever's foreword to Air Force 375 series of manuals, Air Force Systems Command, for the management of systems management and systems engineering, tells us to "Use it wherever practical."[14] INCOSE is also extending Carnegie Mellon University's Software Engineering Institute's capability maturity model (CMM).[15]

The capability maturity model was based upon the practice experience and academic wisdom of many. It recognized the earlier stages of maturing, when success was often the result of extraordinary effort by individuals who could be recognized as heroes. They were more organized and prepared for their next project. They took part in integrating and documenting the processes that were used to achieve success. Writing processes and measuring operations were the next logical states, along with the eventual plateau of continual improvement. Those who have been in the profession for a long time recognize the initial effort using informal and unpredictable processes. Success, even if accidental, induces some sort of process recall that turns out to be repeatable. As those skills are mastered, they can be defined and

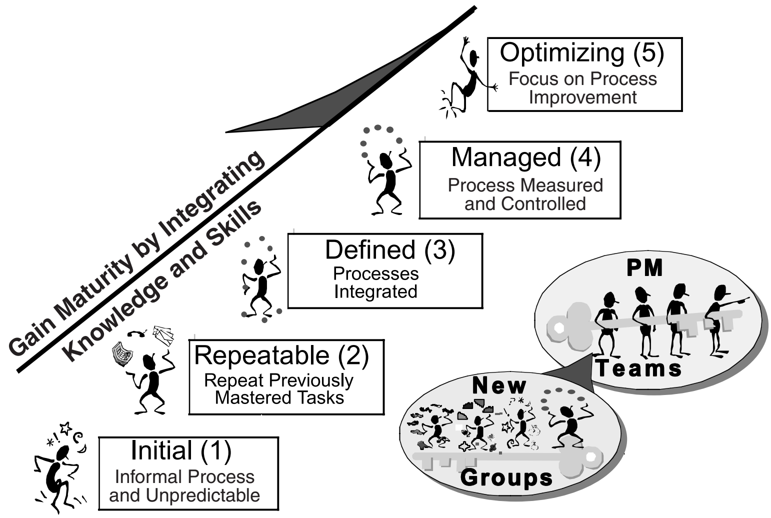

Figure 24–2 Capability Maturity Model
Source: Capability Model (CMM), Software Engineering Institute of Carnegie Mellon University

later measured to determine degrees of success and the focus on process improvement.

Those of us who practiced project management and systems engineering and then moved to academics embrace some form of the the metaphor pictured in Figure 24–3. We began with lots of questions but found that our ideas moved us toward the strong project-management kind of position or to duties on project-management teams that wove together the expertise of a number of specialities for the greater good. Both paths have grown. The project-management professional certification that PMI developed recognizes phase of development to reach project management professions (PMP) status after a combination of education and experience. Some PMP's go directly to consulting jobs, and others move to project team duties.

For me, the integrative application disciplines of project management and systems engineering are synonymous with common sense, which means, the *American Heritage Dictionary* says, ''make[ing] whole, or unify[ing], by bringing the parts together with sound and reasonable judgment.'' As I began my life's work in an agrarian world on the prairie, I felt a growing confidence in my common sense. I soon knew that successful farmers understood integration in all aspects of their operations and business for the production of food. I observed and internalized knowledge about when and how to draw upon which other disciplines. Knowledge of purpose, work, time, and resources of the contributors and stakeholders were obvious major influences on priorities. I learned to sort things to be done into categories some now call ''on-specification,'' ''on-time,'' and ''on-cost.''

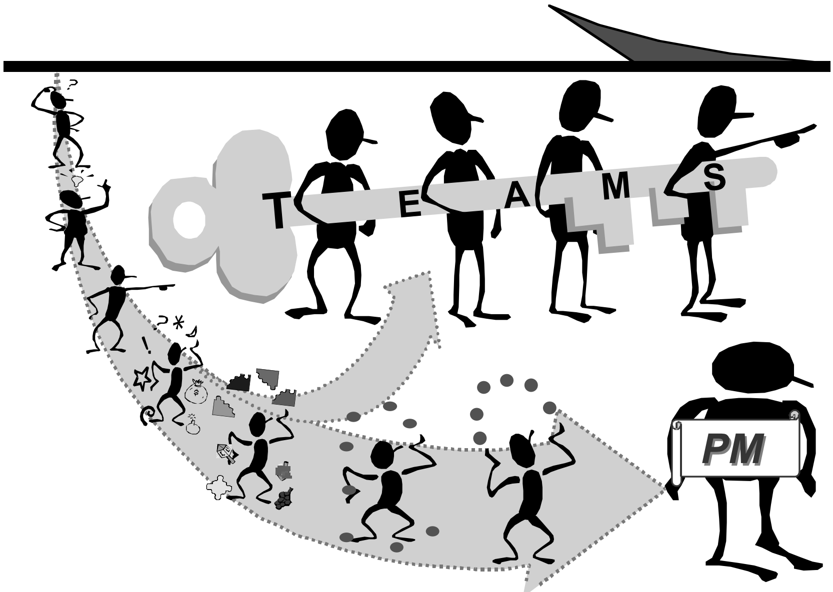

Figure 24–3 Let's Mature Our Capability to Manage Projects

An interest in the sciences and mathematics influenced my decision to study engineering. As my studies progressed, I felt a gradual decline in confidence in my ''common-sense quotient.'' Intensive study of science and math, without lessons that linked to comparable breadth of application disciplines, left me uneasily tethered to the world of handbooks and formulas. Integration of that learning would come later through work world projects and readings for life-long learning, often ''just-in-time.'' After graduation, I contributed to many teams that conceived, made, proved, supported, and operated new devices. I learned to practice integration in teams, make and use checklists of tasks and glossaries of terms, and lead, in part, through better definition of organizations, plans, processes, and orientations for new team members. Confidence in my common-sense quotient returned.

Volunteering for the tasks no one else recognized, or wanted to do, led to lots of interesting learning experiences. Handling unknowns was a good forcing function: ''unknowns 'unk's,'' known unk's, and/or unknowns 'unk-unk's.'' They became watchwords for maturity. When I was a journeyman project manager in the C-130 Hercules transport office, there were many opportunities to learn things about integration, at the lowest levels of components through the highest levels of missions, systems, changes and growth. The Hercules or ''Herc'' was becoming the airborne suburban or utility transport for the world. If I go to out-of-the-way places, I want to go and return on a Herc. It has been everywhere, and is often in the news for its services to humanity and diplomacy, as well as for its military prowess and support. It has been in production for 50 years and has undergone a myriad of updates and improvements with countless alternative source components.

The Herc program helped me and lots of other people learn to integrate technical and business operations and projects. The work prepared me to recognize the importance of levels of understanding as treated in *De Bono's Thinking Course*.

With contributions to highly integrative projects and programs, success or failure can balance on the integration of top-down with bottom-up. Both are needed. The contributors who start at opposite ends of this list ''simple description'' or ''full details'' in visions and language may take a little longer to get acquainted, but they can do it.

Five years of duty as a project manager and systems engineer on the equipment, subsystems, and new models of the Herc filled my mind with questions that I'd be asking of new situations for decades. My next opportunity for learning integration was in Education-with-Industry with Boeing in Seattle. A part of that was working in the systems-management and systems-engineering areas with those who were building up to the 747 commercial transport. I found they had, in a sense, operationalized the Schriever guidelines. That wisdom had had a major influence on their creation of intercontinental ballistic missiles and early space systems. I was in many discussions about the application of those bodies of knowledge to the next generation of commercial airplanes. The 747, like the Herc, travels the world over and is also still in production after 35 years. When I have a long way to go, or return from, if I can't go on a Herc, I want to be aboard a 747.

My career continued in project management and systems engineering with work on more complex systems: airplanes, missiles, satellites, command, control, and communications. The projects involved many levels of

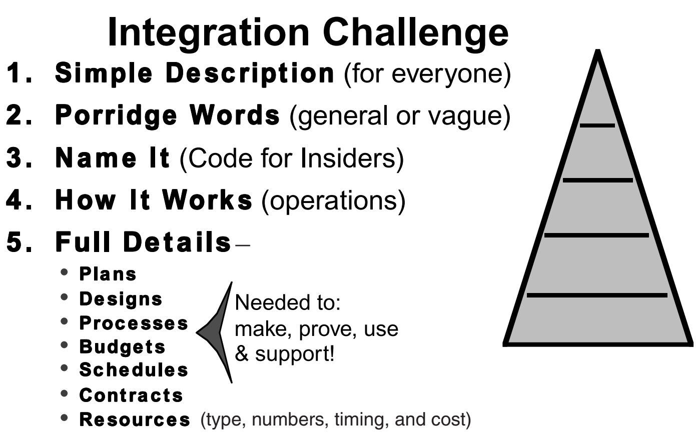

Figure 24–4 Levels of Understanding

Source: De Bono, Edward. *De Bono's Thinking Course.* New York: Facts on File, 1982 effort for global communication, transportation, and fighting systems. Subsequent jobs would bring expanded challenges for sensors and data links (TV, IR, radar, lasers, signal intelligence), weapons (guided conventional and nuclear), test and training ranges. I really had become an integrator of all project-management and systems-engineering functions and the resulting products and support.

The most powerful tools in my kit were the emerging integrative disciplines of project management and systems engineering. I could confidently plan, advocate, initiate, implement, and complete complex undertakings for needed, specified, and promised results. I was a peer of project managers who would become famous for their successes, or in some cases for their problems. I was invited to the deanship of DSMC to lead the first major upgrade of their curriculum, which taught program, project, and acquisition management for many generations of project managers. I had mastered much of what project managers are supposed to do in practice and integrate it. But I worried because I would be working with a much different population of contributors in academia.

The proclivities of academics are legend. Working with them, instead of multidisciplinary teams of aerospace practitioners, would be quite another education in integration. I found that the academics I would be working with had deep credentials in a relatively narrow range of know-how and put high value on statistical significance. In my earlier systems and projects work, MIT's Lincoln Laboratory, Johns Hopkins' Applied Physics Laboratory, and the Environmental Research Institute of Michigan (ERIM) were leading contributors of knowledge of physical phenomena, devices, operations, and systems.

A rare opportunity to work with Harold Meyer, Aerospace Corp., on communications satellite development brought other lessons on integration. His credentials were from self-study. He had taught himself physics and calculus with books from the New York City public library. He was a superb integrator. Academics who knew a lot about subject matter would defer to him when it came to integration. Unique and memorable integration lessons kept arising. Interface coordination at the Cape for an MIT Lincoln Laboratory experimental satellite and R&D Titan IIIC launch vehicle is fun to recall. The Lincoln satellite had been integrated with the launch vehicle in the vertical assembly building. The Lincoln lead engineer/manager was watching carefully as the reinforced fiberglass nose shroud was lowered over the payloads. He created quite a fuss over what he thought was a defective shroud. He was certain he saw signs of delamination that gave him great concern about putting it over his satellite. He stood in the way until an alternative shroud, without obvious blemishes, was put in place. The launch was a success and the major objectives of that first phase of the Tactical Satellite Communications program were proven in the first three days in orbit. A subsequent launch of the R&D Titan IIIC failed; eight satellites went into the ocean after the nose shroud failed.

The curriculum I inherited at DSMC was laid out in concurrent courses. The degree of integration among the courses was left to the instructors. As the new dean, I caused a ripple in academic operations by raising the question of integration among what seemed to be too many stand-alone courses. A meeting held every week to discuss integration among individual lessons the following week was frustrating to the instructors and to me. Prior to much discussion, the linkages seemed vague and fuzzy. It was tough getting instructors to feel responsible for the content of another instructor's course through active, detailed coordination. Something called ''academic freedom'' was mentioned. Real progress in the teaching of integration was occurring at DSMC in their management laboratory. ''Systems X,'' a set of cases evolving through the life cycle of 20 progressive project-management stages and milestones (R&D, production, test, logistics, and operations). Instructors coached teams of five students who integrated the learning from the stand-alone, parallel courses.

The Commandant of DSMC had hired two Harvard consultants and named five faculty to an academic planning committee that I was to chair. The only acceptable starting point we could find was the purpose of DSMC, as stated by David Packard on Founding Day.[17] The first meeting produced no agreements. All the members had a minority view and weren't much interested in considering things outside their comfortable zone of background. The Commandant wanted consensus. As a group, we finally agreed to do a survey of graduates and their employers: (1) What were the toughest parts of their jobs? (2) What took the most of their working time? (3) What were the greatest weaknesses they saw in their peers and subordinates?

The survey of 127 practitioners included many familiar names. Two well-known project managers: James Abramson (later President Reagan's Director of the Strategic Defense Initiative) and Forrest McCartney (later Commander Air Force Space Division and then NASA's Kennedy Space Center, after *Challenger*) were contributors. Both served as Lieutenant Generals in the U.S. Air Force, after distinguished careers as project managers. They contributed to the survey and spoke regularly to DSMC students and faculty.

General Abramson's earlier jobs included project manager of the Maverick missile (AGM-65), PM Falcon fighter (F-16), and the USAF Systems Command's Program Management Assistance Group (PMAG). Integration was one of the things they emphasized. While project manager of Maverick, Jim Abramson was heard telling his boss that a venture being considered was technically feasible but the management state of the art mitigated toward a decision to not go ahead with it. He did go ahead with another unique venture, founding a bank to handle currency exchange for the F-16, a major integration challenge for the four countries participating.

General McCartney had led planning and advocacy for the Tri-service Tactical Communications Satellite program in the Pentagon. He directed the project manager in the field to lead the preparation of an integration plan to cover the first stages of demonstrating the use of satellite links for communications among tactical forces: airplanes, ships, vehicles, and so on. The effort involved scores of agencies and companies: equipment and systems developers, logisticians, operators, academics, and producers. The integration plan initiative was a stroke of genius. It facilitated the definition and review of all aspects, roles, resources, and plans. Later Forrest McCartney was project manager for progressively larger satellite communications programs until he was selected to command the USAF Space Division. After the *Challenger* accident, he was selected to command the Kennedy Space Center to put the Shuttle program back on track.

The top ten from the DSMC survey of project-manager needs were highly integrative. They are listed in Figure 24–5 and were forcing functions for course revisions and the selection of PM's and policy people as guest speakers. About 10 percent of the lessons were from the field, industry, and the Pentagon as guest. A report to the Board of Visitors (BOV), chaired by Dr. Ronald Fox, of Harvard, on the committee's recommendations for curriculum changes gained their full support for more integration. When someone asked if they, the BOV, did that kind of integration go on their campuses, the reply in unison from the academic members was ''Hell, no.'' They saw it was the right stuff for our progressive curriculum but could not bring something so drastic into their traditional curricula.

Parenthetically, thoughts about the evolution of academic organizations comes to mind. Neil Postman's book *Technopoly: The Surrender of Culture to Technology*[17] discusses categorization of knowledge and its control. He contrasts the present practices to the times of Leonardo da Vinci, a leader of knowledge development in both arts and sciences. After da Vinci, academia defined itself into what would become our academic departments. They assumed responsibility for ''what would been allowed in the bodies of knowledge and what would be taught.'' Ken Wilber's book *The Holographic Paradigm*[18] documents the meeting between academic camps, classical

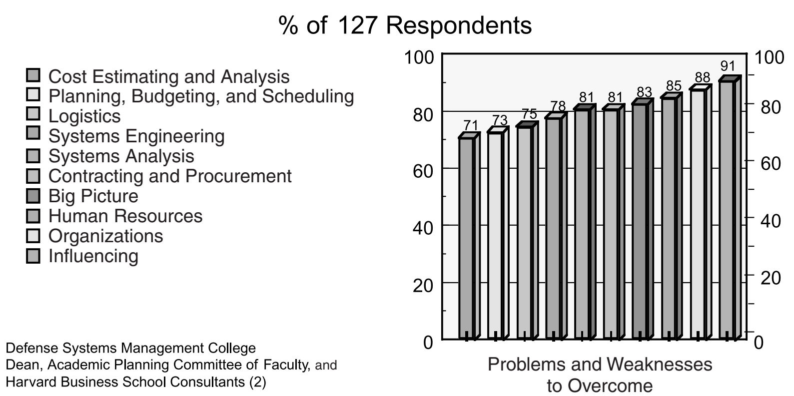

Figure 24–5 Top 10 Needs of 50 Categories Reported All Involved Integration Challenges

physicists and mystics, who had been accused of avoiding each other for centuries. At last they became acquainted through discussions of what was important to each group. They agreed to the following common priorities:

1. Activities (functions, processes, means)—events, frequencies, and synchronicity
2. Potentialities (outputs and inputs)
3. Configurational patterns and symmetries (form and fit)
4. Inseparable interconnectedness (interfaces and communications)

These perspectives, major elements of project-management and systems-engineering practices and curricula, converged in the DSMC curriculum and in the bodies of knowledge of PMI and INCOSE. Figure 24–6 was inspired by Tom DeMarco's book *Structured Analysis and Systems Specification.*[19] The functional activities (verb statements) to be performed by the project team or the target system are central to the analysis. The outputs (targets), inputs, controls, and means (all noun statements) can be viewed as ''throughput'' and ''organizational'' couples. When the stakeholder team does such analyses, it has a high probability of reaching a specification that describes the intended result and the program that needs to be performed in terms that all participants can accept. DeMarco recommends the use of structured English, pseudocode, linguistic specification, pidgin language in that it uses a vocabulary of one language (i.e., English) and the overall syntax of another (i.e., a structured programming language). In use, the vocabulary is trimmed extensively. Some of the more elaborate facilities of the language are ex-

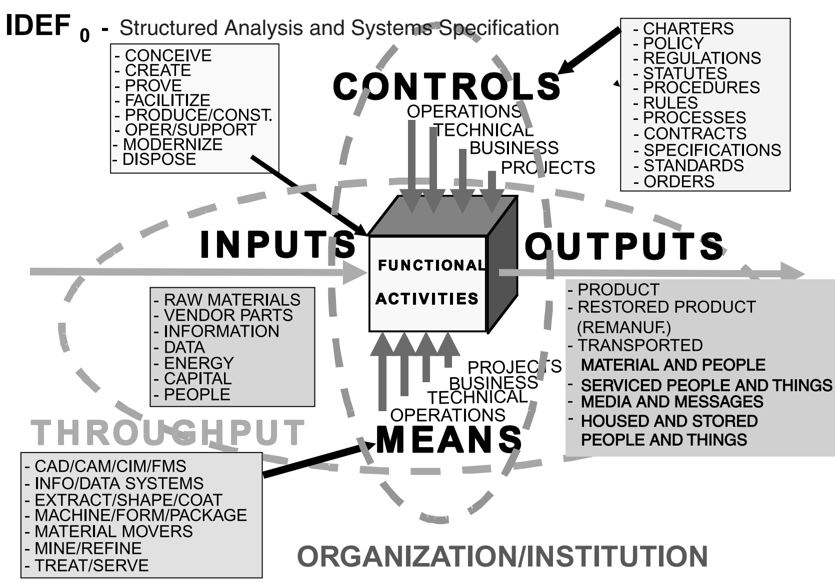

Figure 24–6 PM Organizational Engine

cluded: wishy-washy qualifiers (adjectives and adverbs), compound sentences, most punctuation, out-of-line descriptions, and all modes but imperative (verbs). It uses a data dictionary, reserved words, and simple declarative sentences. A recent student project for a computer science capstone dealt with the multilingual challenge for Microsoft's Business Solutions Division. They limit the vocabulary to about 1500 words and labor with translation vendors to go from American English to German, French, etc.

When I retired from the USAF, I chose full-time academics. Moving from DSMC to NDSU meant moving from a somewhat integrated curriculum to a more traditional one. Industrial engineering and management offered building blocks for a more integrated curriculum. The American Board of Engineering and Technology (ABET) accreditation reviews led to interesting discussions as we brought on line new courses (systems engineering, logistic engineering, healthcare engineering, integrated information systems, and people/organizational systems). The set of project-management and systems-engineering courses and integrated capstone enabled giving papers at IIE, PMI, and AAEE conferences. I wrote a book, *Integration in the Integrative Environment of Program and Project Management.* At about the same time, I joined the Project Management Institute. The integrated capstone course gained high acclaim from graduates and their employers. It engaged the world of practice through real client projects with students working in a matrix structure (projects, technical, business, and operations). Eighty-three major capstone projects were done for regional companies. Over a hundred projects were done for the buildup courses. After retiring to emeritus status, I helped computer science and business MIS curriculum collaborate on projects in their new curricula, digital enterprise and software engineering.

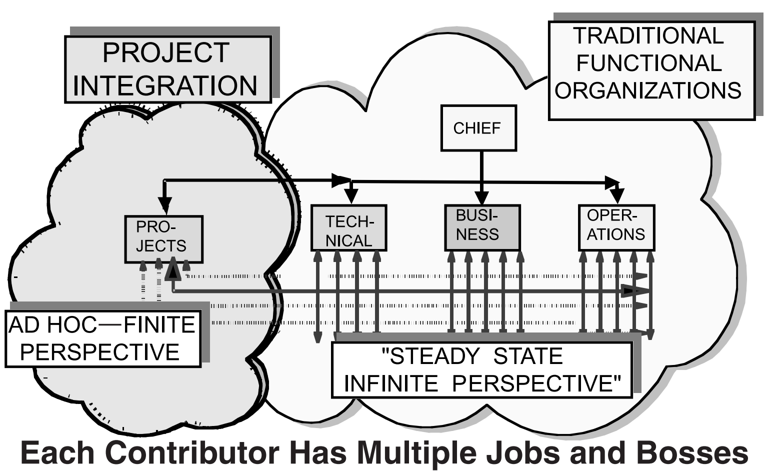

Figure 24–7 Integrated Capstone Matrix: Vertical and Horizontal Roles

When PMI advertised for a new Director of Educational Services when I was at one of their international conferences, I applied, was interviewed, and was offered the volunteer position. After assuming the responsibility for educational initiatives and joining their Board of Directors, I chose to survey the members regarding their educational needs. The first block was 500 members with representatives from every domain of practice: engineering, construction, energy, manufacturing, information, pharmaceutical, environment, education, rail, airlines, trucking, shipping, mining, petrol/chemical, and so on. The results of that survey are listed in Figure 24–8. Dr. C. C. Crawford of the University of Southern California (USC) Productivity Improvement Center facilitated the data analysis using the Crawford slip method (CSM).[20] The suggestions from the data confirmed integrative needs. The database was broadened with surveys of more members in chapters, specific interest groups, and students in a dozen short courses conducted around the United States and abroad.

The above needs were used to define a menu of seminars and workshops offered at conferences. That input was also used to assistance academia in the development of project-management curricula. The seminars and workshops developed offered continuing education credits but were tailored significantly to answer membership needs. Professional educators and trainers were solicited and selected to teach the seminars. Formal critiques were used to gather feedback. The materials developed were made available to PMI chapters and interest groups for their courses.

Seminars from other associations were also offered at PMI conferences (IIE—Breakthrough Thinking & $IDEF_0$, NCMA—Managing Risk, and

Figure 24–8 PM Education and Skill Needs: Results of a survey of over 3000 business and industry professionals, PMI members, and continuing education students, 1987–1996

Source: Analysis done in collaboration with Dr. C. C. Crawford, USC Productivity Improvement Center, using the Crawford Slip Method (CSM)

INCOSE—Systems Life Cycle). The systems-engineering discipline integrates the technical input to projects. INCOSE, DSMC, and NASA systems-engineering handbooks were referenced. The INCOSE journal *Systems Engineering, Insight* magazine, and extensions of the SEI capability maturity model provide a rich reference basis for the study and application of SE disciplines. Collectively, the project-management and systems-engineering bodies of knowledge and standards provide the essential references for planning and execution of projects for new or updated products, processes, plants, information, and support systems. Figure 24–9 guides the integration of efforts to begin and prepare to execute project-management and systems-engineering undertakings. Processes that historically involve numerous steps to acceptance by many different special departments have been revisited and shortened. A series of in-baskets has been replaced by a small number of sign-offs and electronic signatures in process streamlining. The graphic portrays moving from the determination of needs through design activities for comprehensive, test/evaluation, and qualification.

The decomposition and differentiation involved are shown above for the determination of requirements and allocation to levels of specifications (paper solutions). That progress demands review and agreement by stakeholders to build confidence before fabrication, assembly, and construction begin. The integration process of building up to the proven final configurations for productions and accompanying support is shown. The portrayal of activities below, with increments of evolving purpose and milestones of progress, are major integration items. The build-up to qualified configurations with proven functions, performance levels, physical configurations, proven capacities, published limitations, and restrictions is essential preparation for production, operational usage, and support.

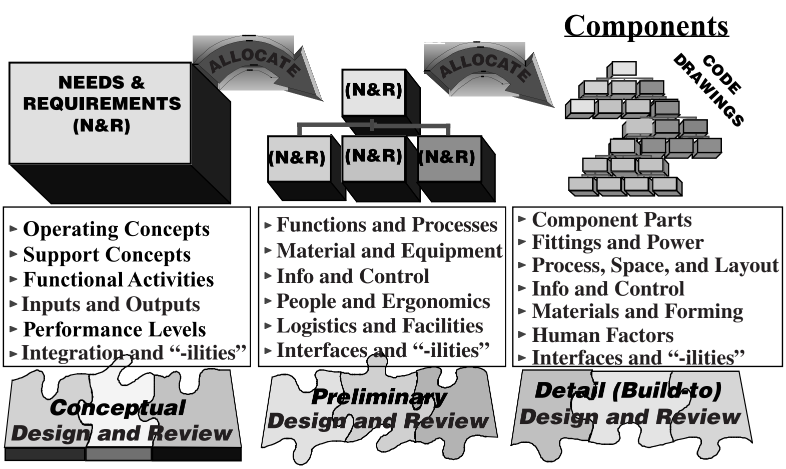

Figure 24–9 Systems Engineering Process: Allocation of Needs and Requirements

The sequence of reviews and audits shown above and in Figure 24–10 integrates the highly differentiated processes of project, programs, and systems creation. Reviewing progress with the family of contributors and stakeholders, with these categories of specifics, is vital to progress acceptance or rejection. Usually, reviews trigger action items that may be needed to define redesigning and replanning needs. The dynamics of configuration discipline to integrate for production are like a symphony.

The Gantt chart sequencing over the life cycle for the project or system (Figure 24–11) in the dimensions of work, time, and key milestones serves to integrate various levels of integration. The key milestones are shown in Figure 24–11 in a top-down for documents, agreements, and deliverables. Below, the integration of results, work, time, and costs has produced conventions identified within logical sequences of effort and use of resources. Every task defined, assigned, and performed must have project purpose, comprehensive schedule and sequencing, allocated and available budget for in-house and purchased effort and parts.

The sequences of progressive thinking and actions are shown in Figure 24–12. In step 1, the end deliverable is defined. In step 2, the work-breakdown structure (WBS) is organized in a chart in narrative form. In step 3, work packages are assigned to organizational elements in bite-sized pieces, in step 4, work packages with budgets and schedules are defined and assigned, and in step 5, plans and achievements are shown in terms of work, budget, and time. Milestones nearer in time are better forcing functions for progress than distant ones. Step 5 accumulates the information from step 4 in increments of time and budget and calculates variance (work, time, and cost) and project outcome (on-target, overrun, or underrun). Often management builds in a financial reserve that can be used to resolve unforeseen contingencies before the project is completed.

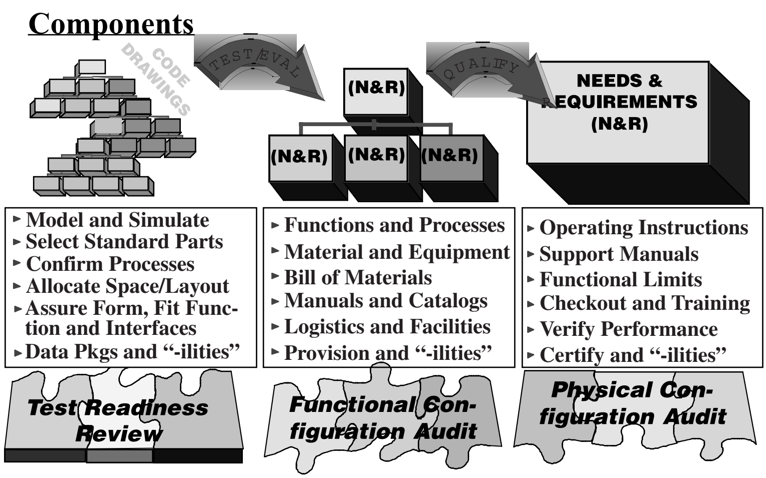

Figure 24–10 Systems Engineering Process: Prove and Qualify

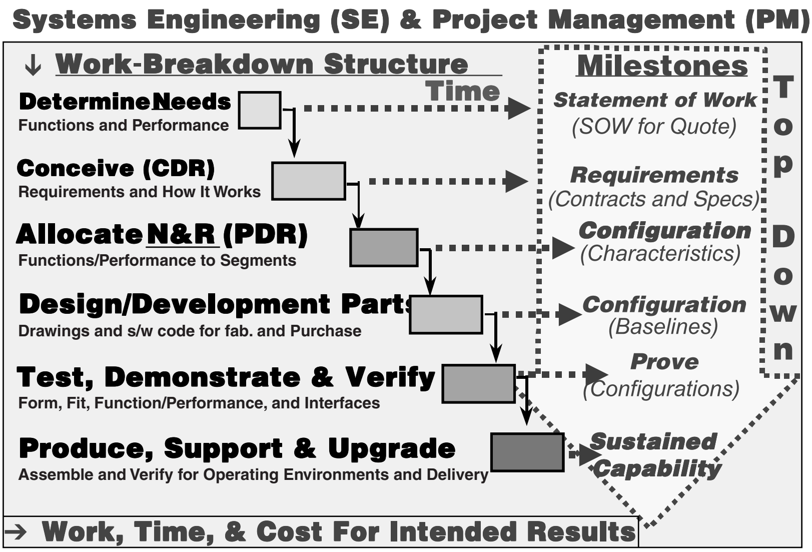

Figure 24–11 Life Cycle of System and Project

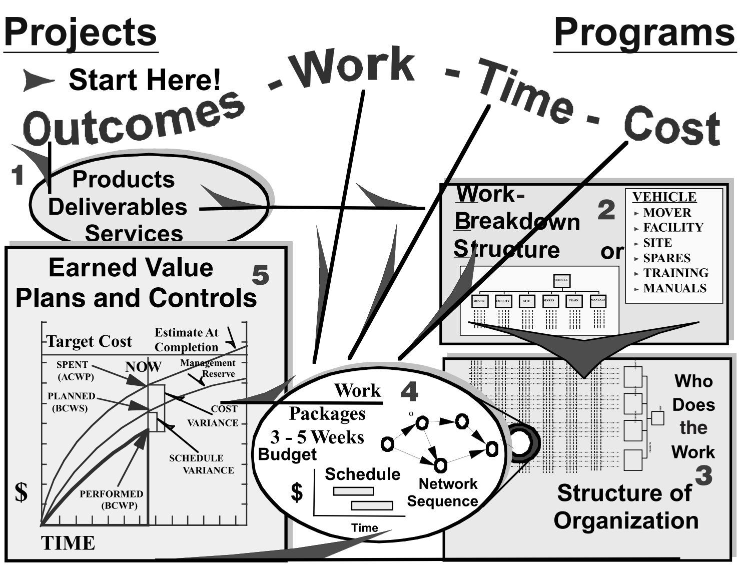

Figure 24–12

Through integrating numerous thoughts, data, and information for a diversity of undertakings, I gained growing respect for the families of specialties that evolve and support projects. I began to see each community of contributors (business, technical, operations, and projects) as systems in a universe of different motives, knowledge, dynamics, and bodies of knowledge. Figure 24–13 portrays the diversity of job descriptions that project contributors come from. Each has a unique background and path to competency.

Figures 24–14 to 24–18 focus on the integration of the universes of disciplines that contribute to projects. The centering forces behind those disciplines influence effort somewhat as the gravitational field of a sun influences its planets. The acceptable approaches to a number of discipline-unique requirements emerge and grow in the background but must be interpreted and satisfied. When the ENRON and Arthur Andersen troubles came to light a few years ago, cost-accounting standards were reviewed again and revised to satisfy regulatory agencies. Changes to the way we do business are occurring as we plan work, do, and redo.

The communities of contributors (business, technical, operations, and projects) each can be seen as separate systems in universes of different motives, knowledge, dynamics, and bodies of knowledge. The figures below focus on the integration of those universes by project disciplines, the chief integrators.

The project forces focus on various documents, plans, and content to integrate the collaborative work for best integration. The work to be done is complex. The agreements to be reached may be involuted. The environmental studies and approvals are illusive. The turnovers and transitions from supplier to user/recipients are dynamic. A myriad of status, progress, and action items for each must be done.

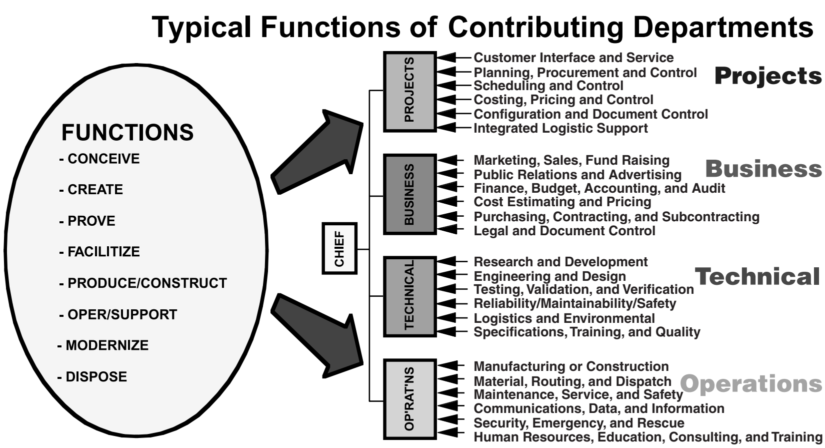

Figure 24–13 Life Cycle Activities Assigned to Typical Functional Departments

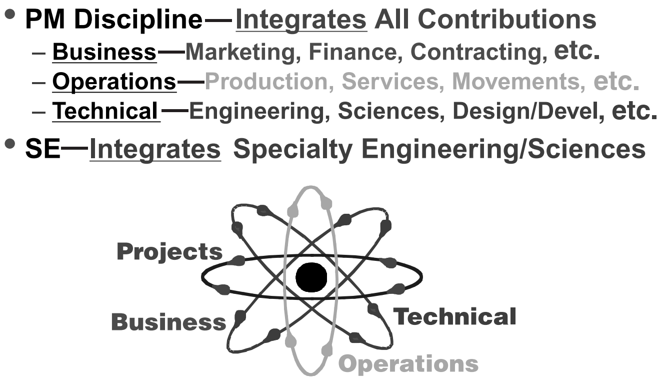

Figure 24–14 PM Taps Universes of Disciplines, Professions, and Cultures

The business family of contributions might be described as constellations of orbital systems: accounting, marketing, purchasing, procurement, contracting, legal, and documentation converge in fields of management (finance, operations, human resources, international marketing, venture capital, globalized customer and contributor influences, exchange and currency rates).

The engineering and scientific contributors must be masters of the natural sciences. They move thinking from hypotheses to research, design, development, verification, processes, and tooling. Design needs to be done for

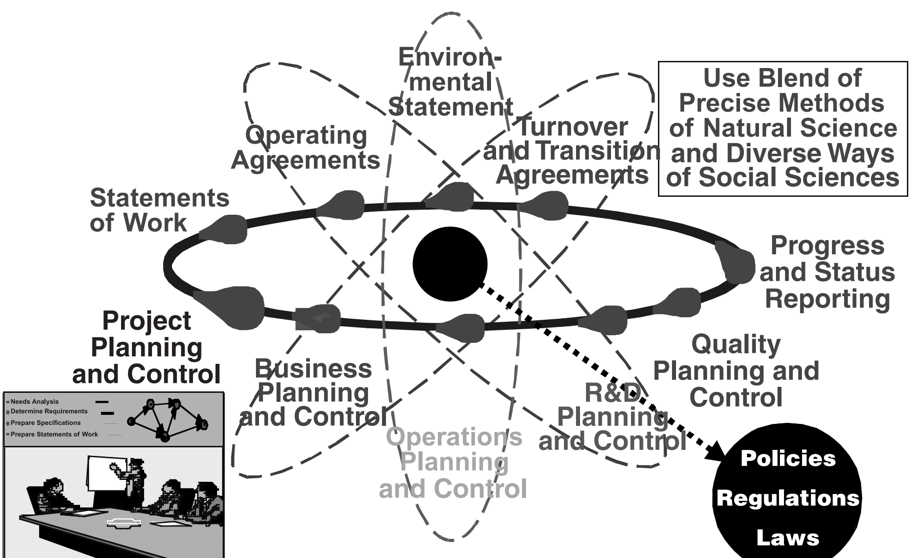

Figure 24–15 Project Disciplines

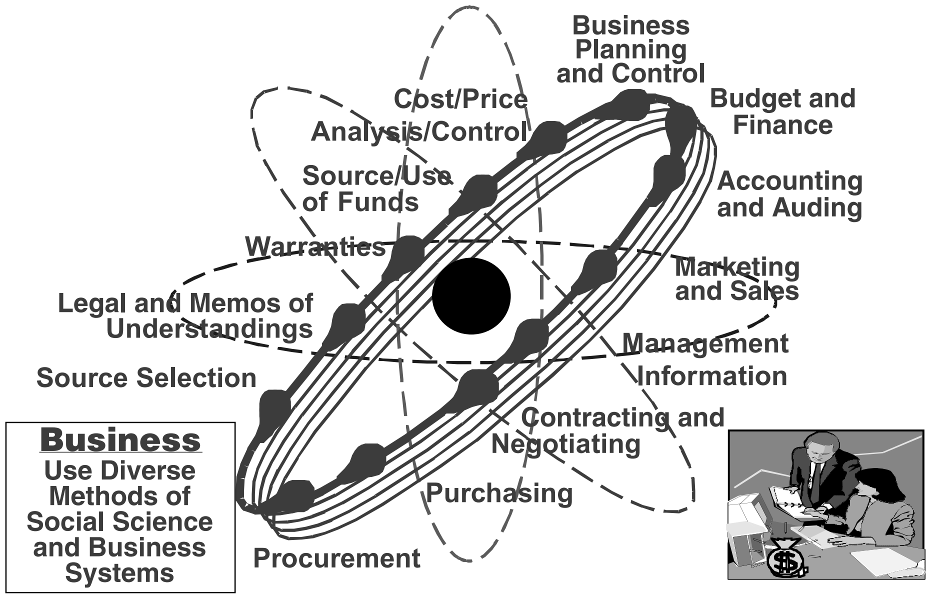

Figure 24–16 Business Disciplines

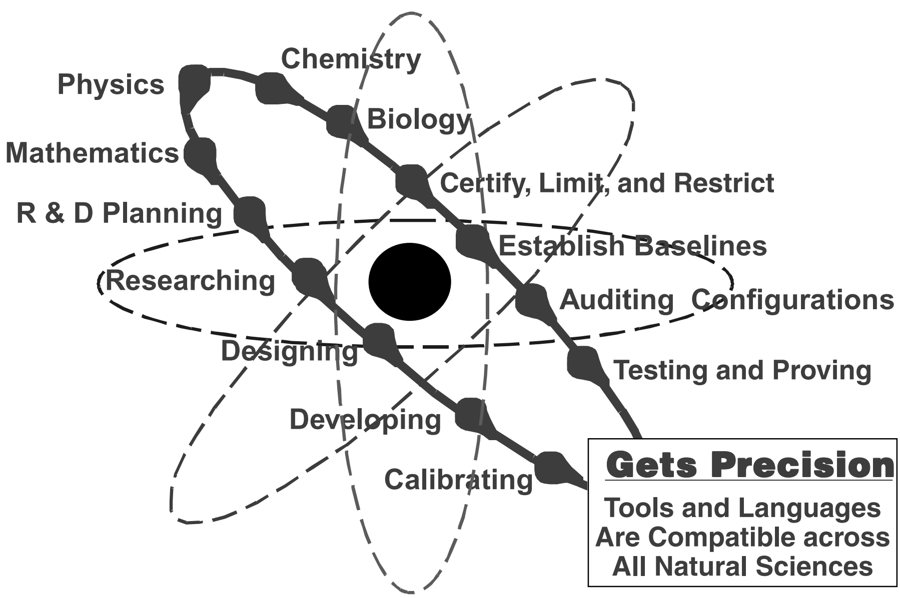

Figure 24–17 Technical Disciplines

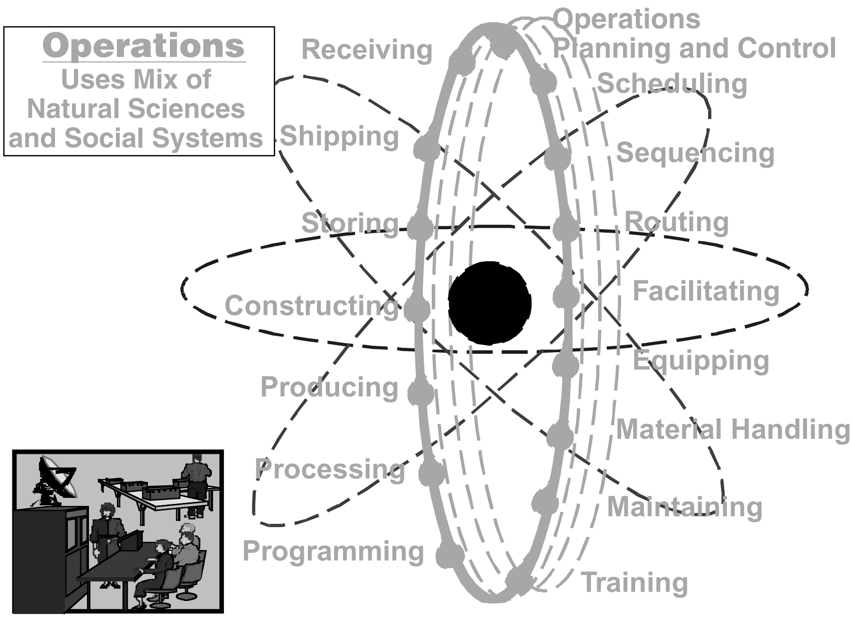

Figure 24–18 Operational Disciplines

manufacturing and logistic support. Blends of off-the-shelf and custom designs and sources are traded off for best performance and life-cycle supportability and costs.

The universes of operations that produce and service are in the trenches, so to speak. The factory, distribution center, data and information center, maintenance and overhaul, blast furnace and continuous-casting facility, paintings and coatings, floor and scrub nursing, examination and operating rooms, and laboratories for diagnoses and teaching are the places where actions take place.

In the work being done on components and limited-size systems developments decades ago, the potential power of integrated information systems with broadband communication links was emerging. Today those capabilities are in use in factories, hospitals, and battlefields to enable things like 24/7, precision, lean and mean, and fast-moving capability. We saw such capabilities in action in Afghanistan and Iraq. Technological achievements in devices from a couple of decades ago can now be integrated and fulfill promised force multipliers. Technology integration is possible. Operations integration can be seen. Business integration facilitated the wherewithal to do it. Projects integrate technology, operations, and business for purpose on-specification, on-time, and on-cost. James Carse provides an appropriate metaphors.[21] Projects are finite increments of effort, resources, and objectives done and achieved within infinite, on to perpetuity organizations and settings.

Recent articles in *U.S. News & World Report* illuminate the power of broadband sensing and communications and can help us think about the future in specialty universes or the integrative universes of project, program, and acquisition management.

1. ''[P]rocess simplification and information systems helped gain about 10% more product each year from the same [Mercedes] plant and people.''[22] This is happening all over. Lean, finely tuned factories, health services, financial services, logistic and distribution services, and retail/wholesale purchasing are approaching theoretical optimum capacity. Web-based broadband information systems enable true integration.

2. ''[S]pecial operations forces are fighting an unseen war. . . . [T]hey secured airfields for re-supply, seized oil terminals and oil fields before they could be destroyed, . . . took down an observation post in southern Iraq to blind Iraqis for the war's first hours. . . . [S]pecial boat teams boarded 90 vessels in less than a week [and] ran high speed surveillance mission into the heart of Iraq to pinpoint targets. . . . Typically, the forces rely on lightness, speed, surprise, and technology to get the job done . . . piloted MC-130 to pitch black runway . . . flies as low as helicopters, thanks to terrain-following radar . . . landing and getting special operations forces to the fight and keeping them alive . . . is most capable penetrating transport aircraft ever built . . . can spew out an array of electronic countermeasures, chaff, and jamming to thwart detection . . . can spot targets . . . gun-ships turn targets to rubble . . . call for close support . . . roar of F-18 Hornet jets sound overhead. One swooped in and lets loose a bomb that whistled down and pounded the ground with a burst of fire and puff of smoke. . . . [I]t has fallen to special forces to organize opponents, win hearts and minds, and conduct their own raids there.''[23]

3. ''Perhaps the most important parts of the war plan were the built-in 'decision points' that allowed individual commanders, like the run-and-gun quarterback, to call audibles as conditions on the ground change. Audibles, in fact, resulted in the first several plays of the game.''[24] The network pundits doing 24/7 second-guessing of the combatants may know better next time. General Franks had real-time aerial and terrestrial status for the theater from AWACS and Joint-Stars. The newspeople had detailed knowledge at points from embedded reporters and visions from long ago generations of combat. At-home companies are structuring information systems to give them real-time order of operations information and capacity realization for optimum courses of action.

4. ''[A]bout half of the Predators in the theater [were] operated from the United States . . . for the first time . . . pilots have 'flown' combat sorties without leaving their home bases. . . . The pilot operating the Predator was sitting in a trailer at an American air base, 7,000 miles away. . . . [These] operators helped find and destroy hundreds of targets.''[25] Technology, training and information systems are transforming the way we do everything corporately: fight wars, produce and service needs from anywhere to anywhere through inseparable interconnectedness and integration.

Today, after 50 years of practice and academics, I mention these perspectives to college students when introducing them to clients with real-world project needs for them to satisfy to earn their course grades. Recruiting secondary schools, I invite students to take part in dynamic exercises: paper airplane design and manufacturing, logistics services for some products, healthcare services (processes and information), or an e-commerce start-up. Their common sense comes out as they integrate their thinking and actions with those of their peers for corporate purposes. Hopefully, they will keep those feelings in mind as they choose courses of study for high-probability paths to career success.

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11 "In proposing the *scholarship of integration,* we underscore the need for scholars who give meaning to isolated facts, putting them in perspective. By integration, we mean making connections across the discriplines, placing the specialties in larger context, illuminating data in a revealing way, often educating nonspecialists, too. . . . In calling for the scholarship of integration, . . . we mean *serious, disciplined work that seeks to interpret, draw together, and bring new insight* to bear on original research. . . . It is through connectedness that research is ultimately made authentic. . . . Such efforts are increasingly essential since *specialization without broader perspectives, risk pedantry.* . . . What do the findings mean. . . . Today, interdisciplinary and integrative studies, long on the edges of academic life, are moving toward the center, responding both to new intellectual questions and to pressing human problems. As boundaries of human knowledge are being dramatically reshaped, the academy surely must give increased attention to the scholarship of integration." Boyer

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16 ''[W]e sought ways to improve the management of our development & procurement programs. . . [A]s we reviewed program after program . . . it was almost impossible to find a major program that was not in trouble. *All were behind schedule . . . showed large cost growths and . . . fell short of results* . . . case after case of just plain poor management . . . [P]utting better managers in charge would do more to bring about improvement than anything else . . . [E]stablish Academy of Management . . . where the best of modern management practices are taught . . . researched . . . christening . . . practical school for, after all, management is a practical profession.'' Packard, David S. Remarks on DSMC Founding Day
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SECTION IV

Project Oversight

Field Guide to Project Management, Second Edition. Edited by David I. Cleland

Chapter

25

How to Monitor and Evaluate Projects

James R. Snyder

Biographical Sketch . . .

Mr. Snyder is a retired Associate Director of Planning & Business Management, Strategic Product Development, at GlaxoSmithKline. Jim has 37 years' experience in the pharmaceutical industry in computer sciences, operations research, international marketing, marketing administration, and finance. He is a project-management practitioner who has been involved in developing and implementing systems as well as using project-management skill in a wide variety of project types since 1969. He is a Founder of Project Management Institute, Fellow of the Institute, past Executive Director, President, and Chairman of the Board. He is currently serving as Chairman of the PMI Educational Foundation Board of Directors. He continues as an active participant in the activities of the Institute. Jim is a member and VP Finance of the Delaware Valley Chapter, the College of Scheduling, and the Pharmaceuticals Special Interest Group. He is also a member of the Publications Board of the Institute.

In the life of every project there is a point where the project definition is complete, the life cycle planned, work-breakdown structures prepared, activities scheduled, cost estimates made, risk evaluated, and the team motivated. Like it or not, the project manager must now take some action to monitor and evaluate project activity and evaluate the impact of both activity progress and project environment on the project scope and objectives.

One significant decision remains for the project manager: whether or not to implement a formal monitoring and evaluating process. Some projects may not require monitoring processes, while others may demand state-of-the-art computer systems to track their complex activities. When monitoring is required, it is only to identify change and respond with appropriate action.

Field Guide to Project Management, Second Edition. Edited by David I. Cleland

If the process of monitoring does not result in action, it may not be necessary or appropriate. Many small projects are completed without any formal monitoring process. These projects derive most of their project-management value from the process of planning and developing the initial schedule. Many life skills projects, such as home renovation, vacation planning, and civic projects, are of this type. They are usually of very short duration and require few critical resources. There is nothing wrong with not using formal monitoring systems for projects of this type. The planning exercise is well worth the effort even for the very small project.

The completion of larger, more complex projects will require a monitoring process if they are to be on schedule, within budget, and within acceptable risk. Monitoring, evaluating, and reacting to the progress of a project are a project its self. As with any project, one must review the project objectives and plan how to meet them.

This chapter deals with the *monitoring* and *control* parts of the classic project planning and control loop, shown in Figure 25–1. The amount of emphasis on the monitoring and control phases of a project becomes the driver in the management process. All projects will be managed; it is the

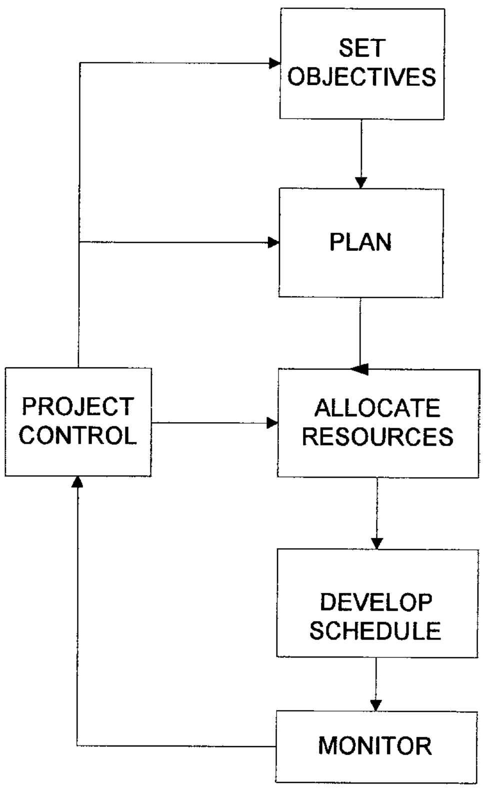

Figure 25–1 Project Process Flow

amount of emphasis on the monitoring and control phases that clearly distinguishes how a project is managed. Let's look at the emphasis placed on control and see how it affects the management of a project.

EXAMPLE. An administrative group recently undertook a computer systems project involving the implementation of a new version of a piece of software. While having some knowledge of major networked software systems, the group really did not have vast systems-implementation experience. The team did have good project-management skills and set about using those skills to deal with the unknown. They devoted lots of time and analytical ability defining what had to be done, how it would be done, and who would do it. At the end of the exercise, they had a plan that was reviewed by knowledgeable systems analysts, whose comments and suggestions were incorporated in the plan.

The result was a plan that was very simple and straighforward, both to the team and to the analysts who had critiqued it—so much so that it was not referred to again throughout out the very successful implementation of the project. Here the emphasis was on the planning aspects of the project, not on the monitoring and control process.

Another team was challenged to shut down one facility, move equipment to a new location, and start up at the new location. The process was not complex, the activities were well defined, and the timing was realistically based on lots of experience. Here again emphasis played a major role in the way the project was managed. The planning process, or how to do the job, was not as difficult to define as the control and monitoring process. If each part of the project did not occur within the planned time frame, the planned restart at the new location would not meet target. It was important to monitor each step of the process so that the planned time parameters would be met and that the final delivery of operational systems would be on time. In this case the emphasis shifted from planning, in the first example, to control in the second.

It is important to know how much emphasis to place on the monitoring and control phases of a project. If no actions will be taken as a result of collecting and analyzing information about project status, if the project is of a very short duration, or if the experience gained from a project cannot be applied to future projects, then the use of resources to monitor and evaluate project status may not be justified. Too often the nature of the project, or the project environment, precludes any change to a plan once it has been agreed upon. Measuring and evaluating change in a simple, small project may consume more time than may be required for the completion of the remaining project activities. Also, the resources used for monitoring and evaluating project progress may be the same resources allocated to the project activities, thus diverting resources required for a timely project completion.

Not all projects require full-scale monitoring processes. Often small computer systems-development projects suffer from over control and monitoring. Using project-management skills to define application objectives and identify key activities and resource requirements may be all that is needed to ensure that a small, uncomplicated application-development project is brought quickly to completion. Knowing when it is enough to plan and schedule a project, and then to work the plan, is a learned skill, based on experience. New project managers often become discouraged early in their careers by trying to use all of the components of major project-management systems for all of their projects. However, where the opportunity exists for changes to plans, schedule improvements, new resource allocations, or even revisions to the project objectives, monitoring and control become key project-management components.

Other issues that may drive the requirement for a monitoring and control process, even for small projects, include:

- Contractual requirements for progress payment.
- Major change to project objectives. Research projects, or projects dealing with creative activity, such as creative writing, may demonstrate significant change from their original objectives as they progress. Monitoring and progress tracking are essential to identification of shifting objectives.
- The size and complexity of a project demand that progress be tracked to ensure that major milestones and interfaces are met. These projects include most construction projects.
- Key resources, not activity progress, are the project drivers. In the research process, the priority-driven allocation of resources often determines project-completion dates rather than logical activity relations.

Each of these reasons for monitoring and evaluating project progress requires a different approach to the collection of information, evaluation, and action. Change is the one sure element in every project. The successful project manager is well prepared if he or she knows what changes to measure, how to measure them, and what to do with the results.

The Monitoring and Evaluation Process

The decision to monitor project progress must be taken early in the project life cycle. It is based on a determination that knowledge of progress can result in changes to any the following:

- ***Activity duration:*** The length of time future activities will require and their impact on project completion
- ***Resource allocation:*** The way in which money, materials, equipment, people and other key resources are assigned to uncompleted tasks
- ***Project logic:*** Revisions to the sequence in which work is performed

- ***Scope:*** Modification of the defined completion of the project and its deliverables

If none of these project components can be directly changed by evaluating actual progress, then monitoring may not be cost-effective. Once it is determined that the results of project monitoring can result in project change, the monitoring process becomes very important.

The output from the process of monitoring progress is information that either confirms the original assumptions about the planning, scheduling, cost, and resource requirements or suggests that the original assumptions were not valid. Depending on the extent of the variances from original estimates, the original objectives and plans may be changed, slightly or significantly, each time progress is monitored.

A CONTINUOUSLY CHANGING PLAN

One of the most difficult lessons for the new project manager is to learn that an absolutely accurate project plan is not usually possible. As quickly as decisions are taken on the basis of new knowledge derived from the project-monitoring cycle and the project environment changes, the project plan must change. When this continually changing project complex consisting of logic, time, cost, resources, and the project environment is captured at a moment in time and evaluated, it is called a project update. However, while the project manager is struggling with these complex interactions and making decisions on the basis of observed changes, additional changes are continuing to take place. Dealing with change is a prime responsibility of a project manager This ability to deal with continual and complex changes is a measure of a good project manager and is one of the reasons they are often hard to find. Change begins the instant a project starts, and ends when the project is complete. A project manager must be prepared to identify these changes and react to them. Creating the snapshots in time is the function of monitoring processes and is the basis for dealing with change.

EXAMPLE. An experienced construction manager responsible for a major pharmaceutical laboratory renovation project was having trouble dealing with the concepts of project management. His young planner was trying to apply his new project-management skills to the project. Frustration was evident on the part of the construction manager when he was given a weekly update that showed a slightly different completion for the project than the week before. After one particularly long and difficult meeting with subcontractors, the construction manager bellowed at his planner that if he kept changing the completion date he might get it right when the project was over! Here was a clear case where there was no appreciation of the virtual nature of a project plan. Sometimes the changing nature of a plan is understood by the customer and becomes the reason for rejecting monitoring processes, and even planning systems. While heard less frequently now than in the past, "Why should I plan, it will just change?" is still a reason to reject project-management processes.

Realization that project change is constant regardless of actions, or lack of actions, is the first major step in making appropriate use of the knowledge derived from progress monitoring. Equally important is acceptance that project updates are only snapshots of a moment in the project life cycle.

THE IMPORTANCE OF THE MONITORING AND CONTROL PROCESS
Project-management systems give us a wealth of information even before a project starts. They identify, clarify, and communicate project objectives and scope. They provide methods for quick visualization of difficult concepts, help determine the practicality of ventures, and aid in the identification of time and resource requirements. However, once a project is underway, it is the monitoring, evaluating, and control processes that become the project drivers. The processes for monitoring and evaluating the status of projects are as important to the project as the processes for developing schedules or building project teams. Often very large projects have project-control systems imposed by the owners. These systems are usually designed to track corporate milestones regardless of their relation to the project plan. Monitoring and evaluation of these milestones for the sake of corporate reporting is often of little value to those who are responsible for successful project delivery. Little in this chapter will be valuable if the project manager is not willing to plan the project-control project with the same dedication with which the project itself is planned. A measure of the commitment to non-mandated project monitoring is the extent of the commitment of resources (time/people/money) to planning the monitoring and evaluation processes. Project owners who are not willing to commit resources to the monitoring, evaluating, and control cycle are not serious about the project-control process.

What to Monitor

Monitoring a project is tied directly to defining project objectives. Unless the objectives are clear with regard to completion expectations, it is difficult to know what to measure. The question more often may be where to place the measurement emphasis as much as what to measure. Project activities are completed through the application of resources to a defined task. Task progress is measured by the amount of each resource consumed over a defined period versus the amount remaining to complete the task. Resources are key to activity completion and may be dependent on, or linked to, other resources. However, the key resource determines activity progress. For example, the setting of poured concrete in a construction project is an activity almost completely dependent on the resource *time*. Design of a promotion brochure cover as part of an advertising project is much more dependent on the resource *designer*. In general, key resources are time, money, materials, and skills. Of course, a long list of very specialized resources may be required for any project. This list will differ even within the same type of projects. Knowledge of what is really important to the owner/stakeholder is the best guide to knowing what must be monitored and is so significant that it should be a part of the project objectives. This objective for a systems-development project might look like the following.

> The objective of the ''Quick Connect'' project is to design develop and implement a computer backbone capable of interfacing the administrative, engineering, and financial operations at the five major plants of X-Company. Quality and reliability of the system are the most important criteria. While time and cost are significant factors, success will be measured in terms of the reliability of the installed system.

This statement leaves little doubt that the monitoring and evaluation process should not permit the sacrifice of quality assurance testing throughout the project to save time or money. Of course, the statement of objectives could go on to include limits to the other major resources, including time and money. The point is that without knowing what is important to the owner/customer, it is not possible to design appropriate reactive processes to monitor the project.

Very similar projects can have significantly different objectives and therefore very different monitoring processes. In any industry where innovation is key to financial success, the definition of what to monitor on two development projects is quite different if one of the projects leads to an innovative new product in a highly competitive market, while the other project aims at a less competitive market. In the first case, time is likely to be the major objective, with cost second. The development of products in less competitive markets may be allowed more time if cost to completion can be reduced.

EXAMPLE. The monitoring of progress against time was a prime objective to the contractor rebuilding a fire-damaged section of I-95 near Philadelphia. The project contract had as its major objective the restoration of full use of the highway as soon as possible. To emphasis the importance of this objective, a $30,000 per day penalty/bonus based on project completion was part of the contract. Careful monitoring with emphasis on the management of the *time* resource was an important element of the project plan.

DEFINE COMPLETION

The completion of any activity, task, milestone, or subprojects is a key event that is included in the monitoring process. Knowing when one of these events is completed is a significant piece of the monitoring and evaluation process.

It is very difficult to be just a little bit dead! However, some activities, and even projects, are a little bit finished for long periods of time. There is probably some reason for concern if an activity moves to 90 percent completion in 10 weeks and requires 30 weeks to complete the last 10 percent.

Progress cannot be monitored if completion of components is not recognizable. Project managers need to monitor consumption of resources related to time, with emphasis on those resources that are key to meeting definable end points.

Just as a project has a definable start and end point, so must every one of its project components. If this very basic rule is violated in the planning process, it is much more difficult to monitor progress than if activity definitions have been clearly agreed upon.

TIME IS A SPECIAL RESOURCE

Project-monitoring measures resource consumption and work unit completion. To measure work unit completion, it is important to understand the very special properties of time. Time is often the sole measure of activity progress. Although it is a separate measure in the monitoring process, it is also a resource. Why not, then, be concerned only with the definition and measurement of resources, time included, rather than introduce a concept of activity progress/completion monitoring as a separate consideration? The answer is that time is a very special resource. There is no known way to increase or decrease the rate at which this resource is used. Where time is a limiting factor, no amount of money or application of other resources can buy more of it. Time is also a limiting factor when exceeding the available time results in a consequence that is not tolerable to the project stakeholders. Another special property of time is that once a project starts, time is used at a constant rate. While we can stop the consumption of other resources, time continues to be used, and past time can not be recovered to be used again!

The term *buying more time* has little to do with time-limited projects. Time is not for sale in these cases. What is being bought is a delay in delivery of a project that was never time-dependent in the first place. This is a question of negotiation of completion objectives rather than resource allocation. The penalty/bonus clause is the closest a project manager may ever come to buying, or selling, time.

Penalty/bonus clauses are completion negation exercises up to the point at which the ''penalty'' cannot be tolerated. At that point, time becomes a limiting factor—no more time can be ''bought.''

EXAMPLE. People who manage events live every day with time as the key controller of their projects. Once a date has been set for a major convention, symposium, sporting event, or other fixed-time project, time becomes the controller. In the ever-changing business of international exhibit management, the one, and often the only, sure thing is that the doors to the convention hall will open at the designated time. Late arrival of the exhibit can be fixed by using more people to assemble the exhibit. Loss of handout material can be rectified by purchasing more. Even a change in marketing direction can be dealt with by alteration of exhibit design and sale training. But no matter what, the doors to the exhibit will open.

When to Monitor

Because project plans are always changing, continual activity monitoring is ideal. But the size of projects often prohibits continual activity monitoring as the template for most projects. Resources available to control a project have limits just like the resources used to complete the project objectives. The factors contributing to the establishment of the timing of the monitoring process include the following:

- Management information needs
- Acquisition of new activity information
- Changes in resource mix
- Occurrence of major events
- Passage of time

Each of these contributes to the determination of when and how often activity or work unit completion and resource consumption should be measured. The criteria used to determine further when updating of project status should occur are easy to identify. Some are factors that are not within the control of the project team. Other criteria are established by things that happen in the project environment that have a significant impact on project status. Other very important criteria leading to the determination of status reporting are those criteria completely at the discretion of the project manager and the project team. These criteria for monitoring are likely to be significant since they represent those things that the project team thinks are important. By looking at these criteria in light of the identifiable events, it is easy to see when to take the important snapshot of the project for evaluation and action.

MANAGEMENT INFORMATION NEEDS

Most companies and large projects have them. They are called different things in different industries and in different professions. However, they are all mandated systems that attempt to give a small group of top-level people a clear, uncomplicated view of the status of major projects for which they ultimately have responsibility. Usually the information that is desired by these people or groups is extremely simple and straightforward. They want to know if their commitments to stakeholders, investors, partners, and customers will be delivered as defined, on time, and at the projected level of resource (dollar) consumption. These people are project owners. Given positive assurance that the set of objectives to which they are committed is being met on a regular basis, they will leave the daily problems to the project team. If, on the other hand, these groups think that the reliability of project completion is in jeopardy, they will be on the project team like bears on honey.

The project components that are of interest to the owner group may not be of logical importance to the project team. They may only represent the completion of groups of work that is significant to the owners.

EXAMPLE. Although completion of 85 percent of the construction of a strip mall in a small town may be of no be significance to the construction project manager, it may be a key event in the eyes of the owners, in that it defines a point at which additional investors may be willing to join the project.

Key events are milestones, and regardless of how they are defined or for whom they have significance, their status should be captured. Many milestones signal availability of information to other systems. They are established primarily as information system links and trigger wide ranges of activity both within a project and in other projects. When one of these key items completes, it is of interest to many different management levels because it indicates a new project phase, shift of resource emphasis, or critical decision point in the project. When milestones are reached, activity should be measured and project status evaluated. A major event has occurred, and its impact on the project should be evaluated.

NEW ACTIVITY INFORMATION

Way back in the planning phase of a project, the big problems were to define what activities were required to meet the project objectives, what resources were needed, and how long these activities would take. While others emphasize the accuracy of the activity definition, the reliability of resource allocation, and the precision of time estimating, the really important thing was do develop a plan that best represented reality, *as it was know at that point in time*. In the planning phase it was important to use the best estimating skills available yet not to be overcome by a demand for complete accuracy. Less than complete precision of estimates can be tolerated as long as the control process is responsive to perceived changes in the project environment and new information. A project manager's performance is measured not by how good the estimates *were*, but by how well the project team responds to the real environment. The planning and control cycle continually offers the opportunity to change the elements of a project plan as the real situation changes. The capability to identify new information and incorporate it in the project plan is critical to managing a project.

A reason creative people resist the application of project-management systems has always been the proposition that creative work ''just happens.'' It cannot be managed because it cannot be planned with any degree of accuracy. Good project managers counter these arguments by explaining that it is not as important to get the initial estimates right (within acceptable limits of reality and available resources) as it is to identify, report, and respond to change as it occurs.

It is more important to record change and react to new information as a project progresses than to be dead right in the planning phase. It is important to learn to identify when new information is available and where knowledge has increased to the point that including it in the project plan adds value. Usually this happens when significantly difficult activities complete, when new information is available on which to base decisions, or when the passage of time generates real data related to progress rather than estimate. At this point it is critical that plans be updated with the new information.

CHANGES IN RESOURCE MIX

It is very important to the success of a project to be aware of the changing resource mix. Every activity in a project has a real or implied resource assignment. Any change in either the quantity or quality of resources assigned to an activity can change the completion profile for the project. An obvious example of this type of change is the removal of a key person, say the lead market planner, on a strategic marketing plan-development project. The result can be either a change in the direction of the project or an increase in duration, or both, based on the quality and experience of the replacement.

Unlike changes in the time to accomplish an activity, or the change in logic, changes in resource mix are often difficult to detect. Unless the resource is money, where significantly cuts or increases are obvious, processes must be in place to identify and monitor the changing resource mix.

OCCURRENCE OF MAJOR EVENTS

The completion of a major event is significant in the project life cycle and should be used as an opportunity to collect data about the project and review its status/progress.

Completion of a major event can be viewed by the project manager as either a positive or a negative occurrence. If an event completes ahead of schedule, it offers the opportunity to improve time performance, reduce cost, or make other significant resource allocations. It may even offer the opportunity to modify project objectives or change project logic. If completion is behind schedule, all of the opportunities become essential elements of a review aimed at returning the project to the scheduled completion.

PASSAGE OF TIME

Although it is hard to imagine, there are a number of projects that do not have defined reporting points, changes in resource mix, occurrence of major events, or the discovery of new information occurring over reasonable time periods.

EXAMPLE. The development of a trademark is a good example of this type of project. At the beginning of a trademark-development project there are many activities dealing with name definition, language conditions, name development, preliminary screening, focus groups, and name selection. This is followed by a period after name filing with various governments where very little happens for as much as eighteen months. Names are published and a response period for objections takes place. The question is, with no activity over an eighteen-month period, is any monitoring required? Even when nothing appears to be happening, project status should be monitored on some routine schedule to be sure that changes have not occurred during the long period of inactivity. It is much better to know that a number of negative reactions are being received to a trademark filing as they occur than to learn of them at the end of an eighteen-month period even if no action will be taken until the period for objection expires.

Project managers may want to consider reviewing project status on the basis of the passage of time only (once a month) even if there is little or no activity.

Who Monitors Project Status

Many projects require that third-party teams monitor project progress. While these groups can collect and analyze data and prepare reports, they are not usually able to take action to change project progress. Of course, they do make recommendations to project teams and owners.

The only group that truly can evaluate the impact of information collected in the monitoring process is the project team. Members of the project team must have responsibility to monitor their own activity, evaluate the information they collect, and recommend action to the team or project owner on the basis of their analysis.

Project team members are stakeholders in a project. They participate in the definition of tasks and identify the logic and resource requirements. The team is a part of the definition of the project objectives. They are best equipped to interpret what is really happening in the project and prepare appropriate responses. Where third-party monitoring is used, it often leads to unrealistic evaluations of status, inappropriate recommendations, and costly changes to project plans. Without a stake in the project, it is difficult to see and react to changes as they occur.

How to Monitor

It would seem to be quite easy to monitor project progress. Just go out and look at what is happening and compare actual progress to the plan. This is easier said than done, however. Monitoring is plagued by two major problems: the accuracy of the information collected, and the way the information is presented. Understanding these two potential problem areas will make the process of collecting and reporting project progress less difficult and result in a better understanding of the true status of a project.

The purpose of monitoring a project is to learn as much as possible about what is happening in the project environment *now*. It is not about what would be nice to happen, what happened yesterday, or what may happen in the next few weeks. Monitoring is real time, here and now. By the time events start to happen in a project, the processes to capture the activity must be in place and the project team ready to act on the information.

COMPUTERS: THE GOOD, THE BAD, AND THE UGLY

We would find it very hard to imagine a world without personal computers. The inexpensive availability of computing capacity and the arrival of the Internet have made a significant change in every aspect of life. We now rely on computers to bring us the news, answer our questions, process our business and personal communications, and simplify our financial and banking business. Each day computers touch another part of our life, making it a bit easier to do the routine and not so routine tasks of life.

Like every aspect of life, managing projects has been significantly changed by computers. The arrival of fast, large-capacity computer systems has made the scheduling of extremely large projects possible and permitted the analysis of resources, risk, and value in ways that were not possible a few years ago. Computer support for the analysis of project logic and the graphic display of network logic has significantly advanced our understanding of project interelationships. They have allowed us the luxury of ''what if'' analysis not possible without their speed and capacity. Collecting data and reporting every aspect of project performance is enhanced by computer systems. Without computers, it is difficult to understand how data collection, analysis, and meaningful response could keep pace with the modern project. These concepts represent the *good* computers have brought to project management.

This good is offset by some *bad* aspects. Some younger project managers have lost sight of the meaning of the schedules and reports generated from them. An understanding of the basics of scheduling and the meaning of the task relationships in a network plan is critical to understanding practical responses to project problems. Computer systems generate results without explanation of how the results are obtained or their impact on project decision-making. It is now possible to generate reports related to every aspect of a project in an almost infinite number of ways. Without appropriate management, information systems overload can hinder appropriate and timely reaction. The demand to provide data to systems often compromises the reliability and validity of the information. Accuracy and reliability of information are critical to the project control system and are discussed in detail below.

A professionally generated report, delivered on time, showing a project tracking to scope, schedule, and budget, can be a credible reassurance to stakeholders that their project is under control. However, the project may be behind schedule and have serious budget problems. Computer-based planning systems make it very easy to generate reports that will reflect any desired status or preconceived result. The fixed date options for event activity often produce reports indicating status that is not reflective of the true status of a project. In a very large project, these fixed dates can be so subtle that even the project manager is not aware of their existence and impact. A new feature of some systems known as *auto actuals* even updates cost on the basis of reported activity duration percent completion. This type of automatic information generation can be extremely deceiving and lead to bad decision-making. This is the *ugly* part of computers.

Project managers of major projects are dependent on fast, reliable computer systems. However, they must be fully aware of the processing algorithms used by their systems, limit the output to meaningful data suitable for decision-making, and avoid abuse of their software systems. The *good* far outweighs the *bad* and the *ugly*, but we must guard against the potential negatives thatcan be created by computer applications.

ACCURACY AND PROJECT MONITORING

The very best project team, with a well-defined project objective, adequate resources, and a sound logic plan, will fail without accurate information. Risks are taken in the planning phase of a project, and it is acceptable to be unsure of the exact logic, time, or resource requirements as the plan develops. It is inexcusable to find that reporting of project status is not accurate. The decisions leading to successful and timely completion of a project are based on a cascade of snapshots, and the monitoring process must be the camera that captures reality.

EXAMPLE. A number of years ago, when computers were big and had their own rooms, a major project was undertaken to build a billing and inventory system for a major department store chain. The project was complicated by reliance on the development of advanced computer hardware systems to capture point-of-sale information. These two projects, one an owner-initiated software system and the other a vendor-supplied hardware system, were to progress in parallel. They were very interrelated projects, and few management processes were available to support monitoring. All went well for months. Regular status meetings showed that the projects were meeting their milestones and tracking nicely towards simultaneous completion.

As the two projects neared completion, it became evident that some of the reports was not accurate. In fact, the hardware project lagged in development, production, and quality of the emerging product. The situation became so bad that the whole project was aborted at significant loss to both participants. The key learning is that while accurate knowledge of the status of the project may not have changed the outcome, it may have contributed significantly to reduce loss.

A monitoring system must be able to identify the expected parameters, collect the data, check that the data are correct, review the data to see that they fall within expected limits, and check one more time to be sure. This process will ensure that the decisions made about future activity or resource allocation are based on reality. Those who monitor project activity may uncover the inevitable deviations from plans and schedules and must be relied upon to report what they observe, not what they would like to observe. Accurate observation and timely reporting are key to the most important step in project monitoring: reaction to change. If monitoring is not accurate, it can be more damaging to project control than no information at all.

PRESENTATION OF INFORMATION FOR ANALYSIS

Simply to collect information about the progress of a project by reporting completion and partial completion of activities is not enough. That partial information tells nothing about the status of a project—itdoes not present a meaningful snapshot. Even the careful evaluation of the type and rate of resource consumption is not enough for a full understanding of status. Monitoring is related to meeting project objectives. Like all other aspects of a project, the objectives may change as the project progresses. To identify a set of activities leading to an objective and monitor progress toward that objective is only part of the responsibility of the project team.

Monitoring includes evaluation of the total project environment. The project team identifies changes in objectives themselves, the tool set available to meet the objectives, the mix, availability, and cost of resources, and the political climate in which the project is operating. The nonactivity, nonresource elements can have as much impact on the status and direction of a project as any of the planned components. Failure to consider the total project environment at any point in the monitoring process can eliminate opportunities to redefine a project to the advantage of owners and stakeholders. A checklist may be helpful to guide those monitoring progress to consider environmental issues. However, a specific list may serve to defeat the purpose. Monitoring should consider any factor that can influence the project.

EXAMPLE. A company was taking high risk and spending money to bring its toy dump truck to market ahead of a competitor. As the project moved forward, it was critical to know that the competitor had gone out of business. This significant event certainly had an impact on the way activities were scheduled and resources allocated for the remainder of the project. It is unlikely that the collapse of the competition was an activity whose progress was part of the monitoring plan. Competitive factors and a long list of other business activities that comprise the project environment can be as critical as any of the planned activities and must be included in the monitoring process.

How to Evaluate Project Status

Three steps make up the project status evaluation process:

1. Establish the evaluation parameters and the status window.
2. Evaluate time and resource consumption against planned activity.
3. Identify environmental factors and their impact.

EVALUATION PARAMETERS AND STATUS WINDOW

Even in a small project, the parameters and status window should be considered and endorsed at the start of every evaluation. It is important to confirm the relative importance of cost, time, logic, resources, and objectives at each update period. Without reconfirmation it is possible for a project to drift away from the parameters selected for emphasis in the planning phase. It also makes sense to define or confirm the status window before each update. Although this concept is more critical to long and large projects, it should be considered for all projects. The status window is the duration of the reporting period. The length of this period is determined by:

- Amount of activity underway
- Occurrence of milestones or key events
- Criticality of resources to project objectives

The window is that next segment of the project that will be most influenced by the information collected in the monitoring process. Of course, it is possible that the analysis of the project status will identify changes to the project far in the future. However, it is most likely that near-term actions will be indicated more frequently. The window is the width of a project snapshot. It is not a fixed period and should change as the project demands. Why update every week if no activity is taking place?

Accuracy of all aspects of the project plan is related to their proximity to the time the evaluation is made. In a very long project, it is not productive to make minor changes to logic, timing, and resource allocations to all the activities in the plan at every update. It is much more productive to concentrate the analysis on the next window or next few windows in the plan.

EVALUATE THE PLAN, SCHEDULE, AND RESOURCE CONSUMPTION

Here appropriate scheduling tools are used to produce a new plan and schedule based on an accurate analysis of the observed status of activities and the consumption of resources. Comparison can now be made between the plan generated from the previous status review and the new plan and schedule. This mechanical/analytical process either confirms previous decisions or presents options to improve the project plan. The options and opportunities surfacing from the comparison of plan to actual are the basis for the decision-making steps that follow.

IDENTIFY ENVIRONMENTAL FACTORS

The evaluation of the environment confirms that the playing field is still level or that it has shifted in one direction or another. Events that may alter every aspect of a project, including its basic objectives, can happen at any snapshot in the monitoring and control process. These events are so significant that they must be part of every project review. This step confirms that the assumptions about the factors influencing this project are the same as they were when the project was last evaluated. If not, their impact on the project must be considered.

Often the answers to these questions are very subjective and require careful consideration. They are also often critical to the decision process related to change. Failure to identify and respond to changes in the environment is often the cause of project failure. It is key to knowing the real status of any project. (See Chapters 17 and 18.)

What to Do with Status Results

With a clear picture of project status, the project team is in position to act on their options and opportunities. Making actions responsive to observed actual situations requires a trip back in the planning process. Depending on what has actually happened, it might be necessary to reenter the planning process at any one or more of the key process flow points as shown in Figure 25–2.

The information from the monitoring process may indicate that it is only necessary to enter the process at the *Allocate Resources* level. This indicates that the project definition and plan have not changed but better use of resources is indicated. Other data may show that it is necessary to reconsider how the remaining work should be performed. Replanning may be indicated. The monitoring process may identify changes to the basic project objectives. This opportunity to revise the plan objectives is often lost and may result in an unexpected end point.

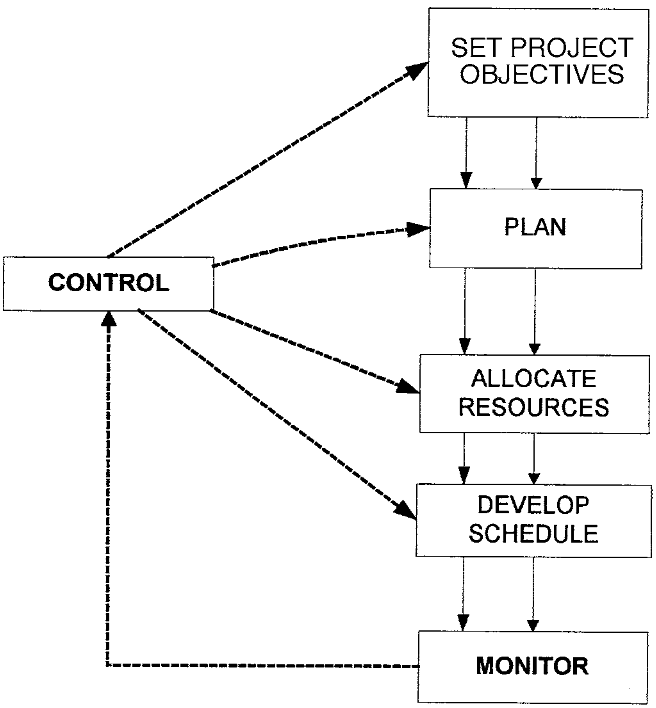

Figure 25–2 Project Process Flow—Reacting to Change

If actions require entry into the project process flow at any point, then all the points that follow in the process must be reconsidered. If replanting of project logic (*Plan*) is indicated, then it will be necessary to review the impact on the allocation of resources (*Allocate Resources*) and then generate a new schedule (*Schedule*). It may be helpful to list the proposed actions resulting from monitoring status and identify the entry point in the process flow so that consideration of all the appropriate steps will be included in the revised plan. Changes in a project can require redefinition of objectives, replanning, reallocation of resources, and rescheduling. Key to what is required is where the process flow in Figure 25–2 is entered.

The end point of the whole monitoring and evaluation process is a new plan. As soon as that plan exists, the process begins again with the establishment of the next point in time, or event, that will activate the process.

Key Points for Project Monitoring and Evaluation

- It is important to know what to emphasize in the monitoring and control phases of any project.
- Not all projects require full-scale monitoring. Decide if monitoring is needed before the project starts.
- All plans change the instant the project starts. Be prepared to see change and react to it.
- If you are not willing to commit resources to monitoring and evaluating your project, you are not serious about control.
- What to emphasize in the monitoring process is dependent on project objectives. Relate monitoring to objectives before the project starts.
- Monitor the consumption of resources related to time, with emphasis on those resources that are key to meeting definable activity end points.
- Know as much as you can about the true time constraints in a project as possible. Is time really a limiting factor? Be aware of the inflexibility of the time resource.
- Monitor project progress when a milestone is completed. Its completion is key to downstream decisions. A major event has occurred and its impact on the project should be evaluated.
- It is more important to record change and react to new information as a project progresses than to be dead right in the planning phase.
- Consider reviewing project status on the basis of the passage of time only (once a month) even if there is no activity.
- The project team must be responsible for monitoring and response to deviation from plans. Ownership is a prerequisite to good monitoring and control processes.
- Monitor the environment as well as project activity. It can be critical to project success.

- Monitoring must be real, here and now. If it is not accurate, it can be more damaging to project control than no information at all.
- Subjective measure of changes in the environment may be as critical as completion of an activity or change to project activity logic. Evaluate the environment every time you measure project status.
- Changes in a project can require redefinition of objectives, replanning, reallocation of resources, and rescheduling. Key to what is required is where the process flow for project monitoring is entered.

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Chapter

26

Project-Management Software: A Guideline for System Selection and Use

Bopaya Bidanda and David Hackworth

Biographical Sketch . . .

Bopaya Bidanda is the Earnest Roth Professor and Chairman of the Department of Industrial Engineering at the University of Pittsburgh. His research is in the area of manufacturing systems with a special focus on cellular manufacturing, product development, project engineering, rapid prototyping, and manufacturing modernization. He has industrial experience in aerospace manufacturing, precision manufacturing, and tooling accrued before graduate study. He has co-authored two books for McGraw-Hill (*Automated Factory Handbook* and *Shared Manufacturing*) and has published over 100 papers in international journals and conference proceedings.

He is active in the Institute of Industrial Engineers and is currently a Fellow of IIE. He has also completed a variety of national and international consultng assignments on different aspects of industrial engineering, manufacturing systems, and project engineering.

David Hackworth is a recent M.S. graduate from the industrial engineering program at the University of Pittsburgh, where he concentrated his studies in the areas of manufacturing and project management. Prior to his industrial engineering studies, David worked in industry as a cost analyst, senior financial analyst, and corporate planner. David also has an undergraduate degree from the University of Pittsburgh, B.A. in economics, and an M.B.A. from the College of William and Mary.

This chapter will provide a brief overview of the role of software as part of the project manager's toolbox. Software needs, selection, implementation, and testing are discussed. Common project-management software tools will be briefly discussed and issues regarding them, such as

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Gantt charts, work-breakdown schedules, scheduling engines, network flow diagrams, resource charting, tracking tools, cost-control mechanisms, project communication systems, and project portfolio tools, are detailed. Sidebar commentaries on other resources for information and a warning for project managers about control of the software are provided.

Project management is a field that predates computers. However, as desktop computers began to proliferate within the workforce, project managers quickly began to utilize this emerging technology to help manage projects. Today, as computing costs drop and the speed of communications increases, almost every project manager uses the computer to help manage projects in some way. Whether it is simply using spreadsheet templates for a work-breakdown schedule or a using an off-the-shelf enterprise-wide system, project managers everywhere can use information technology and project-management software to make their task easier.

There is no doubt that project managers have seen revolutionary changes in the information technology in the past fifteen years. The number and variety of commercially available project-management software packages have simply exploded. An Internet search for ''project-management software'' will yield many, many links with literally thousands of offerings for PM software. The Directory of Project Management Software (www.infogoal.com/pmc/pmcswr.html) lists almost 300 project-management software packages, from the most generic to software specifically designed for industries from chemical processing to printing.

There are free shareware software packages available, templates to download into your spreadsheet package, and even free Web-based tools. With all of the available options, the task of selecting project-management software can easily become so large that the project manager is overwhelmed and simply uses the same software he or she has always been using.

The selection of a project-management software package can also be influenced by the industry of the user. A study of members of the Project Management Institute (PMI) showed a significant variation in usage from industry to industry.[1] This is not surprising given the number of tools available to the project manager and the number of tools available.

Despite the number of specialized offerings, a complex tool is not required for project management. A recent Project Management Institute survey indicated that four of the top ten most commonly used software tools for project managers are not actually project-management software: the Microsoft applications Word, Excel, Access, and Visio.[2] Except for Visio, almost every personal computer in the corporate world has these applications. If every project manager already has these tools on his or her desktop, why are there so many other project-management software applications?

The selection of project-management software should not be such a large task that it becomes a project itself. There are several tools to help the project manager select the proper software tool. Several groups offer evaluation and reviews of commercial software packages. While these reports often offer concise and accurate third-party evaluations of software, these reports are usually offered for a fee. Groups offering these evaluations include the META Group and SPEX Enterprise Software Evaluations (www.metagroup.com). While these reports may be useful to the experienced project manager who knows exactly what he or she is looking for, they do not help the inexperienced project-management software user understand his or her needs.

This chapter will provide a framework to first evaluate the needs of the project manager before the project-management software is selected.

Selection Process

The selection process is a systematic decision process that will lead the project manager to evaluate the needs and desired functions of the software, evaluate the alternatives, then select and implement the software. A seven-step process for selecting and using project-management software is recommended:

1. Review current project-management tools.
2. Review other basic project-management tools.
3. Establish basic system requirements.
4. Review available software options.
5. Select software.
6. Test selected software.
7. Implement project-management software.

REVIEW CURRENT PROJECT-MANAGEMENT TOOLS

The project manager should review the tools that he or she currently uses in order to manage projects and list these tools as the basic list of functional requirements for the project management software. The project manager may want to call a meeting of typical project stakeholders and list their needs, common tools they currently use, and additional tasks they would like to accomplish.

REVIEW OTHER BASIC PROJECT-MANAGEMENT TOOLS

The next step is to review other basic functions that are common in today's project-management software offerings and determine which of these should be added to your current set of project-management tools. Table 26–1 provides a list of the most common project-management software tools. Each of these tools will be explained briefly in a later section.

ESTABLISH BASIC SYSTEM REQUIREMENTS

The third step is to determine the basic system architecture. The checklist in Table 26–2 should be reviewed for the basic system setup.

Once the basic functions required from the project-management software have been determined, the project manager should then review the

Table 26–1 Checklist of Basic Project-Management Tools

√ Basic project information
√ File security
√ Gantt charts
√ Work-breakdown charts
√ Linear task scheduler
√ Responsibility charts
√ PERT charts
√ Earned-value charting tools
√ Resource-availability charting
√ Resource-capacity tools
√ Resource-leveling tools
√ Cost-collection tools
√ Cost-projection tools
√ Risk-simulation tools
√ Scenario-evaluation tools
√ Timesheet
√ Expense-tracking/budget systems
√ Issue-tracking system
√ Portfolio tracker
√ Integrated e-mail system
√ Other functions

specific functions that will be used as tools to manage the project. After the project manager completes his or her list of tools required from the list of available functions, it is time for the project manager to begin reviewing software.

REVIEW AVAILABLE SOFTWARE OPTIONS

Comparing the requirements established in the first three steps of this process to the available software packages will eliminate many software pack-

Table 26–2 Checklist of Basic System Requirements

√ Single or multiuser—will the PM software be used by a single project manager, or will the system by used by multiple managers, submanagers, or the entire project team?
√ Network- or PC-based—will the PM software reside on a single PC, mainframe, client/server, intranet, or the Internet?
√ Integration with other applications—will the PM software be required to integrate with other applications such as accounting, timecard, or billing systems?
√ Single or multiproject—will the software be used to manage a portfolio of projects or a single project?
√ Industry-specific—does industry-specific PM software exist for your industry, and is this important?
√ Training and support—will the software require extensive training and support and is this offered?
√ Price—what price range can your organization afford?

ages. After narrowing the list of potential project-management software vendors down to a short list of four or five vendors, the project manager will want to sit through a demo from each vendor. Be wary of falling into the trap of being so impressed by the first demo that you cancel the remaining demos. The first demo will be impressive since the tools will be new and the salesperson is paid to make the features impressive. Also, do not fall into the trap of selecting the product from the last demo simply because it was the most recent in your memory. Come to each demo with your list of requirements and determine if the software supports each requirement and how easy the system is to use for each required tool. Also, keep track of each new feature that you see that was not on your original list of requirements.

SELECTION

After all of the demos have been completed, go back to your notes and create a matrix with your list of requirements and vendors. For each requirement, rate each vendor against each other. Also list new features of each vendor's offering and determine if these are important and if the other vendors offer similar features.

Once this ranking is done, the answer to your selection will usually jump right out. If it does not, there are several ways to rank the choices. However, when the user has carefully evaluated the needs and the offerings, adding the price into the decision will almost always yield and easy decision.

TEST SELECTED SOFTWARE

After sitting through the demos and reviewing your selection criteria, the final test before purchase should be a test run of the software. Install the software on one project manager's PC and let him or her recreate a project that the individual has managed. The test project does not need to include every detail of the actual project, but the test must have sufficient data to test each feature desired fully. If the user finds anything unworkable or more difficult to use than anticipated, it is time to call your second choice. If things run relatively smoothly (keeping in mind the learning curve of using the software for the fist time), you have your software.

IMPLEMENT PROJECT-MANAGEMENT SOFTWARE

The implementation phase of the software-selection process gives the project manager a chance to teach the project team the project-management methodologies that he or she uses as well as the software itself. The acquisition of a new project-management software system is also a good time to effect organizational changes in the use of project-management methodology. If a single project manager is using the software, the implementation process is simply the project manager learning the new software tools and converting project information into the new software system. When there are multiple users for the system or the entire project team will be using the software, the implementation becomes more involved.

The project manager must group the users according to what level of interaction the users will have with the project-management software systems and tailor training for each group. For example, there may be a group that only uses the software to access reports or to review project status. Training sessions for these groups should be designed after initial project information is input into the system. For users that will be entering data and using the system at a more involved level, training should come earlier and should be combined with a review of the project-management tools already being used as well as new project-management tools. These reviews should be intertwined with the training of the new software system. The project manager should jointly work through the learning process with the project team to create a sample project in the new software system and go through each function that will be used.

The importance of proper implementation of a new project-management system cannot be overstated. The failures or shortcomings of project-management software are often not failures of the system itself, but rather failures of the users to understand and use the system properly. Similar to expected (but often unrealized) efficiency gains in manufacturing through modern manufacturing technologies (e.g., CAM, CIM, robotics, FMS), the failures of these programs lie in the implementation of the program. The

Table 26–3 System Implementation

In an earlier study,[4] nine elements for successful implementation of a technology project were identified. These elements have been adapted here for implementing a new project-management software system:

- Project manager—the philosophy that the project is still run by individual project managers who are supported by the software system.
- Kickoff—workers should be involved in implementation of the system in early and significant ways.
- Pilot projects—software should be introduced using pilot projects.
- Champion—a high-level advocate should sponsor the implementation of this new software.
- Selection and training—employees who will become system users should be selected for their capabilities to learn the system and, in turn, become mentors to others.
- Overcome resistance—efforts must be made to overcome resistance to new technology.
- Performance and rewards—employees who are leaders in learning and teaching new technologies must be recognized in performance evaluations.
- Organization—the new project-management software system must be synchronized with the organizational design of the company.
- Information access—the project-management software system is designed to give better information about corporate projects; it must be ensured that the people who need access to this information are able to get it through the software.

interaction points between humans and technology are often overlooked and are responsible for failures often blamed on the technology.[3]

Common Tools in the Project-Management Toolkit

As any project manager faces the task of selecting a software tool to help manage projects, he or she will need a set of common tools that the manager and other stakeholders are comfortable using. These tools will usually form the starting point for the desired functions of the software. A basic review of these tools and how they are commonly integrated into project-management software may be beneficial. It is important to remember that, as discussed earlier, the tools should fit the project; the optimal project methodology cannot (and should not) be altered to fit the available tool.

Basic Project Information

Your project-management software should have an area for storing the project's basic information. Use this area to list the project name, project managers and submanagers, mission and goals, statement of work (SOW), limitations, time frame, and any other general background. This information should be the first step in creating the project file. It is important that this information be clearly stated and available to everyone associated with the project. An example of a project review template is shown in Figure 26–1.

Gantt Chart

The Gantt chart function will be found in almost every project-management software package. A Gantt chart presents an outlined task list and the time scale for each task. Many PM software systems use the Gantt chart as the default starting point for the software. Often this view is used when new project tasks are input or when updating project task information such as task name, start date, resource, task type, task length, and so on. Since this view is used often, it is important that any software system selected have a Gantt chart view that you are comfortable with or can be easily customized according to your specific preferences. For the project manager, it is critical that the feature be an easy starting point for jumping to other views or modifying the task list and task information.

For the project team, it is critical that the Gantt view can be customized to show the portion of the project for which the individual or group has responsibility. It is very important that users can easily navigate these views; otherwise the systems will face user adoption problems, defeating the power of the distributed information tool.

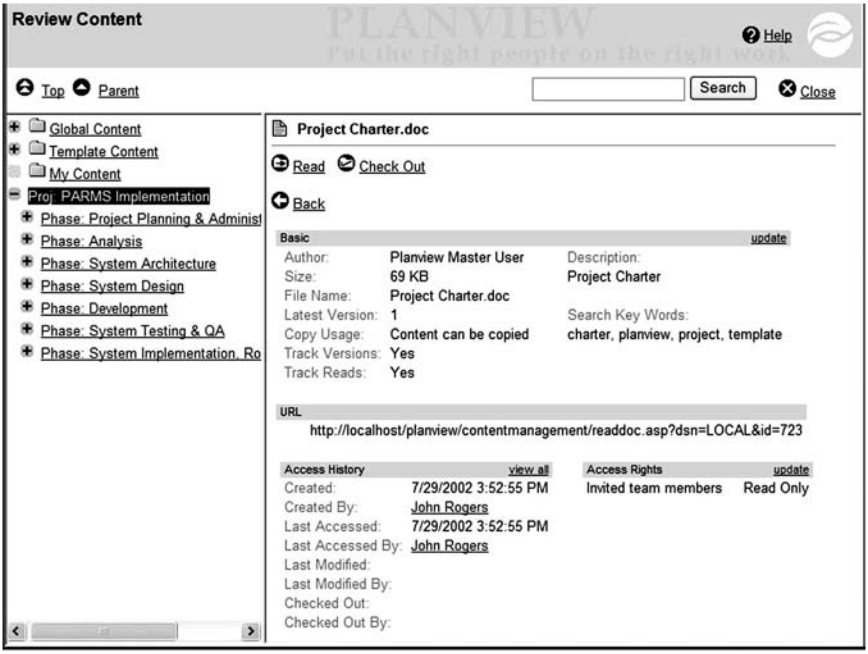

Figure 26–1 Document Repository
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Network Diagrams

Next to the Gantt chart, the network diagram chart is one of the most frequently used features of the project-management system. The network diagram view is a graphical representation of the project where each task or task grouping is represented by a node in the graph. Lines connect the nodes based on dependencies that are assigned to the tasks. The network diagram is useful in presenting a top-level graphical view of the entire project.

Some project managers may prefer to create new projects starting with a network diagram. Some project-management systems allow project creation with the tool and some do not. The network diagram can also be useful for displaying project progress since some systems will color code completed, in-progress, and not-yet-started tasks. The network diagram may also display critical path tasks and project milestones and allow for isolating certain parts of the project. Some systems allow for additional notes or graphics on the network diagram charts or customized node graphics.

Network diagrams can also incorporate probabilistic time estimates for tasks as well a deterministic estimates. Probabilistic estimates make the network diagram much more difficult to display, but various assumptions (range of most likely dates or best estimate) are used to calculate the visual

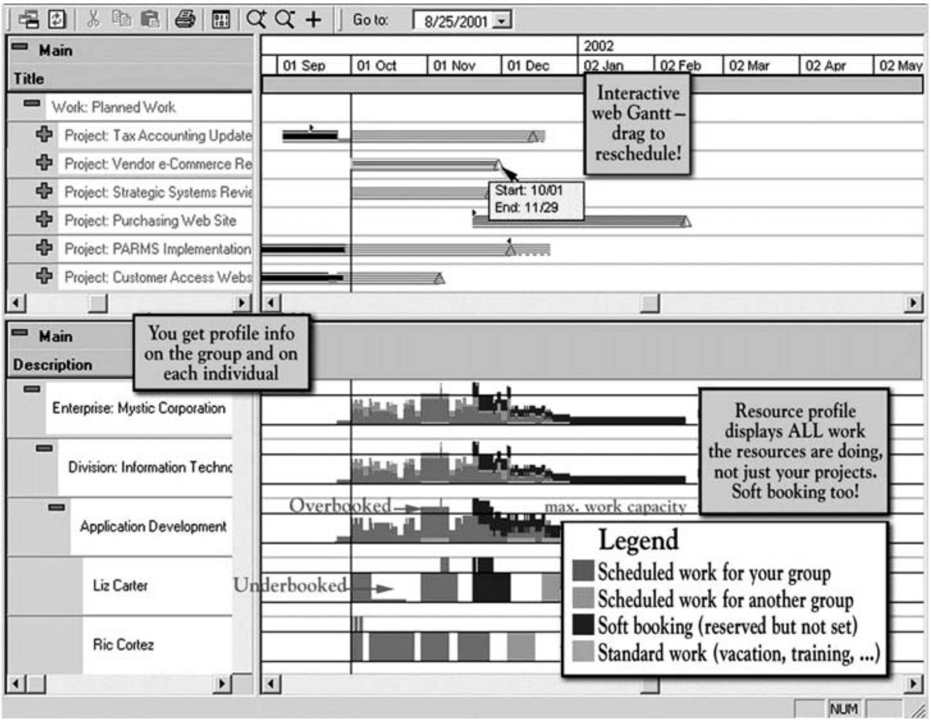

Figure 26–2 Gantt Chart + Resource Histogram = How Organizations Manage to Capacity

diagram. The project manager who prefers to use the network diagram for managing project should carefully review the functionality of this feature for every system reviewed.

File Security

Before implementing any project-management software, the project manager should review or set security policy for the project. Most software systems contain some level of security for the system. If the project-management system will reside only on the project manager's PC, security is not an issue. However, if, as is common, the software resides on a common drive or in a distributed environment, the project manager must consider a policy in regards to whom has access to the system and what parts.

READ-ONLY

The project manager should consider who should have read-only access to the project files. Too often, project managers give read-only access to everyone in the company without considering security issues. For new product development or other critical corporate initiatives, the company may want to be guarded with information and product development schedules. Developing a project on schedule is often the basis for corporate competitive advantage, and the project manager should be very careful about disseminating this information.

READ-WRITE ACCESS

After determining who will have access to the project-management software system, the project manager must decide if anyone else is to be given write access to the system. The advantage to not giving anyone else the access to create, modify, or change information in the system is that the project manager retains total control over what goes into the system. The disadvantage, of course, is that the project manager is responsible for all input of data into the system. For a large project, this can easily overwhelm the project manager. Granting write access to task managers or workpiece managers can make the project manager's job easier. Some software packages allow the manager to give access to only certain areas of the system, and some systems have version-control mechanisms so that the project manager can see who made what changes and at what times.

Careful consideration of which and how many people are given access to the system and to what areas is critical to the success of using any project-management software system. Conversely, project managers should be warned not to fall into the trap of guarding the system too closely and not allowing access to individuals who have a genuine need for the information. The project-management system allows quick and easy access to information about projects and should be used as a tool for improving information among the project team. An example of the setup page for administrative roles for a project is given in Figure 26–3.

Work-Breakdown Structure (WBS)

Virtually every experienced project manager has used a WBS to manage a project. Most project managers could not imagine managing without at some point drawing a WBS. No fancy or complicated software is required to create a WBS—project managers have been creating WBSs with spreadsheets or word-processing software for years. However, when using project-management software systems, the project managers will want to have a mechanism for easily creating the WBS and integrating the WBS with other project-management tools.

The WBS can be displayed in several formats. The most common formats are the outline and the flowchart. Both have their advantages and disadvantages, but if the project manager is set on using one format or the other, it is important that this function be tested in the desired software package since some packages will not support both forms.

Figure 26–3 Role-Based Deployment—Administrator's U/I to Tailor Roles

The WBS should serve as the starting point for the project manager. Every project workpiece should be listed here, and associated information can be displayed as well. The WBS is a hierarchical listing and can be created using a top-down or bottom-up approach. All information for the project should be listed here. Besides being a display of information, the WBS has several additional advantages:

- ***Encourages planning***—listing every workpiece helps organize and encourage thinking about each step in the process.
- ***Reveals dependencies***—listing every workpiece allows the project manager to see any logical problems with the schedule, such as a project resource being scheduled for multiple tasks simultaneously.
- ***Outlines task groupings***—the creation of the WBS often shows that the current thinking about task grouping is not valid. Task groups may be too large or too small or just not fit together. Seeing task groupings in the WBS structure often highlights these problems.

Most software systems use the same general format for input of the WBS. Items to consider when selecting the software package include:

- ***The workpiece or task name***—how large a space do you need and how many layers of project charting are required? Also, how easy is it to move information once entered into the WBS?
- ***Notes or flags***—is there a section to alert users that there is a special note associated with this task or that there are background notes related to this task?
- ***Time***—how is the task time displayed? Does the software allow for early or late start times? Does the system allow for duration times over a range or simply single dates?
- ***Start and finish fields***—does the software allow fixed or floating start and finish dates. Does the system show planned versus actual start and finish dates?
- ***Project milestones***—does the WBS list project milestones in the way you want to display milestones?
- ***Flexibility of the WBS***—is the WBS display flexible? Do you customize the WBS display to show only desired levels of the project hierarchy or desired functional areas? Can you display only items in a range of dates or by responsibility areas? How important are these functions?

The WBS is often the most used function in any project-management system, and it is very important that the project manager be very comfortable with the functionality and ease of use of this function. The WBS is also often the initial starting point for other users, and it is important that the WBS display give the end users information that is relevant to their workpiece.

An example of a linear responsibility chart in a project-management system is shown in Figure 26–4. These charts can take many forms, and this is just one example.

Scheduling Engine

The scheduling engine is the most important feature of any project-management software system. The WBS, Gantt charts, histograms, and project notes can all be created with a spreadsheet or database package. It is the scheduling engine that makes a project-management system unique and powers this tool.

Users of any project-management system should be able to modify the internal calendar to reflect the actual working schedule for your project. The project manager may want to note company holidays, international holidays, and other noteworthy events on the internal schedule. Understanding how this is done, if possible, may be an important decision factor in software selection.

Other items to consider before selecting the software include:

- How are project workpiece dependencies created in the scheduling engine and can these dependencies be overridden?

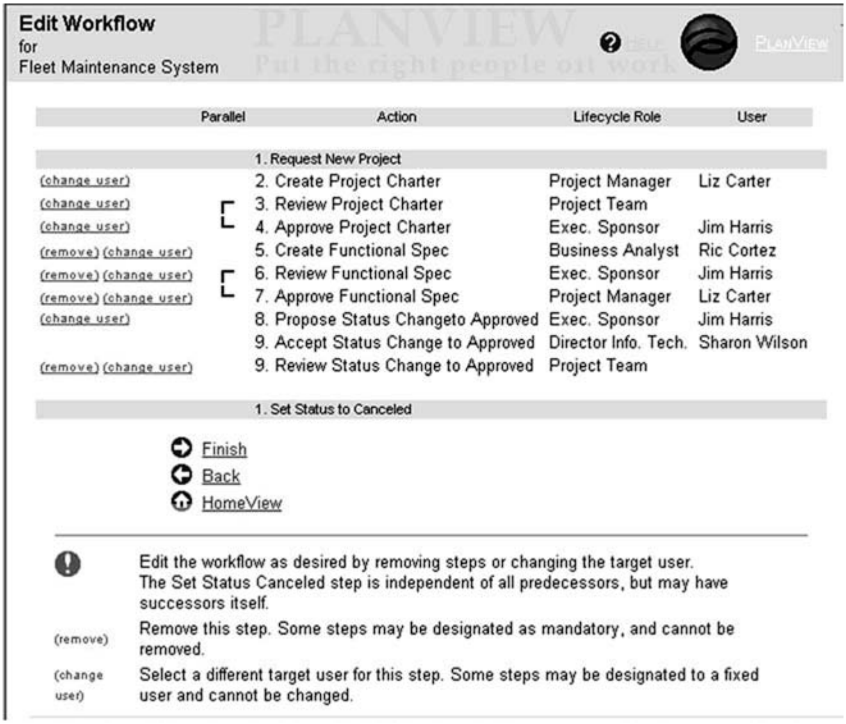

Figure 26–4 Assigning Life-Cycle Steps
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- Can tasks be split on the schedule after being created?
- How are deadline dates created and can these deadlines be moved?
- Will the scheduling engine automatically point out conflicts in information you provide (resource-scheduling problems, end dates before start dates, etc.)?

Performance issues also enter the scheduling engine. Since the scheduling engine creates and updates schedules, you will want to consider:

- The speed of schedule calculations
- If schedule calculations are done automatically or when prompted
- Whether schedules are updated automatically after resource leveling is performed

Customizing and Downloading Reports

Almost every commercial project-management software package will come with a variety of prepackaged standard reports. Many of these will serve as a great starting report for viewing information about your projects. However since each organization is unique, these one-size-fits-all reports typically do no fulfill every requirement for the project manager. The ease of adapting these reports for custom requirements should be considered when reviewing software systems.

Project managers may want to download reports from the project-management system to a spreadsheet or word-processing package for inclusion in reports. Will the software allow easy downloading of reports in multiple formats? In many software packages, these functions are seamless, while in other systems it may require a good deal of work to get information in the desired format.

A project manager will often want to add text notes or a graphic to a chart or report generated from the project-management system. How these items are accomplished should be considered. Do you have to download to a secondary system to add graphics? If so, this may add considerable time to tasks if the report is updated frequently. The process of adding information to reports should be carefully reviewed.

Integration with Enterprise Resource Program (ERP)

Almost every large corporation today has an enterprise resource program (ERP). These systems seek to integrate accounting, purchasing, budgeting, human resources, and manufacturing into one system. Although most major ERP systems do not have project-replace modules, it is not inconceivable that they will integrate this function in the near future.

For those project managers who operate in a company with an ERP system, the ease of downloading and uploading information to and from the project-management system can be a critical decision point in selecting a project-management system. The project manager may want to transfer resource billing rates, time information, overhead rates, and other financial information to or from the project-management system and ERP system. The need, frequency, and ease of such transfers may be an important consideration for the selection of a project-management software system.

Automated E-mail Function

Several project-management systems have integrated e-mail notification systems. These systems may rely on the project manager manfully entering the e-mail for project teams or can be integrated with the corporate e-mail systems. Compatibility with current e-mail systems should be reviewed, as well as how e-mail groups are organized. Incoming e-mail capabilities should also be considered.

Cost-Tracking Mechanisms

Project cost management is often left out of project-management systems or is simply a function not used by the project manager. However, some project managers would not even consider purchasing a project-management system that does not support robust cost-tracking and management tools.

TYPES OF COSTS

Project costs can be broadly grouped into three categories: resource costs, fixed costs, and total costs. Resource costs are associated with using a resource, personnel or equipment, per unit of time. The costs may be input directly into the project-management system or downloaded from another source. The calculation for costs is almost always time-dependent and must be entered as a per-hour or per-day rate. Some systems may allow for overtime rates for labor. Few project-management systems allow for cost to be entered except as per unit of time, and some systems will not allow for tracking of time in less that hourly or daily increments.

Material or equipment costs can also be added to the project and can be accounted for with multiple options. Usually, a per unit cost is associated with material and a time-related rate is required for equipment use. Some construction project systems already feature built-in costing and no modifications are needed. The project manager should have good idea of the type of resource costs and the cost drivers to be used before implementing the software.

Fixed or overhead cost allow for costs to be assigned to a project that are not related to a specific resource. For example, one-time legal, engineering, or architectural fees could be added to a project cost. Most systems will allow this type of one-time costs. More sophisticated project-management systems may allow for percentage overheads to be applied to the project based on the actual expenditure. For example, an architectural firm may want to place a 25 percent overhead on every project and the project-management system will incorporate this into actual and budget costs.

Table 26–4 A Warning about Cost-Tracking

Many project managers use cost-tracking tools for projects and predict that the project is within budget until the last 10 percent of the project comes in over budget. The cost tracking tools in PM software are only as good as the information fed into the system. If time estimates are not updated, fixed costs may not have been included, or resource costs may not be accurate, the projected project cost will not be accurate. Just as in tracking the project schedule, the project costs depend on a fundamental understanding of the issues and project activities on the part of the project manager.

Total cost for the project is the simple summation of resource costs and any fixed plus overhead costs. The total costs can be calculated a number of ways. The baseline or original cost is calculated when the project is first entered into the system. Actual costs are calculated based on actual times for each resource as entered into the system. Cost-tracking mechanisms can also be used to project total cost estimates during the course of the project. Accrued costs may be prorated depending on the percentage complete for each task, only considering costs when a task has been completed for if a task is started.

Summary cost reports can be generated in a number of ways. Creating and saving a baseline budget can be important for future cost comparisons. The baseline budget should be frozen after final approval for the project but before the actual project work begins. As the project progresses, technical specifications may change (project creep) and the project baseline budget may no longer be relevant. A new baseline budget(s) will be developed and saved in the system. Some software systems allow for the storage of multiple baseline budgets. For the project manager who often sees project creep and the process of multiple budget iterations, having the ability to record the

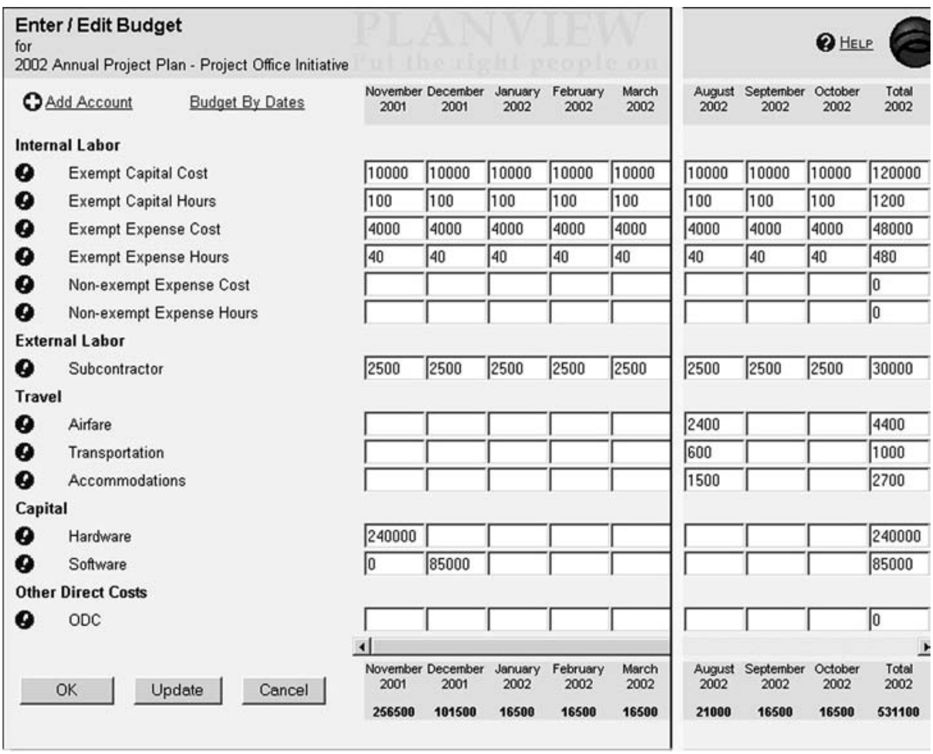

Figure 26–5 Project Budgets/Accounting to Track Costs and Benefits

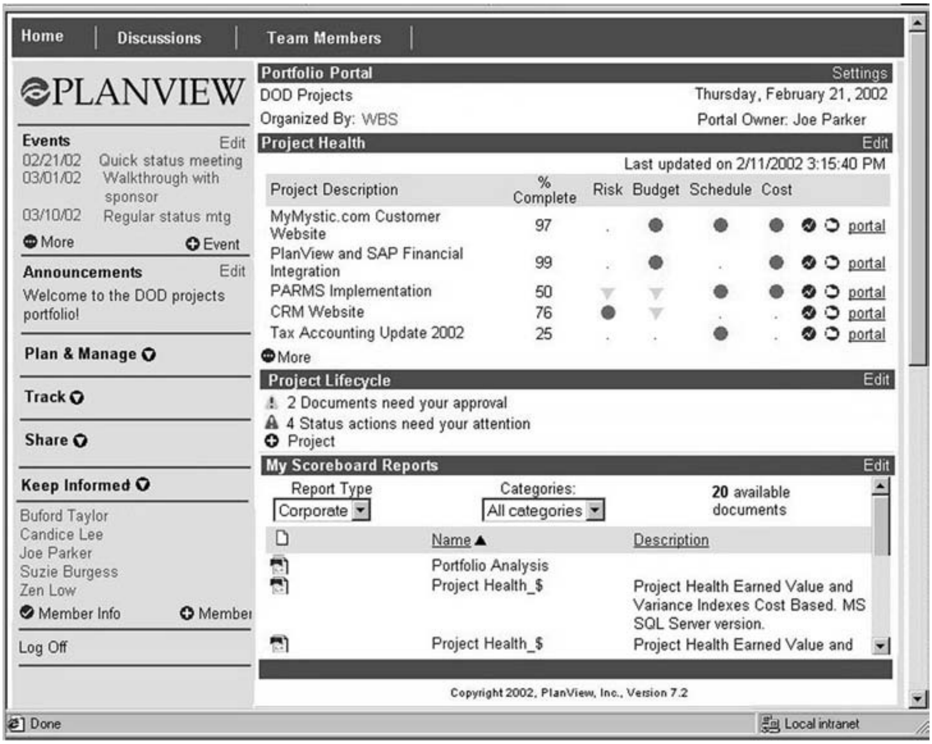

Figure 26–6 Collaborative Web Portal for a Portfolio

history of project budget development can often provide valuable information about how projects are managed (and estimated) within the organization.

Summary cost reports are developed in a number of different ways by project-management software. The most common methods rely on a reporting of the actual start, percentage complete, and remaining work information. This information can be entered into the system by the project manager or by individual workers. How reporting procedures are established should depend on the project manager(s).

Some project-management systems that are integrated with ERP systems or timecard systems will automatically calculate actual project costs based on time worked. These systems are dependent on the accuracy of the workers reporting time and the coding system to track projects and tasks. These systems are usually appropriate for large organizations or organizations where the majority of the work is project-based and billings are based on tracking project costs. The accuracy of these tracking mechanisms is more dependent on the input of data rather than the systems itself (see Table 26–4 on cost tracking).

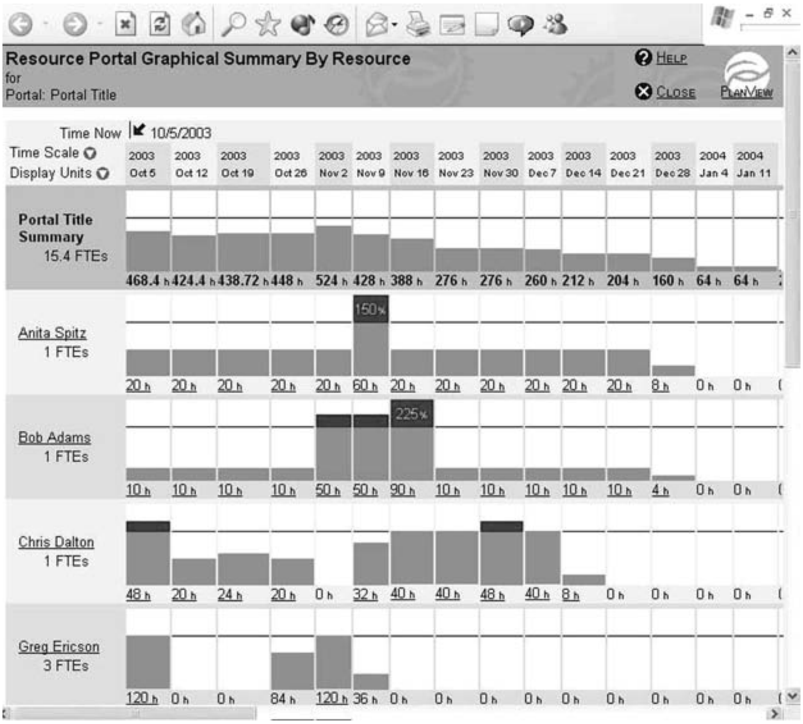

Figure 26–7 Resource Profiles Show Over/Underutilization (thin web U/I)

Cost Reports

Project-management software packages will invariably have some standard cost-tracking reports built into the system. Simple charts showing actual cost versus planned costs as a function of time are the most common and simple graphical cost-control mechanisms. These reports are often misleading since they are often not updated to show projected completion rates. Some systems will only allow comparisons for completed workpieces and will then generate variance reports. Some systems will calculate earned-value reports for companies that rely on progress payments. Other common reports include:

- Schedule variances
- Earned-value variance
- Cost variance—by resource, department, workpiece, etc.
- Cost performance index—ratio of earned value to actual cost
- To complete performance index (TCPI)—ratio of work remaining to the budgeted remaining

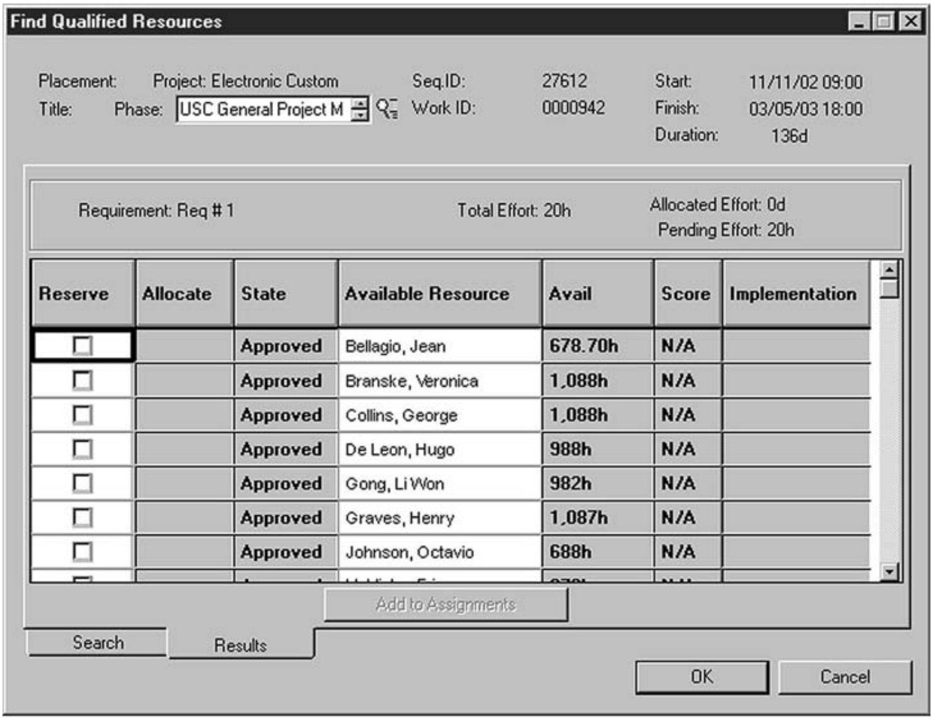

Figure 26–8 Skills Search of Resource Database—Ranked Results
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- Variance at completion—projected actual and percentage variances at completion

The list of possible cost comparisons could be expended well beyond the list presented here. What is important for the project manager is to know what information is important to the organization and what tools will help the project manager to manage his or her project. Additionally, the ability to mine the project-management database for information and export this information, as necessary, should be considered. Determining if certain resources are constantly over reporting project budgets or underreporting percentage work completed while a project is in progress and often be determined by careful examination of the history of a few projects. The ease of extracting this information should be reviewed. Also, much of the reporting for project managers is done in spreadsheet or graphics programs, and therefore the ease of exporting data should be considered.

Many project-management software systems come with templates built into the software for creating project budgets. An example of these templates is included in Figure 26–5.

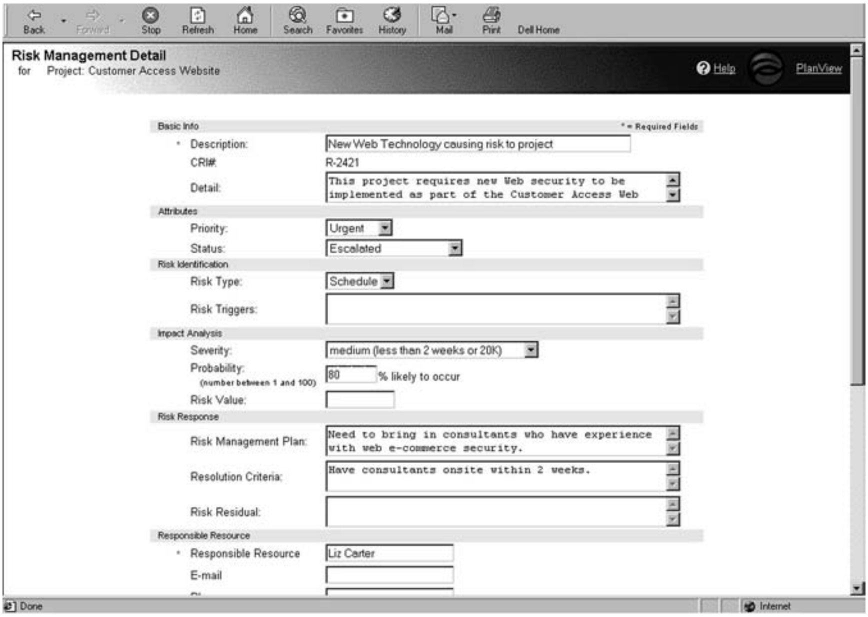

Figure 26–9 Tracking Risks, Issues, Changes

Portfolio Management

There are several project-management software offerings that allow project managers to manage an entire portfolio of projects. Managing multiple projects can be exponentially more difficult than managing a single project. Organizations that are truly project-driven organizations often rely on complex software systems to juggle resources among multiple projects. Smaller organizations or project managers with a few projects in his or her portfolio can also benefit from project portfolio management. Executive management also may benefit by having information about all critical projects in a single

Table 26–5 A Warning: Software will Not Manage Your Project

With so many features now common in project-management software and tools for integrating communications with the project-management software, many managers fall into the trap of believing that the software will run the project for them. It is very important for every project manager to remember that the software is just one tool in the project-management toolkit. It will help you get your job done, but it will not run your project. In order for any project manager to implement project-management software successfully, the basic framework for effective project management must exist outside of the software-selection and implementation process.

Table 26–6 Resource

The Project Management Institute (PMI) can be found at www.pmi.org. The PMI publishes a monthly magazine called *PM Network*. The on-line site provides discussion forums and contains a wealth of information on the field of project management and is a good source for issues relating to project-management software. Group discussion forums are often a good place to find others who may have experience with the software you are using or considering. The magazine will often feature articles describing the latest releases in project-management software.

accessible location for quick and easy overview. An example of the summary information available from a project portfolio is shown in Figure 26–6. Typically, this portal will lead to more information about each project in the portfolio.

Resource Tracking and Scheduling

When multiple projects are being managed in a single company, managing and scheduling the company resources can become a very important task. Knowing when resources are available can speed project completion and help avoid project delays. Resource management can help the project manager see potential problems before they occur and alternative resources that may be available or the skill sets of available resources.

Examples of resource-availability charts and resource-management tools are shown in Figures 26–7 and 26–8.

Risk Management

Many project-management software systems now come with risk-management features built into the systems. The degree of complexity of these risk-evaluation systems varies greatly from the most basic user input assumption flags to full Monte Carlo simulation. Most systems will allow the user to see the effects to the schedule if a workpiece is delayed and to display the likelihood of this delay occurring. If the project manager uses risk analysis in managing projects, current software systems make this task faster and easier than ever. An example of the basic information required for risk analysis is shown in Figure 26–9.

Summary

The field of project-management software has changed dramatically over the past few years with the dramatic proliferation of personal computers in the workplace. Simple software tools can now perform project-management tasks. Increasingly complex software systems are also being offered to the project manager. No matter what tool the project manager is using complex software systems, basic off-the-shelf software systems, or word-processing software; the project-management tools remain the same. The project manager must remember that the software tool selected to help manage projects is a tool and, ultimately, good solid fundamentals of project management must be used to run a project.

ENDNOTES

1 Liberatore, M. J. and Pollack-Johnson, B. Factors influencing the usage and selection of project management software. *IEEE Transactions on Engineering Management* 50(2):164–172, 2003

2 Fox, T. Do the features support the functions? *PM Network* No. 3, 69–73, 2000

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Chapter

27

Effective Project-Management Information Systems

Frank T. Anbari

Biographical Sketch . . .

Frank T. Anbari (Ph.D. Project Management and Quality Enhancement, M.B.A., MS Engineering, PMP, P.E., and ASQ Certified Six Sigma Black Belt) is a faculty member of the Project Management Program at the George Washington University. He gained extensive industrial experience serving in project-leadership positions at the National Railroad Passenger Corporation (Amtrak), Day and Zimmermann, and American Water Works Service Company. He taught in the graduate Programs at Drexel University, Penn State University, and the University of Texas at Dallas, and for public sector and private industry organizations. He served as examiner (1993–1995) and alumni examiner (1999–2000) for the Malcolm Baldrige National Quality Award, as member of the Editorial Review Board of *Project Management Journal* (2000–present), and as member of the Panel of Referees of the *International Journal of Project Management* (2003–present).

Summary

Effective project management depends greatly on carefully designed project-management information systems (PMIS) and appropriate project reporting. These systems allow effective planning, updating, and change control of various project parameters. In this chapter, main issues in successful project reporting and analysis are discussed, including reporting on scope, time, cost, and quality, as well as resource utilization and risk management. Traditional and emerging tools in PMIS are described, including electronic dissemination of project information. Essential elements of progress reporting, performance measurement, and forecasting, including the use of the earned-value method, are addressed.

Introduction

In project management we may get what we control, and we may control what is reported. Items that are not reported go uncontrolled. Left alone, project elements or projects do not fix themselves up. They only go over budget, fall behind schedule, do not fulfill scope and quality requirements, and generally result in customer dissatisfaction. In extreme cases, such projects can result in irreparable damage to the entire enterprise.

Successful project control depends greatly on carefully designed and properly implemented project management information systems, appropriate project reporting, effective project reviews, and meaningful communications. These systems represent one of the primary vehicles for project-management delivery and provide the means of building relationships and trust that lead to productivity and effectiveness.[1] Good information management gives project management the greatest chance of success.[2]

Planning the PMIS

It is important to plan the overall PMIS as completely and as early in the project as possible. An effective PMIS allows the collection, storage, and reporting of information needed for planning, organizing, directing, and controlling the project, and supports the information needs of various stakeholders of the project. A PMIS is essential to monitor project status, evaluate progress, and control the use of resources on the project. The PMIS should be developed as part of the project plan and infrastructure.[3] In some settings, the PMIS must be established at the project level and with the project's stakeholders before the project can be planned. For example, some U.S. government agencies specify project reporting content, format, and frequency in their requests for proposals (RFP), well before the contractor starts project planning.[4]

The overall objective of a PMIS is to provide the basis for planning, monitoring, and integrating project parameters with the strategic direction of the organization. It should help in identifying potential project problems before they occur so that they can be avoided or their impact minimized.[5] The main function of a PMIS is to transform project data to relevant information that enhance decision-making, resulting in improved project performance, as shown below:

Data → Information → Enhanced decisions → Improved performance

PMIS planning involves determining the information requirements of project stakeholders: who needs what information, when will they need it, how will it be provided to them, and by whom.[6] A careful analysis of project stakeholders' information needs should be conducted to ensure that the PMIS will be capable of supporting these needs. It is also important to review the overall design and expected information output with key stakeholders to ensure that the system will support their decision-making needs. Commonly, some of these needs may change and new requirements and technologies may emerge during the life of the project, particularly in long-term projects. Therefore, it is important to design flexibility into the PMIS and to review it periodically with key stakeholders to ensure its continued effectiveness.

The results of PMIS planning efforts can be summarized as shown in Table 27–1.

Designing the Information-Distribution Systems

Once the questions in the PMIS plan have been answered at a reasonable level of detail, the design of the information-distribution system and the media to be used should be addressed.

Information can be distributed in printed project reports. This has been the traditional approach in many organizations. These reports can be generated at various levels of detail and can include tables, charts, and graphical representations of project information and analyses. They can be used to depict project plans and performance, highlight critical issues, support decision-making, meet contractual reporting and archival requirements, and enhance the effectiveness of project-review meetings. Distribution lists for these reports can grow and become obsolete. Therefore, it is important to review and update such lists regularly. Printed reports are giving way to electronic dissemination of project information in many organizations.

Project reports can be distributed as attachments to e-mail. Some stakeholders may elect to print these reports. Others may elect to save the reports electronically or to discard them. It may be worthwhile to specify whether participants in project-review meetings should bring report copies with them to the meeting. It may be a good idea to have a few copies available at such meetings for participants who do not have the current project report.

Relational database technology and knowledge-based project methodology offer the advantages of consistent, friendly data structures, openness, and connectivity. To apply these technologies, project data must be planned as an integral part of the enterprise data model, where the project database is viewed as a consistent set of tables throughout the enterprise. The open architecture of the relational database supports multiproject resource management and forecasting and allows interfaces with other enterprise systems such as the accounting and human resource systems.[7]

Project information can be made available at an intranet site designed for an individual project or for multiple projects. Information can be retrieved and viewed in several ways to enhance understanding and decision-making. This approach has been growing rapidly in recent years and shows great promise for efficient delivery of project information. Data security, format stability, and data backup issues need to be addressed carefully in such settings. Intranet reporting of resource utilization can help organizations

Table 27–1 PMIS Plan

Who Needs the Information?	What Is Needed?	How Often/When?	What Format?	What Media?	Who Will Deliver It?
Stakeholder analysis	Requirements analysis	Weekly, monthly, first day of week, month. . . ?	Summary, detail, tabular, graphical. . . ?	Printed, presentation, e-mail, intranet . . . ?	Project manager, specialists . . .?

develop capacity-planning models to determine how much additional work the organization can handle. Intranet reporting of project information can be particularly valuable to multinational organizations.[8]

New and emerging technologies can be effectively used to support project communications. These technologies include Internet-based discussion boards, where the team can exchange thoughts on project issues by typing messages online at any time. These messages and responses are organized in discussion threads and can be viewed by various authorized participants, who can then add their messages as needed. Real-time Internet conferencing (or chat rooms) is an on-line meeting where participants can exchange thoughts on project issues by typing messages and viewing responses on their computers' split screens. The session can be archived for future review by project team members and other authorized users. The archived file can be used as the meeting minutes. Virtual reality systems provide simulations of real-world activities. Computer-aided design and drafting (CADD) systems are widely used to simulate engineering models and test the results. Similarly, project teams can use virtual reality systems to view plans in three-dimensional space and eliminate possible errors that may be caused by two-dimensional plans.[9] Technology serves as an important enabler of collaboration of virtual project teams. However, the use of specific technologies may become a source of conflict in the team. Therefore, project teams should establish agreement on the purpose and procedure for using each tool.[10]

Formal and informal project review meetings, face-to-face briefings, teleconferences, and video conferences are important components of a PMIS. Such meetings allow stakeholders to probe into the root causes and real meaning behind the reported information, consider alternatives, build trust, and reach buy-in or consensus on courses of action. It is helpful to agree on operating procedures for these meetings, such as having an agenda, staying on track, listening, handling action items, making decisions, publishing minutes, and finishing on time. A good PMIS can increase the efficiency and effectiveness of these meetings and can greatly reduce the number of informational project meetings, improving participants' productivity.[11]

A combination of the above approaches for information distribution can result in a powerful PMIS that helps the project manager and project team guide the project to a successful conclusion. As an example in a contractual setting, the owner may trust the information obtained during face-to-face meetings more than the printed reports, although these reports are required by contract. "Quick verbal updates were especially appreciated by clients as a method for re-assurance of their correct understanding of formal written reports provided to them."[12]

As an example of PMIS practice, the departments of transportation (DOTs) in 35 states in the United States and one Canadian province responded to a survey on their PMIS.[13] Respondents indicated using an array of automated systems and software: 68 percent of the respondents use mainframe project-management systems, 43 percent use LAN/WAN systems, and 25 percent use both mainframe and LAN/WAN or stand-alone desktop computer systems. Sixty-three percent of the respondents planned to change their project-management systems within three years, and another 11 percent expected to change their systems within three to five years. Two-thirds of the states have adopted an approach that gives more complete authority to project managers, which may require a PMIS with broader analytical and reporting capabilities than their current systems.

Reporting Project Performance

Reporting requirements may vary among projects based on project duration, size, complexity, risk, visibility, and other factors. Most projects require reports on some or all of the following: scope, time, cost, quality, resource utilization, procurement, and risk.

Progress Reporting

Information on the achievement of project scope is probably the most important component of project reporting. Progress reports, accomplishment reports, or production reports describe and usually quantify the physical accomplishments of the project. Such reports can indicate the number of units completed, percent complete, milestones achieved, or deliverables submitted as of a specific status date. The information is often provided for the current period (week or month, for example) and on a cumulative basis (inception to date). The information is provided at an appropriate level of the work-breakdown structure (WBS) and rolled up to the appropriate summary level(s). Approved scope changes should be reflected in progress reports with an indication of the approval. Reporting on scope stability highlights changes in project requirements or processes. Scope stability tracking can be enhanced to provide analyses of anticipated impact of changes on other project areas such as cost, effort, and quality.[14] Information that may be included in a basic progress report is depicted in Table 27–2.

Reporting on Schedule Performance

Reports on project time can be prepared in a tabular format, a graphical format, or a combination of the two formats. These status reports can compare actual accomplishments to planned accomplishments or actual percent complete to planned percent complete. The information can be provided for the current period and on a cumulative basis at an appropriate level of

Table 27–2 Basic Progress Report

WBS Number	Description	Unit of Measure	Total Scope	Month Actual	Cumulative Actual	Percent Complete

the WBS and rolled up to the appropriate summary level(s). Reports can show production rate per time period, where appropriate. Graphical reports include Gantt charts, milestone charts, and network diagrams and can be generated using widely available software packages such as Microsoft Project and Primavera. Figure 27–1 shows a Gantt chart with milestones, summary tasks, and percent complete.

Project progress should be compared to the approved schedule baseline. Such comparisons provide enhanced understanding of variances and strengthen schedule control. They should be used wisely, since they can result in possible conflicts and finger-pointing. Figure 27–2 shows progress tracking using a Gantt chart with milestones and percent complete. The baseline is shown on the lower task bars. The percent complete is rolled up to the summary tasks and shown as the lower bar on these tasks.

Reporting on Resource Requirements and Utilization

Reports on project resources can be prepared in a tabular format, a graphical format, or a combination of the two formats. Reports on resource requirements can specify the type of skill required or the amount of time needed from specific individuals during various time periods. Figure 27–3 shows a resource histogram indicating the resource requirements by month and resource availability during the project for the resource ''Designer.'' This histogram example indicates that four Designers are available throughout the duration of the project. When resource requirements are below resource availability, a resource surplus is observed. When resource requirements are above resource availability, a resource overallocation (i.e., resource shortage) is observed.

Reports can be generated to compare actual resource utilization to planned resource requirements and resource availability, and can compare actual productivity to planned productivity. Collecting this information requires effort and time. Depending on the project and organizational structure, such effort may or may not be justified. Information on resource requirements, utilization, and availability across various projects and operations in the organization, division, or department is very useful for multiproject management and project portfolio planning. Collecting and re-

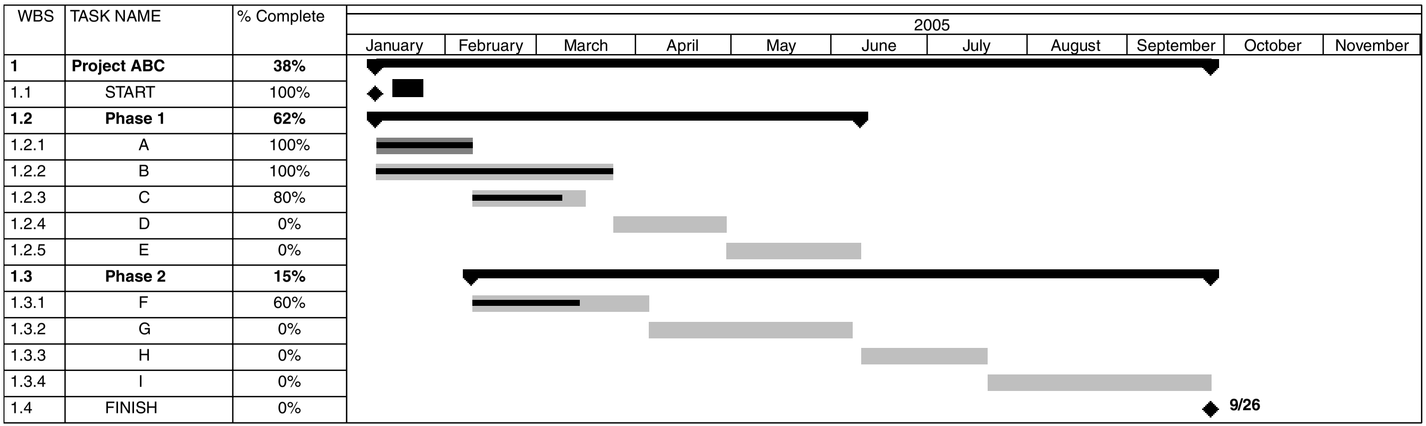

Figure 27–1 Gantt Chart

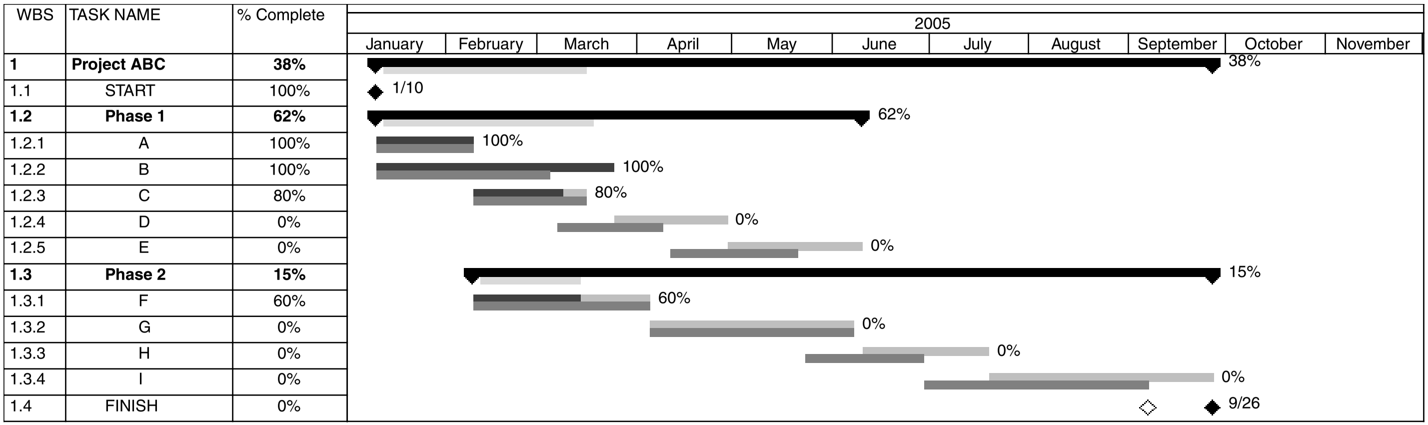

Figure 27–2 Tracking Gantt Chart

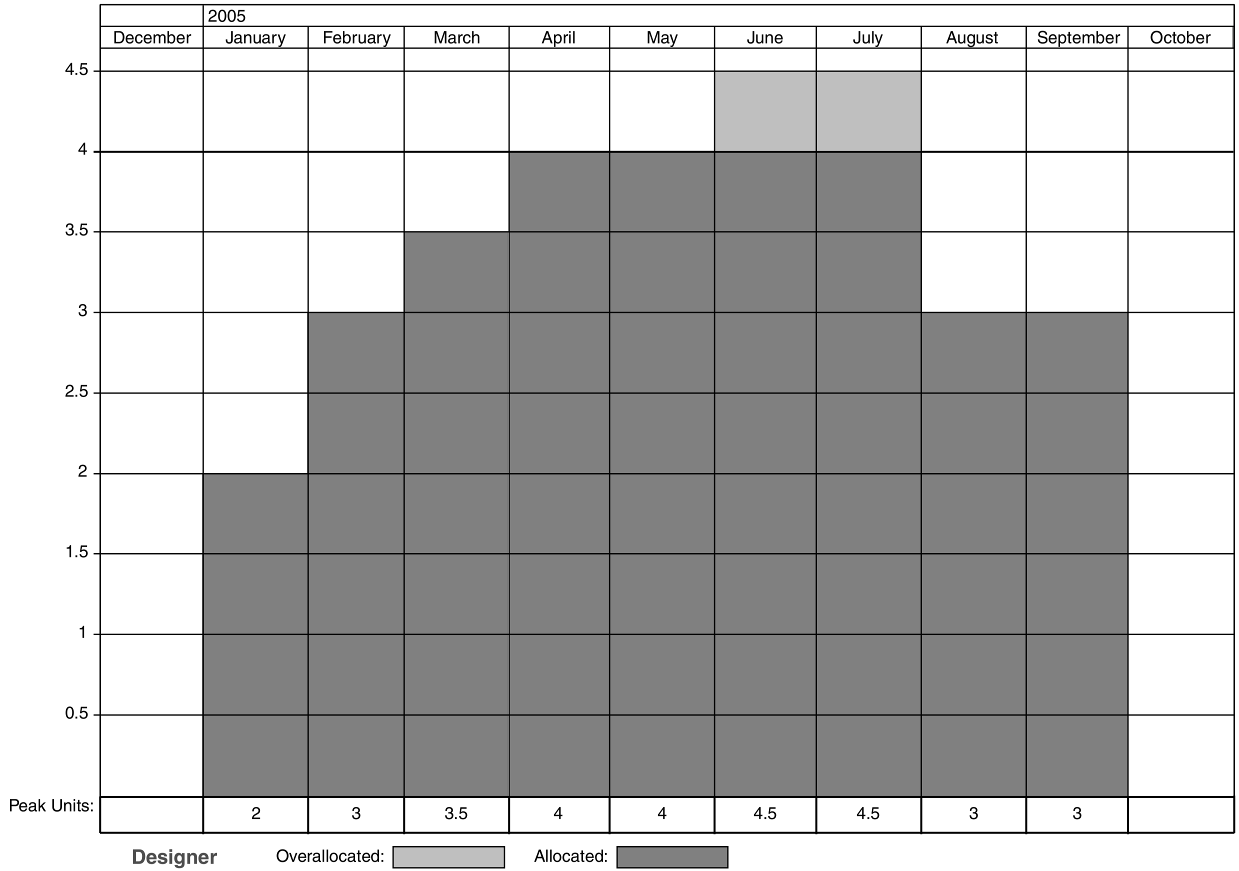

Figure 27–3 Resource Histogram

porting this information requires yet more effort and time and a system that allows meaningful integration of this information. Availability and capabilities of software packages for collecting and reporting project workers' time across the enterprise are growing rapidly.

INTEGRATED COST AND SCHEDULE PERFORMANCE REPORTING

Cost should be compared to the approved cost baseline and physical scope accomplishments. Cost reports can cover labor, material, equipment, procurement, and other cost. They can show cost per unit, where appropriate. The earned-value method (EVM) is a powerful tool that allows the comparison of actual cost, accomplishments, and project baseline. It supports forecasting of project cost and schedule at completion and highlights the possible need for corrective or preventive action. EVM uses the following project parameters to evaluate project performance (Figure 27–4):

- Planned value (PV) is the time-phased approved budget baseline, often referred to as the S-curve. It was previously called the budgeted cost of work scheduled (BCWS).
- Budget at completion (BAC) is the total budget baseline and the last point on the cumulative PV curve.
- Actual cost (AC) is the cumulative actual cost up to the status date. It was previously called the actual cost of work performed (ACWP).
- Earned value (EV) is the cumulative earned value of the work completed and represents the amount budgeted for performing the work accomplished by the status date. It was previously called the budgeted cost of work performed (BCWP). To obtain EV for an item, its total

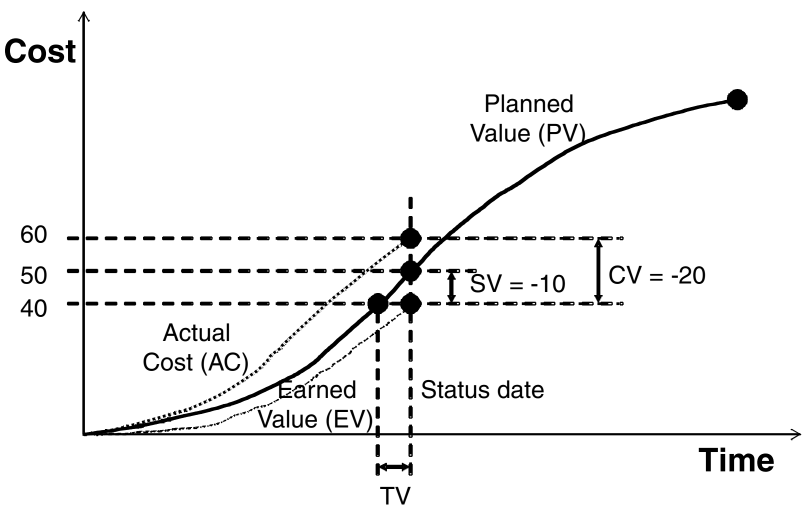

Figure 27–4 The Earned-Value Method

budget is multiplied by its proportion complete. EV translates project accomplishments from physical units of measure, such as cubic yards of concrete, linear feet of cable, percent complete, and deliverables submitted, to financial units of measure, which can be expressed in dollars (or any other currency), labor hours, worker days, or similar measures of value and cost.

Figure 27–4 illustrates a project with a total budget of \$100. As of status date, the planned value is PV = \$50, the actual cost is AC = \$60, and the earned value is EV = \$40.

Cost performance is determined by comparing EV to AC. Schedule performance is determined by comparing EV to PV. This can be accomplished by calculating the variances and the performance indices at the desired levels of the WBS. The following formulas are used to calculate the variances:

Cost variance (CV): $CV = EV - AC$. For the above project: $CV = 40 - 60 = -20$.

Schedule variance (SV): $SV = EV - PV$. For the above project: $SV = 40 - 50 = -10$.

The average PV per time period can be called the planned value rate, or the PV Rate. It is defined as the baseline budget at completion (BAC) over the baseline schedule at completion (SAC): PV rate = BAC/SAC. SV can be converted into time units by dividing SV over the PV rate. The result is the SV in time units or the time variance (TV): TV = SV/PV rate. If the above project were scheduled for 40 days, then: PV rate = 100/40 = \$2.5 per day, and $TV = -10/2.5 = -4$ days. The measurement of TV can be performed and reported graphically by drawing a horizontal line from the intersection of the EV curve with the status date to the PV curve, and reading the distance on the horizontal time axis.[15]

In the above formulas, 0 indicates on-target performance. A positive value indicates good performance. A negative value indicates poor performance.

The following formulas are used to calculate the performance indices:

Cost performance Index (CPI): $CPI = EV/AC$. For the above project: $CPI = 40/60 = 0.67$. CPI can be simplified as follows: CPI = % complete/% spent. For the above project:

$$\begin{aligned} \text{\% complete} &= 40/100 = 0.40 = 40\% \\ \text{\% spent} &= 60/100 = 0.60 = 60\% \\ \text{CPI} &= \text{\% complete}/\text{\% spent} = 40/60 = 0.67 \end{aligned}$$

This simplified formula provides a more intuitive understanding of CPI based on information readily available in many organizations.[16]

Schedule performance index (SPI): $SPI = EV/PV$. For the above project: $SPI = 40/50 = 0.80$.

The critical ratio can be used as an indicator of the overall performance of the project: CR = CPI × SPI. For the above project: CR = 0.67 × 0.80 = 0.53.

In the above formulas, 1 indicates on-target performance. More than 1 indicates good performance. Less than 1 indicates poor performance.

It is important to synchronize the status date for data in the analysis by using the concept of accrued cost, which includes expenditures made but not yet reflected in the financial system.

Graphs of performance indices and the critical ratio over time provide valuable indicators of trends in project performance and the impact of any corrective actions, as shown in Figure 27–5.

EVM can be used to calulate the estimate at completion (EAC) based on actual performance: EAC = BAC/CPI. For the above project: EAC = 100/0.67 = 150.

A graph of EAC can provides a valuable indicator of trends in project cost performance and the impact of any corrective actions, as shown in Figure 27–6.

Reporting on Quality Performance

Quality is an important factor that can greatly affect the success of project-management processes as well as project deliverables. Examples of processes that can benefit from quality enhancement include scope definition, scheduling, estimating, and change control. Examples of deliverables within which quality needs to be considered carefully include software, facilities, and studies. Failure to achieve required quality and technical performance levels in project deliverables results in rework, scrap, repairs, discovery, and fixes of defects. All of these non-value-added efforts affect project cost and

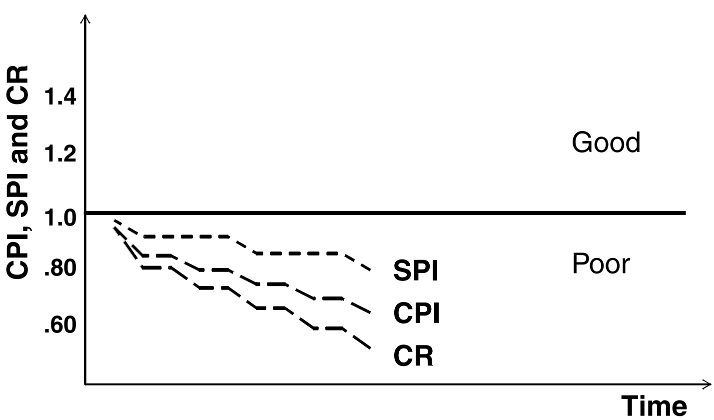

Figure 27–5 Graph of CPI, SPI and CR

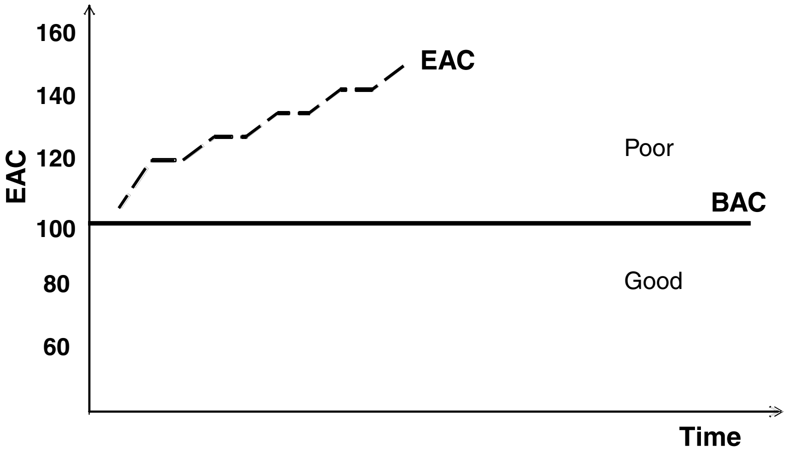

Figure 27–6 Graph of EAC

schedule and can impact customer satisfaction and project success significantly.

It is important, as part of the overall PMIS, to identify factors that are critical to project quality and provide information on them regularly. Such information can include results of project design reviews and walkthroughs, software testing, facility inspection, customer acceptance, and comparisons to historical averages, benchmarks, and targets.

Tools for planning, enhancing, and controlling quality have been used widely and effectively to monitor and adjust systems in various operations. These tools include Pareto analysis, cause-and-effect diagram for root cause analysis, and the control chart, as well as tools associated with the Six Sigma method, such as quality function deployment, failure mode and effect analysis, designed experiments, and regression analysis.[17] However, use and applications of these tools remain limited in project management.

As an example, Figure 27–7 shows a control chart, which provides a view of the process characteristic of interest over time and allows differentiation between common-cause variation and special-cause variation. Observations, or sample means, are plotted on the chart. The centerline (CL) of the chart is the mean of the data, the upper control limit (UCL) is placed three standard deviations (3σ) above the mean, and the lower control limit (LCL) is placed three standard deviations (3σ) below the mean. These values are calculated from observations on the process itself, and the quality control chart represents the voice of the process. When the process is in statistical control, the process is said to be stable, predictable, or in control, and approximately 99.7 percent of the plotted points will be within the control limits, assuming the data are normally distributed. The remaining 0.3 percent (or 0.003, or 3 per thousand) of the plotted points will be outside the control limits: 0.15 percent above the UCL and 0.15 percent below the LCL.

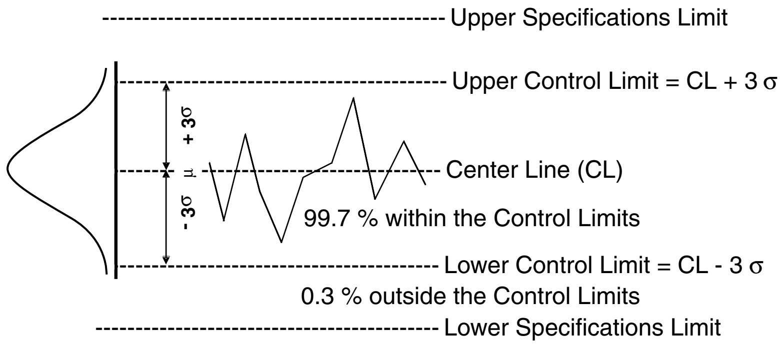

Figure 27–7 Control Chart and Specifications Limits

Customer requirements may be stated in terms of a target value, an upper specifications limit, and a lower specifications limit. Integrating the voice of the process with voice of the customer, we obtain a clear indication of whether the process is capable of meeting specifications and customer requirements. The process represented in Figure 27–7 would be considered capable of meeting the specified requirements.

Reporting on Project Procurement

In many projects, the performing organization acquires goods and services from outside entities. The PMIS should be capable of supporting the management of these contracts to ensure that vendors and contractors are performing their obligations to complete contract scope according to the agreed upon schedule, price, and quality. It also needs to allow the project manager and project team to keep track of contractors' accomplishments, invoices, progress payments, change requests, approved changes, and contract closeout.

An effective PMIS can provide valuable support to the project-management team throughout the requirements, requisition, solicitation, award, and contract administration cycles.[18] Youker and Ng note that ''procurement activities are better planned and managed using a Data Base Management System rather than a critical path plan and schedule since the activities are completely lineal.''[19]

Reporting on Project Risk Management

Projects are risky endeavors that generate new and unique products and services. Therefore, it would be helpful for the project manager and team to understand project risk and manage it appropriately. Our understanding of the effectiveness of project risk-management tools is growing with use and application.

Studies of current project risk-management practices show value and potential applications of risk management. Kwak found that: ''Although risk management is a daunting task, organizations that implement effective processes proved to be successful, while those that fail in this effort will be unsuccessful.''[20] Hobbs found that risk-management documents, ranking of risks, and database of risks had high unused potential, whereas Monte Carlo analysis, PERT analysis, and decision tree had low unused potential.[21]

An effective PMIS can facilitate the integration of risk management into project management. The PMIS can support this effort by providing documentation and dissemination of the project risk plan and by allowing the evaluation of the plan periodically and at major milestones. Information that may be included in a basic project risk management report is depicted in Table 27–3.

Conclusion

Successful project management depends greatly on the careful design, implementation, and maintenance of effective project-management information systems (PMIS) and appropriate project reporting. We may control what is reported. Therefore, it is important to ensure that the PMIS provides appropriate information about the key factors critical to success of the project. These factors generally include scope, time, resources, cost, quality, procurement, and risk.

Information can be distributed in printed project reports, as attachments to e-mail, or by being made available at an Intranet site designed for an individual project or for multiple projects. Information can be presented at formal and informal project review meetings, face-to-face briefings, teleconferences, and video conferences. A combination of these approaches for information dissemination can result in a powerful PMIS that helps the project manager and project team build trust and guide the project to a successful conclusion.

It is important to ensure that the PMIS is capable of supporting stakeholders' changing requirements for information needed for decision-

Table 27–3 Basic Project Risk-Management Report

WBS Number	Description of Risk	Risk Owner	Probability	Impact	Risk Response	Risk Status

making. Therefore, it is important to design flexibility into the PMIS and to review it periodically with key stakeholders to ensure its continued effectiveness.

Tools to support project analysis and performance reporting include progress reports at appropriate levels of the work-breakdown structure (WBS), Gantt charts, milestone charts, tracking Gantt charts, network diagrams, resource histograms, resource-utilization reports, tabular and graphical earned-value method (EVM) reports, quality-control charts, procurement progress reports, and risk-management reports. Our increasing understanding of these tools, the advances in communications technologies, and effective verbal communications and face-to-face meetings will continue to enhance our ability to manage projects successfully.

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Chapter

28

Total Customer Satisfaction

Lewis R. Ireland

Biographical Sketch . . .

Dr. Lewis R. Ireland consults in project-management applications to support organizations' efforts to enhance productivity and efficiency. He has worked in the telecommunications energy, healthcare, and information technology industries, providing project-management coaching, mentoring, and system analysis. Dr. Ireland is active in advancing the state of the art of project management through service as president of the American Society for the Advancement of Project Management (asapm). He is a veteran of 20 years' service with the Project Management Institute and recipient of several awards including, being elected a Fellow of the Institute. He resides in Clarksville, Tennessee.

What Is Total Customer Satisfaction?

Motorola Corporation uses the term *total customer satisfaction* to describe its quality program.[1] This approach to quality uses the concept of customer focus to deliver satisfaction to the customer through products manufactured by Motorola. The program also includes the concept that anything that has a negative impact on a customer is a defect that must be corrected.

Total customer satisfaction is defined as the *vision for the business*. Anything less than total customer satisfaction raises a concern about how to change products, services, or processes to bring about customer satisfaction. Rather than a single customer category such as the buyer, all categories of customers must be considered in the customer satisfaction equation. For example, there are internal and external customers who may be ranked in categories of primary, secondary, and tertiary customers for their distance from the provider.

Field Guide to Project Management, Second Edition. Edited by David I. Cleland

Total customer satisfaction recognizes the fact that not all customers can be pleased and that instantaneous achievement of quality levels may not be possible. It does, however, concentrate on setting goals for continuous improvement and striving to meet those goals through a steady, certain pace toward a constantly changing target of customer expectations. This focused effort encompasses assessing customer desires for new and improved products and services while setting higher organizational quality goals.

An Example of Challenges to Total Customer Satisfaction

Total customer satisfaction is adopted by many companies for their overall approach to delivering quality in products and services. Total customer satisfaction focuses on the buyer of the product and service and aligns the company's practices with satisfying those buyers' needs.

A major consideration in project management is that contracts are often signed with the best of intentions and with the expectation that the other party will fulfill every element of the requirements. Contracts, however, are often developed by the provider's sales department and the salesperson is rewarded for closing the deal rather than for any major concerns over the feasibility of project implementation. The project manager is the person who must deliver.

Project managers may be placed in untenable situations when projects are sold without consideration for delivering the required products or services. Project managers are torn between the parent company's goals and customer satisfaction. The project manager's long-term interests are best served by the parent company, and many times the truth gets lost when dealing with the customer.

Some individuals see the quality movement as a fad that will soon pass. Skeptics may believe this because there have been many false starts on the road to improved quality products and services, and many workers have been frustrated through misguided efforts of managers. Some skeptics also see the quality movement as a jobs program for the quality-control people.

Champions of the quality movement, however, view the situation differently. Total customer satisfaction is seen as the only way to be competitive and to grow within their particular industries. These champions of quality believe that establishing a total quality program and practicing continuous improvement of products, services, and processes are vital to the growth and survival of a business.

Although there is obvious controversy associated with the two extremes, there is little doubt about the need for quality improvements at all levels within private and public sectors. Consumers are demanding better products based on value rather than price alone. Terms such as *best value* are being used to evaluate proposals rather than *lowest price.*

Cost of Quality[2]

Customer satisfaction has a price that must be included in the cost of the product or service. Cost of quality is most often added to a product or service cost as a direct result of the organization's quality program. Typically, the cost of quality is included in the following categories:

- ***Prevention costs.*** Costs associated with preventing defects in the product or service, such as special training for workers, planning and designing product manufacture, and designing and establishing proven processes. Prevention costs in a mature quality program should equate to approximately 70 percent of the quality budget. The majority of effort in any quality program should focus on avoiding defects in products and services.
- ***Appraisal costs.*** Costs associated with inspection, evaluation, measurement, and tests performed to determine whether a defect exists. A mature quality program relies very little on the appraisal efforts because prevention measures are designed with proven processes that only yield the required product.
- ***Failure costs.*** Costs associated with product failure, either prior to or after shipment to the client. These costs in a mature quality program should be minimum and result from variances in the development or delivery process. They may also result from a flawed function in the delivery of a product such as improper packaging or excessively rough handling.
- ***Measurement and test.*** Costs associated with equipment, gauges, measuring devices, and other tools that support the appraisal process. Costs in this category should be less than 1 percent of the quality budget in a mature quality program. Repairs to measurement instruments or upgrades to the type of devices may be one time costs during any change to the quality program.

Customer liaison and customer reviews would be included under prevention costs if the purpose is to identify requirements, work the requirements, and keep the customer informed about progress. On the other hand, customer liaison and reviews would be included in failure costs if the purpose were to repair the customer relationship after significant defects had been identified. The emphasis should be placed on the customer relationship that prevents the defect rather than on the attempt to repair an eroding relationship.

Any program that attempts to achieve total customer satisfaction must consider the costs associated with quality. This cost is an investment and should have a return on the expenditure many times over. The investment may be a burden if not planned, budgeted, and managed.

Linking Quality to Profits

During the 1980s, many companies started quality programs with the expectation that the cost of the program would be easily recovered during the first few years of implementation. In the early 1990s, some companies experienced a shock when the cost of the quality program exceeded the benefits (i.e., additional profit generated). A quality program that focuses strictly on quality improvement without considering the accompanying financial benefits may have a serious affect on a company's existence.

For example, several companies in Europe had the experience of trying to perform all tasks to achieve customer satisfaction and found that total commitment to correct all items caused chaos. There was always emphasis on continually improving the product and process. Some improvements were costly without the resultant return in sales or value added to the product or process.

To solve this problem, these companies adopted a rule of thumb that stated: ''Any improvement must raise customer satisfaction by 30 percent and contribute to profit by 10 percent.'' Rather than having change for change's sake, the improvements were directly linked to customers and profit.

Continuous Quality Improvements

Customers' expectations grow over time, and they expect better and different products. Therefore, companies must constantly and continuously make improvements. Products may be improved with more features, longer durability, more reliability, and features that are easier to operate. Competitive offerings by other companies may cause sales to be lost when the customers' expectations are not met. Continuous quality improvement exists in two primary areas: product and service improvements and process improvements.

Product and service improvements add value in the eyes of the customers over a previously sold or competing product or service. This added value is often provided the customer at little or no additional cost when the product or service is changed to align more closely with the customers' expectations. Organizations must recognize the life cycle of products and services to plan for and implement replacements that meet customer expectations.

The key to product and service improvement is dialogues with customers to determine where changes are needed. It is often more important to identify what the customer wants or likes than to identify dislikes. A few companies are requiring senior executives to visit customers specifically to discuss the customers' product-capability requirements. Many other companies are relying on surveys to collect information on customer satisfaction levels and future desired features in products and services.

Product improvement is specific to the industry or the business and results in products that have greater value for customers. The automobile is an example of the many innovations made to satisfy customer desires. Dual controls on heating and air conditioning systems allow the driver and passenger to have different-temperature air directed toward them. Electronic door locks, delayed cutoff of interior lights, lighted ignition switches, and compact disk players in automobiles also represent product improvements. These improvements, however, do not enhance the basic purpose of the automobile—to provide transportation. These improvements are made to satisfy customers' expanded needs.

Service offerings, similar to products, must be improved to meet evolving customer expectations and requirements. Service providers often differentiate the value of their service by understanding the customer and his or her needs. Consistent, uniform delivery techniques that set a higher standard in the method of delivery are needed. Customers often rate delivery of services by timeliness, amount of disruption of other customer activities, and contribution of the service to the customer's business.

Product and service improvements can result from an improved process. Processes can be improved through such methods as instituting additional training for workers, simplifying the flow of the process, using materials that more closely match the manufacturing requirements, and purchasing machines to provide more uniform products than by manual means. Process improvements will typically reduce cost, enhance the product grade, and shorten the time required to perform a given function.

An example of process improvement was demonstrated by the Roanoke, Virginia, Department of Public Safety when it was learned that a fire engine could not respond to a given location within five minutes, the standard for responding to reported fires.[3] The process was placed in a flowchart with a resultant eighteen serial nodes of activity. This process was refined to five nodes with two operating in parallel. A one-time cost of less than $300 for a printer in the firehouse to print the fire location was required. The five-node process reduced the response time by 29 percent.

Process improvements are within the authority of any company to analyze its functions to determine where changes can be made to simplify, correct, or replace the process. Process improvements can easily be conducted by in-house multidisciplinary teams with little training and without major expenses of contracting out the work. Flowcharting, Pareto analysis, and frequency counts provide the means to determine where the changes may be made.

One method of bringing visibility into a process to understand the sequence of actions and to identify where improvements may be made is through flowcharting. Flowcharting is used to identify the basic functions and decompose each node into smaller and more granular components of the process.

An example is where a government agency didn't understand its help desk function—the central contact for all computer repairs and upgrades. Using the flowchart, managers were able to identify the three major actions of the help desk—receive and log requests for services, dispatch or assign work to a repair person, and close completed work orders. Detailed examination of the help desk revealed that there were 186 separate nodes that fully described the activities. This analysis of the actions possible at the help desk resulted in this agency being able to estimate times for computer repairs and provide that information to its internal customers.

Customer Focus

Any company's quality program must have the customer as the focal point for all decisions. Identifying those customers, reviewing their needs, and meeting their expectations for products and services will more likely lead to greater customer satisfaction. Product and service quality is determined by the customer, and therefore the customer must always be the primary consideration in any quality program.

Although some companies have direct contact with customers, others do not. Direct sales in a restaurant give the business an opportunity for contact with final customers, whereas a manufacturer of sheet metal may never have this direct contact.

Quality is customer-driven because all products and services are judged by customers—not by the manufacturer or other provider. Inspections by quality-control personnel and hyperbole by sales personnel do not provide customer satisfaction. Inspections only identify part of the total defects in a product. Sales personnel believe they add value to a product in customer's eyes. Initially, this may be true. However, in the long term, customers are satisfied only when the product or service delivers the desired level of performance.

Projects' charters are more frequently prescribing the working relationship between the project manager and the customer. These instructions will often specify the frequency of contact and information to be routinely provided to the customer. By doing this, the project manager becomes solely responsible for ensuring that customers' legitimate requirements are met within the context of an ongoing project.

An Example of Meeting Customer Requirements[4]

A waiter in a restaurant is perhaps the ultimate person to deliver total customer satisfaction. A waiter must recognize the customer's needs or desires in a relatively short time and meet those expectations. Meeting customer expectations is more than accurately transcribing the order, delivering the order, and presenting the check.

One test of whether the waiter has achieved total customer satisfaction may be represented in the form of a monetary tip. The real test is when the waiter presents the customer with the check, and the customer actually wants to pay the amount billed. This is a big point of differentiation that is often overlooked. Think about how many bills you would rather not pay, but do so out of a legal obligation. Even though you pay the bill, you are clearly not satisfied. Legal obligation does not connote customer satisfaction.

Characteristics for the waiter to assess that may determine how the customer is to be treated should be developed for routine recognition of the customer's needs. A partial list of the environment and customer characteristics is shown below.

- Gender—male, female, both
- Time— in a hurry or leisurely meal
- Attitude—friendly, unfriendly, or neutral
- Food order—snack, sandwich, or full meal
- Drinks—hot or cold
- Frequency of visit—new customer or regular customer
- Communication—easy to understand or difficult to understand
- Vocal—loud and boisterous or quiet
- Duration of visit—less than fifteen minutes or more than one or two hours

Characteristics and attitude of the waiter also are important to consider for total customer satisfaction. Some characteristics that may be considered are shown below.

- Friendly—smiling, helpful, cheerful
- Unfriendly or neutral—blank look, sour look, avoids customers
- Attention to customer—talks to other employees rather than customer or focused on present customer
- Attire—uniform or neat, clean clothing
- Grooming—neat, clean without perfume or cologne
- Pace—deliberate or casual
- Presence—confident or unsure of self

One may reflect on a visit to a restaurant that was ideal and another that was totally unsatisfactory. What should be changed in the ideal visit and what should be changed in the unsatisfactory restaurant situation to achieve total customer satisfaction?

Customer Identification

A customer is defined in ISO 9004[5] as the ''ultimate consumer, user, client, beneficiary, or second party.'' This definition generically encompasses many different individuals. Companies may have other customers who are specific to their line of business and in categories other than the direct consumer or user. The following is a sample of customers and stakeholders in projects:

- Project's sponsor or financing organization
- Government regulatory agencies, such as the Environmental Protection Agency
- Public interest groups
- Congress for federal agencies
- State and local governments for state and local agencies

When the definition of customer is expanded to include several stakeholders and anyone having an interest in the project, several more customers may be identified. The customer list may expand and contract for long-term projects. For example, once the decision is made to issue a construction permit, most issues should have been resolved to the satisfaction of all major stakeholders. These individuals are no longer active customers to the project. Customer identification is critical to the process of achieving customer satisfaction.

There is a balance between meeting the requirements of a few senior managers and trying to meet the requirements of all project stakeholders. Meeting only the senior manager's requirements is following internal rewards and not necessarily satisfying the buying customer. On the other hand, one may view all participants as customers and try to satisfy each one's needs, which may be conflicting. There is a midpoint at which one should strive to meet customer needs and give those customers satisfaction.

Customer Types[6]

Customers vary across a wide range of characteristics and attributes. The author's experience gives some insight as to possible classification of three types of customers.

- *Customer A* gives vague descriptions of the requirements for the product or end result of the project. Typically, this customer only has a general description of the product and its use. The product may be described by comparison with a dissimilar product or service. Guidance or clarification may result in a statement such as ''You make it happen'' or ''I'll know it when I see it.'' The customer may or may not be pleased with the results of the project.
- *Customer B* gives specifics with regard to the requirements, the purpose of the product, its functions and characteristics, and the internal and external interfaces. This customer responds to questions the project manager may have regarding the product, operating environment, and delivery, for example. This customer places confidence in the performing project manager and only asks to be kept informed of progress

or issues. The customer is typically satisfied with the results when there is a competent project manager overseeing the work.

- *Customer C* gives specific, detailed instructions on all work activities to include the process to be used, the specific standards to be applied, personal considerations for the product, and who should work on the project. This customer sets unrealistic expectations on product features that may significantly drive cost and schedule for the project. Rather than giving guidance to the project manager, the customer responds, ‘‘I will be working with you throughout this project to fine-tune your system.’’ The customer is often dissatisfied with the product because it failed to meet some arbitrary and capricious specification, such as shade of the paint or degree of shine.

Different types of customers require different approaches to satisfying their needs. Changing the customer to the type that is most easily satisfied is probably impossible. Therefore, one must recognize the different styles and work diligently to meet the stated and implied expectations.

Trust and Confidence

A trusting environment with customers supports a total customer-satisfaction program. A trusting environment for customers and project managers can all too frequently change to one of open hostility. Changes from mutual trust and confidence are not normally the result of one incident, but a series of incidents over time.

Some demonstrations of less than open and honest dealing with customers are the following:

1. ***Fast talk about schedule slippage.***[7] A company was significantly behind schedule and stated that employees would work overtime to correct the schedule slippage. The company's program executive explained to the customer that the employees would work overtime 50 hours a week until the schedule slippage was corrected. The manner in which the statement was made led the customer to believe that a total of 50 hours a week would be worked, when in fact, as the program executive explained several months later, the correct interpretation should have been 50 hours a week of overtime work, an impossible task. The customer lost confidence in the program executive because of the overtime issue and several other similar incidents. The program executive was subsequently removed from the company. This major project failed to achieve its technical goals and was canceled two years later.
2. ***Overly optimistic productivity projections.***[8] A major provider of specialized software was developing a data-collection system for a telecommunications company. The project schedule continued to slip each week and the customer questioned the validity of the schedule.

Each week the provider of software assumed an optimistic productivity rate in the future that had not been demonstrated in the past. To achieve a show of progress, the provider redefined the work-in-process to indicate more progress than was actually accomplished. The redefinition and shading of the truth on the actual progress resulted in more questions from the customer. Customer inquiries about progress validity increased. Because of a less-than-honest approach to progress and providing the customer with invalid information, the customer could not plan to meet its commitments to consumers. The customer refused to make progress payments in excess of $1.5 million. The situation did not improve over an eight-month period and the project was subsequently canceled after an expenditure exceeding $27,000,000.

3. ***Truthful Reporting of Results.***[9] A project to replace and upgrade an organization's information systems fell behind schedule because of weak planning and changing requirements for the project. This condition was documented for the client, but one of the project managers objected to giving the customer the information. Confronted by the insistence of the project-control person that not only did the customer have a right to know, but it was the only ethical manner of working with the customer, the project manager blurted out, ''We can't tell him the truth, we have a reputation to protect!''

Trust between business associates is a must to ensure a smooth and open relationship for producing any product. It is commonly accepted that if a person lies once, that person's statements must always be checked prior to taking any action.

An example of a person's reputation is clearly apparent from an incident in 1985 during a discussion between two workers.[10] A project analyst complained about his boss to a fellow worker: ''Every time he opens his mouth, he lies, he lies, he lies!'' Being a fair person, he corrected his statement: ''I take that back, I heard him tell the truth one time!'' His colleague responded in an even tone: ''Well, that must have been an honest mistake!''

Trust is fragile and can be easily broken with one deviation from the truth. Project managers who bend the truth to fit immediate situations will lose credibility when it is truly needed. The following are four principles for good customer relationships:[11]

- Establish a good relationship and a sense of trust.
- Try to understand the problems of your counterpart.
- Learn to lose an occasional battle.
- Develop a general and highly visible ability to handle interpersonal relationships with the customer.

Attitude

Attitude is a vital part of achieving total customer satisfaction.[12] A positive attitude conveys to the customer important elements about the relationship and sets the climate for a cooperative partnership. A negative attitude, however, conveys to the customer a completely different picture of the relationship. One manager characterized the attitude of the project team as ''ignorance emphasized by arrogance.'' The project-team leader refused to acknowledge that some minor errors had been made in the schedule and that these errors could be easily corrected. He would not admit that a minor error had been made because he felt any error would make him look foolish. His insistence that it was proper to execute and plan at the same time lowered his credibility with the customer.

Nine "Cs" of Quality[13]

A concise list of items that encapsulates total customer satisfaction, as viewed by one company, is titled the nine Cs of quality. These nine Cs reflect the general areas in which a project manager should concentrate either to build a total customer-satisfaction program or to validate an existing quality program. The areas are as follows:

1. ***Customer awareness.*** Project managers and team members should have an awareness of customers and their respective roles in making projects successful. This includes being aware of internal and external customers as well as the different levels of customers. Different levels are the following:
   - Primary customer—one who is the direct recipient of the benefits of the product or service being provided
   - Secondary customer—one who is the indirect recipient of the product or services being provided, such as a manager of the primary customer
   - Tertiary customer—one who has an interest in the product or service and possibly its use
2. ***Communication.*** Communicating with the customer is essential to determine requirements and expectations as well as to set the customer's expectations for quality levels and delivery procedures. Communication is also important to maintain confidence with the customer about the progress of the project's schedule.
3. ***Cost avoidance.*** Cost avoidance pertains to all actions taken to restrict expenditures to necessary work for the project. This includes all actions taken to avoid waste of time and materials. It does not imply or suggest that inferior materials should be purchased at lower cost than the proper grades.
4. ***Contribution analysis.*** Contribution analysis is the comparison of actual actions to the planned actions and the use of metrics to measure contributions.
5. ***Controls.*** Controls are those necessary checks and balances to ensure that the project is progressing as planned, or that the work is being

accomplished within the bounds of approved variances from the plan. Controls also identify those variances that require management action.

6. ***Coordination.*** Coordination is the element that ensures all affected participants are informed of future activities and that these participants concur with the planned actions. Coordination also ensures integration of efforts by all parties and prevents surprises.
7. ***Competence and congruence.*** Competence is the physical and mental capacity to perform the work, which entails knowledge, skills, and attitude. Congruence is the consistency between what is written or stated and the work being performed. Overall, congruence is the continual focus and closure on project achievement.
8. ***Commitment.*** Commitment is total dedication to performing all accepted tasks without excuses for not being able to do so. Commitment requires completion of the tasks to the level of required performance within the time frame. If it is determined that the task cannot be accomplished, team members should request relief from the person to whom the obligation was made.
9. ***Cooperation.*** Cooperation is making every effort to work with others in an open and supportive manner. Cooperation includes assisting fellow workers, being receptive to the boss's instructions, and being friendly to others. Cooperation does not require an individual to compromise on ethics, values, or beliefs just to be one of the team. Honest disagreement over principles, practices, or procedures is acceptable behavior.

Principles for a Quality Program

Quality programs must provide for the company's continued existence and growth as well as provide for a high degree of customer satisfaction. Principles associated with total customer satisfaction are the following:

- Satisfied customers make positive referrals for new business.
- Dissatisfied customers don't always report their issues with the product or service.
- It is easier and less expensive to obtain repeat sales from satisfied customers than to find new customers.
- Negotiating changes is easier with satisfied customers than with dissatisfied customers.
- Satisfied customers have confidence in the ability of the project manager and require less proof of progress.
- Quality programs focus on eliminating waste as means of achieving customer satisfaction.

Summary

Total customer satisfaction is achieved when the customer accepts the product or service and is pleased to pay the bill. This is accomplished through a disciplined approach that recognizes the customer's needs and meets those needs. It is the customer who determines whether the product or service meets his or her needs—not the provider.

To be successful, product and service providers need to understand the customer, identify the customer's requirements, evolve the work when changes occur, and deliver on time. The provider-customer relationship is best described as trusting and mutual respect.

Products and services must continually evolve to meet customers' expanded expectations. New features on products and better delivery methods for services are a few of the enhancements needed to thrive in business. The organization that fails to recognize customers' changing needs risks serious problems with growth and possibly continuing in business.

ENDNOTES

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3 Department of Public Safety Report to Quality Improvement Class. Roanoke, VA, 1992
4 The concept of a waiter being the ultimate deliverer of customer satisfaction is paraphrased with permission from Mr. Graham C. Bale, a senior project manager residing in Lebanon, OH, 2003
5 ISO 9004. Quality Management and Quality System Elements: Guidelines, 1994
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7 Personal observation during a project review. Toronto, ON, 1986
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Chapter

29

Project Evaluation at Lucent Technologies

Daniel P. Ono*

Biographical Sketch . . .

Daniel P. Ono directed project managers within Pacific Telephone, AT&T, Lucent Technologies, Cisco Systems, and Excite@Home for the past 30 years. His PM organizations have been responsible for projects valued at over several billion U.S. dollars. During the past several years, he spent his time, training, coaching, mentoring, and consulting with project managers from Lucent Technologies, Cisco Systems and Excite@Home as well as commercial training companies in Mexico, the United Kingdom, Australia, Singapore, the Philippines, Canada, and across the United States. Most recently, Dan was the Principal Consultant of Ono & Associates.

Introduction

Since the publication of the original version of this chapter, Lucent Technologies has gone through many changes, principally caused by the recession in the capital investment areas of major corporations. This recession caused the spinoff of the PBX organization, among others, from Lucent Technologies. The PBX organization continues to do business as Avaya, Inc. Along with the spinoff have come many layoffs and other cost savings-related reductions in funding. The organization described by the author in the original chapter has been disbanded and most of the project managers have retired or been absorbed back into local entities within Avaya. Consequently, the Project Evaluation Review Process is no longer in use at Avaya or Lucent Technologies. Unfortunately, the Project Evaluation Review Process and other fundamental processes of the organization were

*The project-management community lost Dan Ono shortly after he submitted his chapter for this Field Guide. He was a notable and contributing member of that community. Dan will be missed.

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deemed too expensive by the management of Avaya and done away with. Since these fundamental processes no longer exist, the resource pool for these highly professional and skilled project managers will no longer be developed. Consequently, the foundation for producing the strategic advantage in project-management capability has been lost.

Prior to these changes at Lucent Technologies, the author moved on to employment at Cisco Systems and Excite@Home as the Director of Project Management and, finally, as principal consultant with Ono & Associates, which specializes in project-management training and consultation. The author introduced these processes at the first two companies during his tenure there.

Today's reality is that corporations oftentimes need to focus attention to cash flow and immediate financial results to minimize losses on the quarterly balance sheet. This focus is driven by the legitimate need to maintain financial and other investments in their companies. The Project Evaluation Review Process needs to be modified to maintain or improve its benefits, but at a lower cost in dollars and in human resource commitment. Fortunately, project-management process, scheduling software advancement, and other ERP-related disciplines have been integrated with the Internet to provide opportunities that can facilitate this modification.

These enhancements to the project-management environment allow the Project Management Office and/or the Director of Project Management and other executives to be able to monitor project progress from afar. Of course, there has to be integrity and timeliness in the project status reporting. This requires some special attention to ensure this integrity and timeliness. Fortunately, with ERP's capability for real-time financial results, the PMO has available the ability to correlate project status with project spending and revenue, which will assist in validating project results. This type of ERP capability allows companies to do amazing things, like Cisco Systems' process for closing the books every month instead of every quarter.

Additionally, with the Internet providing drill-down capabilities of new scheduling and project-management software, the PMO can investigate in detail any aspect of a project. This powerful combination of new developments allows the PMO/Project Director to carry out many of the tasks that were formerly conducted by the Project Evaluation Review Team and, importantly, it can be carried out on a real-time basis. While this capability reduces the number of activities that a PERP review team needs to carry out on-site, it still does not replace the benefits of on-site observation of deliverables and interaction with the project team members. Consequently, while the tasks and duration of a PERP review have been reduced, there is still the need for a smaller on-site review, which will cost less but still provide many of the same benefit of the original PERP objectives.

Changes to this chapter are minimal but have been created to address the above-mentioned factors.

The strategic intent of Lucent Technologies' project-management process was the creation of a strategic competitive advantage by possessing a world-class group of professional project managers. The Project Evaluation Review Process is one component of this overall effort.

The following is a modification of the project-review process that was developed to provide a means of continuous improvement for the Lucent Technologies–Business Communications Systems Project Management Process. The Business Communications Systems' project-management process was created as a tactical tool for the long-term successful delivery of large communications infrastructure and PBX implementations. The particular group within the Lucent Technologies Strategic Business Unit was the National Strategic Opportunities Division, which specialized in large telecommunications-related projects in the national and international environments. The group consisted of a presale group, which included presale strategic sales managers and presale strategic system designers as well as fully qualified presale senior project managers, and a postsale group consisting of senior project managers, project coordinators, and system administrators.

The project-management organization preceded the creation of the presale group by four years and was in existence for thirteen years. Since an early requirement to enter the project-management group was the dedication of six years or the rest of a person's career, many of the senior project managers had over thirteen years in the organization and over thirteen continuous years of managing large telecommunications projects. The reason for the unusually long commitment was the author's belief that you cannot build world-class competence in a short amount of time. This was going directly against the culture of the AT&T/Lucent Technologies employee of the time. The AT&T/Lucent Technologies job paradigm at the time the project-management group was created was one where employees changed positions every two or three years in a misguided belief that the more jobs they knew, the more valuable they were to the corporation. Unfortunately, this paradigm made the employees jacks of all trades and masters of none. This practice qualified these AT&T/Lucent Technologies people for jobs in other Bell System companies, but for little else. Unfortunately, this was a time when all of the former Bell System companies were laying people off. This project-management organization was able to stay intact for thirteen years, while everything around them changed. With this corporately unique opportunity, the project management group was able to build a process that was classified as ''best in class'' by several benchmarking initiatives and was widely recognized as being a premier organization from inside and outside of Lucent Technologies.

This project-review process, known as the PERP (Project Evaluation Review Process), was part of the project management process being used by the senior project managers in the organization. The documentation of the project-management process was called the Lucent Technologies-BCS Project Management Guidelines (PMGs). The PMGs consisted of five (2-inch) volumes of process descriptions, examples, and operating instructions.

These Guidelines covered the recommended processes for each of the PMI life-cycle phases involved in the communications projects.

Due to considerations of space, the actual questions have not been included in this chapter, but the table of contents for the entire document has been included in the pursuit of clarity, while addressing the publisher's requirements. See Appendix 1.

Project Evaluation Review Process

OVERVIEW

The PERP was developed with several objectives in mind:

1. It was reasoned that if the review process were conducted at an early enough point in the project life cycle, benefits could be derived on the current project. Consequently, instead of the traditional postimplementation review, where improved results are anticipated on some future project, one of the objectives of this particular review process was to deliver improved results and improved client satisfaction on the project being reviewed. Related to this objective was the complementary objective of maintaining the already established record of consistent delivery of high quality, on time, on budget, and meeting the highest client-satisfaction projects.
2. The second objective was derived to facilitate achieving the first objective. The project-review team was responsible for working with the project manager and the project team to correct any project-management-related variances discovered on the project. It was reasoned that, since the company was focusing some of its best and most knowledgeable project-management resources on the project, the company should be able to take advantage of this investment while this expertise was on the project site. If any variance was too large to resolve while these resources were on-site, action items were created to resolve the variances. These action items identified the tasks required to resolve the variance, who was responsible for completion of the action item, and when the action item would be resolved. A follow-up process was incorporated to ensure effectiveness and timely completion of the action items. This requirement was a change in philosophy from the traditional view but consistent with fundamental project-management objectives. The company wanted to head off any future problems on the project at hand rather than bringing in the experts to identify what had been done wrong after the ramifications of the errors had become visible in project results.
3. The third objective of this process was to provide a means of measuring the quality of the implementation of the PMGs, which provided the standard from which variance was measured. Consequently, the PERP was the means by which quality assurance of the project-

management process was measured within the organization and on specific projects.

4. The fourth objective was to provide a training vehicle for the project managers to learn the PMGs better and acquire additional professional project-management skills. With on-site, one-on-one resources with PMG expertise, learning was greatly enhanced because of the ability of the project managers to associate the application and implementation of the methodology and principles included in the PMG on their own project. The company was highly successful in this area. One of the senior project managers was quoted as saying the review process was the best learning experience he had had in his AT&T career.
5. The fifth objective was to provide a means of continuous improvement for the project-management process. The people doing the reviews were also the authors of the PMGs. Whenever they found a poor result or a better method, their task was to include the improved methodology into the PMGs. Additionally, since they were in direct interface with the project manager, if the project manager related a lesson-learned experience to the review team, the review team was to develop and add the lesson learned to the PMGs in order to retain permanently the process required to avoid the lesson-learned event in the future. The company's philosophy about lessons learned was that unless the lessons learned were integrated into the process description, in our case the PMGs, they would not be properly documented for long-term benefit and retention. The company's philosophy was that the PMGs served as its corporate memory, which is why they were updated annually.

DESCRIPTION OF THE PROJECT EVALUATION REVIEW PROCESS

The PERP provided a means to review the specific project-management deliverables within any phase of the life cycle of the project. A phase-identification process was utilized to determine the current phase (i.e., conceptual, planning, implementation, or closeout), and the extent to which that phase was completed. The targeted cycle for review was determined by project complexity, the project manager's experience, review team availability, project health, and impact of the project on the organization. Most reviews were conducted at the end of the planning phase, when the potential to influence project results was greatest.

The review process focused directly on the status of the project-management deliverables within that phase. Once the current status of the project was determined, the project-management deliverables from the preceding phases that flowed into the current phase were reviewed for compliance with the Project Management Guidelines.

Upon completion of the review process, the project manager received a verbal and a written report documenting the results of the evaluation. The entire process was managed as a positive, beneficial experience for the project manager and the project team. If the project review identified specific areas for improvement, the project review team, the project manager, and appropriate project team members developed plans and/or a replan of activities to correct the identified areas. An agreed-upon process was to be established to monitor the implementation of the corrective plans and the status of activities up to the completion of the project objectives.

After completion and acceptance of the project by the client, the project manager conducted an internal project review with the project team and an external review with the client to document lessons learned throughout the duration of the project and to ensure customer satisfaction. These lessons learned provided a basis for process improvement and continued development of the Lucent Technologies Project Management Guidelines.

SELECTION OF PROJECTS FOR EVALUATION

Initially, at least one PERP was conducted for each project manager during a calendar year. However, this process was reviewed each quarter in regard to a value analysis of the findings, district budget constraints, and resources available to conduct the reviews. The selection process for projects considered the following factors:

- Identification of all current projects in the organization
- Prioritization of high-risk projects
- Project financials such as budget and revenue
- New products or technology (controlled introductions)
- Project complexity (number of interfaces, project duration, and technical complexity)
- Geographic impact
- High exposure, political ramifications
- Client risk
- Project manager experience
- Resource team availability
- Formal request for a review by a project manager or supervising manager

Evaluation Process

EVALUATION TECHNIQUES

The project-evaluation team did the following:

- Ensured that each project team member was properly introduced to the review team and the purpose of the review was adequately explained
- Informed the team that the reviewers would be documenting Q's & A's to maintain accuracy

- Was prepared to offer recommendations and suggestions to improve areas found to be in noncompliance with a standard or guideline
- Identified each area that might have required improvement or enhancement. The project manager had the prerogative not to follow procedures in the PMG if he or she could provide a good rationale for the variance. If a variance was identified, it was important to understand why specific standards or guidelines were not being used for the project being reviewed
- Emphasized the strengths of using established standards and guidelines
- Established a supportive atmosphere for the participants in the review
- Displayed and maintained a professional approach to the review process
- Maintained a focus on factual information, not assumptions, rumors, or hearsay

REVIEW TEAM COMPOSITION

The project-review team normally consisted of other unassigned senior project managers. Participation by supervising managers could have been suggested for review feedback sessions. Actual evaluation teams were negotiated with the District Manager and Supervising Managers. The training plan for evaluators assisted in identifying resources for project reviews.

The minimum size of the project-review team was two. In the new environment, a single review team member was possible, but not feasible, since the time required to do a full review would be excessive for the project team, detrimental to the project, and untimely. The review package design allowed for group or individual review of a specific phase by members of the review team.

PROJECT-EVALUATION PROCESS

The project-evaluation process required the review of specific deliverables as defined in the Lucent Technologies Project Management Guidelines. These deliverables included:

- Contract/scope of work, project-assurance documentation, and handoff materials
- Kickoff workshop documentation
- Work-breakdown structure
- Master schedule
- Responsibility matrix
- Overall project PERT and cutover PERT (as applicable)
- Project plans such as quality, training, escalation, implementation, cutover, etc.
- Monitor and control procedures, project escalation/jeopardy plans, and correspondence

- Monthly status reports, meeting agendas, and minutes
- Project budget tracking based on district guidelines

The documents were reviewed by members of the project-review team and compared with the Lucent Technologies PMGs. Specific questions were asked to gain an understanding of how the project manager and project team were utilizing the deliverables to monitor and control the project activities. The interview questions were structured to generate conversation with the project manager and the project team members. The intent was to establish a supportive environment that would allow the interviewing team and the project manager to discuss project details in a positive, educational manner. The data developed from this dialogue, coupled with the review of the deliverables, provided a basis for summarizing the results of the review.

Depending upon the project phase and based on professional experience, the review team made a determination about the health of the project and identified areas of strengths and areas that required replanning. Using the information from the PERP, the review team, working with the appropriate team member and/or directly with the project manager, developed plans to correct areas identified as requiring improvement or replanning. The findings regarding each deliverable were summarized in the project review summary. The summary provided the project manager and the team with a detailed, objective document that could be used to improve the quality of the project deliverables. The project-review summary also provided input for the overall Lucent Technologies project-management process-improvement deliverables.

FEEDBACK

As the review progressed, the review team provided feedback that supported project strengths and identified areas for improvements to the participants on specific findings. This would encourage open dialogue with the participants and minimize negotiation and conflict at the conclusion of the review.

A formal meeting was conducted at the completion of the review to provide a summary of all findings and recommendations to the project manager and the project team.

REVIEW REPORT DISTRIBUTION

A copy of the final review report with a developmental plan, if required, was distributed by the project-review team to the following persons:

- Lucent Technologies project management district manager
- The supervising manager, project manager, and project team members
- Other key individuals as deemed appropriate by the project manager

REVIEW SCHEDULING

Initially, identification of the specific phase of all projects that were currently in progress was utilized to develop a master schedule of projects for review for any given calendar year. The priority of the scheduling was based on cutover schedules.

Evaluation Process Specification

PHASE IDENTIFICATION

Before the initiation of a project evaluation, it was necessary to determine the current phase of the project (conceptual, planning, implementation, or closeout) and the extent to which that phase was completed. The following describes phase identification:

- ***The conceptual phase*** ended when:
  - A signed contract existed
  - Technical design reviewed, the project-assurance documentation
  - The project handoff documents were received
- ***The planning phase*** encompassed:
  - All kickoff workshop activities
  - Committee formation
  - Draft plan preparation tasks
- ***The implementation phase:***
  - Began when the functional organizations began their tasks
  - Concluded with completion of project objectives
- ***The close-out phase*** began with:
  - Client acceptance of the completed project
  - Included postcutover review(s) or postproject reviews
  - The implementation of the operations, administration, and maintenance plan (OA&M)
  - The final bill processing

The phase identification was not meant to delineate all activities within the four major categories, but rather to define, in generalized terms, those basic activities associated with the transition between phases. In all project evaluations, the project scope, master schedule, and monthly status reports were reviewed for assistance in this determination. Further, and most important, the individual project manager will be consulted for input and agreement. The completion of any particular phase was viewed in both real and ideal terms; that is, in real terms, what had actually been accomplished to date; and in ideal terms, what should have been accomplished at this stage based on the Lucent Technologies Standards and Guidelines.

By definition, a project is a unique undertaking and this precludes any standard elapsed time application of in progress identification; i.e., an implementation phase could be three months or three years in duration. However, all projects did have milestones, which identified and used in the project's progress determination. The following items were used to facilitate in phase/progress determination.

- ***Project scope.*** To maximize the benefits of a project evaluation, it was generally assumed that the evaluation would be conducted at the latter stages of the planning phase. Projects at this point of the planning phase generally had detailed plans and control processes in place. Ideally, the review would occur before completion of project deliverables. This provided sufficient time to prepare and implement required measures to affect project success positively. Review of the project scope, which was normally finalized in the planning phase, would identify the breadth of the project and the necessary components required addressing in a master schedule. This review was essential to obtain a complete overview of the project under evaluation.
- ***Master schedule.*** The master schedule identified activity durations, milestone dates, and planned and actual task-completion dates that were required to ensure project success. Therefore, the master schedule and a detailed implementation schedule, if accurate and complete, was a tool for the reviewers to use in determining the project phase identification. It also provided the progress completion of a particular phase. The various scheduled activities reflected in the PERT/Gantt charts were reviewed to ensure they provided the necessary dependency relationships.
- ***Monthly status report.*** The monthly status report should reflect the current status of the project through the previous month's reporting period. In addition, any critical issues associated with the project should be identified on the monthly status. Along with the master schedule, network diagram, and identified milestones, an accurate estimation of the real progress could be ascertained by the review team.

CONCEPTUAL PHASE CRITERIA

The conceptual-phase review focused on the following three major activities that took place in the precontract environment: the project manager's involvement in the development of the request for proposal (RFP) response, the project manager's familiarity with the project-assurance binder, and adherence to the project assurance standards. The review evaluated the following:

- Participation of the project manager in the preparation of the RFP response and contract determination, precontract scope development, and initial contract management
- The project-assurance binder: custom contract, product agreements, and RFP
- Compliance with project-assurance standards

SELECTION OF INTERVIEW PARTICIPANTS

The project-review team was selected based on availability, project-management experience, PERP evaluation training, and negotiation with the supervising manager or district manager. The candidates for interviews included but were not limited to the following:

- Project manager
- Project team:
  - Design specialist
  - Local project manager
  - Functional team members
  - Technical sales support
  - Network design engineer
  - Other designated team members (based on project requirements)

STANDARD REVIEW ITEMS

Request for Proposal Response

The project manager's involvement in the RFP/project request process determined the need for evaluation of this phase. During the RFP response, the project manager might have been required to deliver detailed presentations to the project owner, the sales team, and/or the client. Introduction of the project manager to the client and the sales team were usually conducted at these meetings. These presentations could include the following:

- The Lucent Technologies Project Management Process
- A preliminary implementation plan
- Key project participants
- Tools and techniques

Project-Assurance Standards

Project-assurance standards/documentation provided a basis for the project manager to begin planning the project in detail. Project-assurance activities were the following:

- Project-assurance documentation.
- All agreements and elements of the project-assurance binder received and reviewed by the project manager and the project team. These included contracts, agreements, scope documents, and notes.
- Project manager acceptance of the project and hand-off from the account team.

When the project scope was understood and the design and project-assurance documentation was in order, the project manager accepted project responsibility from the account team.

PLANNING PHASE CRITERIA

The planning phase included the period of time in which the project team was formed, preliminary cost estimates were determined, initial project plans were developed, and the project team was preparing to begin implementation. The purpose of the PERP was to identify strengths and potential areas of concern in all phases. However, at this time, concentration was devoted to the planning phase. The review assisted in the development of corrective plans and contingencies that might have improved the probability of project success.

Planning phase activities included the following:

- Project team formation
- Project budget
- Project kickoff
- Implementation planning

These activities were reviewed and evaluated during the review process and compared with established standards described in this document.

Objectives

The PERP objectives for the planning phase were to document, evaluate, and provide recommendations for improvement as required in the following areas:

1. ***Project kickoff deliverables:***
   - Kickoff binder
   - Work-breakdown structure/responsibility matrix
   - Master schedule
   - Project scope
   - Project controls
   - Project administration
   - Meeting schedules
   - Reporting procedures
   - Documentation
   - Preliminary cost estimate
   - Finalized project budget
2. ***Initial project plans:***
   - Implementation
   - Monitoring and control plan
   - Safety plan
   - Quality-assurance plan
   - Change-management plan
   - Escalation plan
   - Training plan
   - Test and acceptance plan
   - Cutover/rehome plan
   - Client acceptance plan
   - Operation, administration, and maintenance (OA&M) plan
   - Disconnect plan
3. ***Use of the organizationally defined project-management software***

The planning phase component of the project-management process was used as a basis for the review process.

Team Formation

Project documentation should have included a complete list of the project team assigned as well as second- and third-level supporting managers. A project team member information sheet should have been included in the initial project (kickoff) binder.

Budget Preparation

The project manager was responsible for the preparation of a preliminary project cost estimate and a finalized project budget. The finalized project budget included project-management overhead expenses, labor, and extraordinary expenses, such as rentals and miscellaneous equipment. The project manager was required to interview the functional managers and obtain all information relative to resource loading. Lucent Technologies budget preparation guidelines were included in the Lucent Technologies PMGs. The project budget review was based on budget preparation, baseline, and resource management as presented in the Lucent Technologies project-management formal budget process training. After negotiation with the functional managers, the project manager finalized the project budget and obtained approval to proceed from the project owner.

The Project Kickoff Meeting

The project kickoff meeting was essential to the planning process. The project manager was responsible for coordinating these planning sessions, the internal kickoff workshop with Lucent Technologies project team members, and the external kickoff workshop, which added the client representative and subs. The project manager coordinated the preparation of the project binder and arranged for the final workshop deliverables.

- ***Kickoff binder Deliverables:***
  - Project scope
  - Project team list
  - Work-breakdown structure/responsibility matrix
  - Master schedule
  - Project-monitoring and control procedures
- ***Planning committees established at project kickoff:***
  - Implementation
  - Quality assurance
  - Change management
  - Safety (as required)
  - Cutover (as required)
  - Test and acceptance
  - Training

- Operations, administration, and maintenance
- Disconnect/closeout

NOTE: Some plans may not be required depending on the nature of the project. Where any of these plans were not utilized, the project manager was expected to be prepared to explain why.

External Kickoff Meeting

Upon completion of the internal kickoff workshop, the project manager scheduled a meeting with the customer/client to review the output of the internal kickoff meeting and get client input. Attendees at this meeting included the project manager, the account executive, the design specialist, and the client representatives. The external kickoff meeting deliverables included the following:

- Completed project binder for client review
- The initial documentation of client acceptance of the initial project implementation plans as developed during the internal kickoff workshop.

Implementation Planning

During the planning phase, the project manager was responsible for the preparation of administrative guidelines. With the assistance of the project team members, the project manager developed the overall project plans. The project manager was responsible for the development of the integration of the various functional units' individual plans. These initial plans were the basis for project control during the implementation phase. A network diagram, based upon information gathered during the kickoff process, was developed for variance analysis. Project-administration items in the project binder included the following:

- Status reporting procedures
- Meeting schedules
- Escalation and jeopardy procedures
- Interface agreements
- Recommended project plans to be utilized during the project life cycle.
- Project-management tools:
  - Lucent Technologies Project Management Process and Lucent Technologies Project Management Guidelines
  - Hardware/software platform
    - Project-scheduling software
    - Network/PERT chart and Gantt chart
    - Ad-hoc reports format
    - MS Word
    - Project status report format, Jeopardy format, and Minutes format
    - Electronic e-mail

IMPLEMENTATION PHASE CRITERIA

The implementation phase of the project was the period of time in which the project plans and procedures developed during the planning phase were actually applied to the project. The Lucent Technologies Project PMP and PMGs were used as a tool by the project manager to further develop plans and assist the project team by identifying critical tasks that required attention. Primary activities within the implementation phase were the following:

- Contract management—managing to contract specifications
- Early identification of variances from any of the plans
- Replanning based on resource availability, schedule changes, budget constraints, scope changes, and external factors
- Identifying and resolving problems
- Monitoring progress by using reports, minutes, and scheduling software
- Controlling change via the change-management plan
- Implementing the project using the project plans
- Implementing the cutover using the cutover plan

OBJECTIVES

The objectives of the review team during the implementation phase included a review of project documentation, interviews with the project manager and members of the project team, assessment of the use of project-management tools, and evaluation of overall project health. The process assisted the review team and the project manager by identifying the following:

- Areas where implementation required replanning
- Project successes
- Change-management effectiveness
- Effectiveness and utilization of project plans
- Project budget actuals versus planned expenses performance
- Project schedule performance
- Quality/process-improvement opportunities
- Project team effectiveness

The implementation phase review concentrated on the activities listed in the section called Implementation Phase Criteria above and on the tasks identified in the project-management process. These activities are further defined as follows.

CONTRACT/SCOPE MANAGEMENT

Project-assurance procedures included documentation of contract deliverables and custom contract requirements. The project-review team compared these documents with the actual work that was being performed during implementation. This assisted the review team and the project manager in determining the degree of compliance with contract specifications. It also identified areas where additional work was required to meet specifications or where unnecessary work was being performed that might have added expense to the project. Contract management included terms and conditions that might have involved subcontractors. An example of this might be a wire vendor's use of non-Lucent Technologies suppliers for material and labor. Terms and conditions may have included specific progress payments to subcontractors on identified dates.

REPLANNING

Identification of any changes in project cost and budgets, scope, resources, contract, schedule, or technical performance standards may have required the project manager and the team to replan certain aspects of the project. The replanning task may have required the project manager and the functional managers to revisit plans developed during the conceptual, planning, and implementation phases.

IDENTIFYING AND RESOLVING PROBLEMS

During the course of a project, the project manager was required to manage various types of problems that might have affected the project's success. Constant monitoring and control of all aspects of the project helped identify these problems. Schedule conflicts, unexpected resource constraints, jeopardies, and budget overruns are examples of the types of problems that are common in a project life cycle.

Problems and challenges that were identified by the project manager and the project team had to be evaluated to determine the impact on the project in terms of time, cost, and scope. After evaluating the impact of a problem on the project, the project manager and team members had to determine what, if any, changes were required to minimize any negative impacts to the triple constraints.

Recommendations for changes to the existing project plans might have required approval from the customer, project owner, or other organizations that might have been affected by the project team recommendations.

PROJECT MONITORING AND CONTROL

Lucent Technologies project managers were required to submit project meeting minutes and status reports to the project team, supervising manager, district manager, client, and project owner with timely information about project progress. Project minutes were provided in a standard format as described in the kickoff workshop training guidelines. Guidelines for project status had been established to maintain overall consistency in the delivery of these reports and their format. Progress reports from team members might have been provided through formal documentation or verbal status reporting at project team meetings. Project minutes could be used as a reference to verify assignment of tasks, action items, commitment statements and to plan project activities. Status reports should address project progress in all areas of responsibility for each team member, such as:

- Implementation progress (master schedule)
- Project costs (actual versus planned)
- Current or potential jeopardies
- Critical issues (task dependencies)
- Resource issues (availability, cost)
- Subcontractor progress reports
- Project safety
- Project quality assurance
- Overall project health

IMPLEMENTING THE PROJECT AND CONTROLLING CHANGE

Managing project activities, events, and milestones required the project manager to use the tools, reports, and quality reviews to ensure that the project met the objectives of time, cost, and scope. As the project progressed through the implementation phase, the project manager needed to identify, evaluate, communicate, control, and coordinate all project changes. These changes might have included the following:

1. Project costs and budget changes
2. Project scope changes
3. Project resource changes
4. Contract changes
5. Schedule changes
6. Technical performance or specification changes

The PERP provided the review team and the project manager with information that could be used to improve the Lucent Technologies Project Management Process. Changes in many cases resulted in increased project cost or delayed project completion. Information gathered during a review could have been used to modify procedures across organizations. Procedural changes could have resulted in object cost reduction, reduced project duration, and increased customer satisfaction.

MANAGING CUTOVER

The term *cutover* was used to describe the event or action that took place when the product, service, or project element contracted for by the client was placed into operation or turned over to the client. The cutover dates were negotiated by the project team and the client. Prior to actual cutover, the project team reviewed the project's state of readiness for the cutover. This was accomplished through a cutover-readiness review usually scheduled two to three weeks before the actual cutover. At this time the project team reviewed the current status of the project and determined the probability of success. Cutover plans and contingency plans were reviewed and finalized. An operations, administration, and maintenance (OA&M) plan was also reviewed and finalized. The OA&M plan addressed procedures and guidelines for use by the client after completion of the project and the resumption of normal day-to-day operations and the departure of the project team.

The cutover-readiness review, conducted by the project manager, was designed to provide the client and the project team with a detailed evaluation of the project's current status and to gain approval from the client to proceed with the cutover plans.

CLOSEOUT PHASE

As the project neared completion, the project manager began the process of formal project closeout. This phase included a number of activities that evaluated the project in terms of final time, cost, and scope delivery:

- The provision of as-built drawings
- Project closeout reviews
- Review of project deliverables
- Client satisfaction
- Effectiveness of the project-management process
- Quality reviews
- Customer billing
- Records retention

The project manager and the project team conducted a postcutover review to determine if and where contract specifications had not been met. A detailed list of items, known as a punch list, was created to identify noncompliance, quality-improvement areas, uncompleted tasks, and client concerns. The responsible project team members were identified and assigned to correct any project deficiencies. Specific time frames for completion of these items could have been included in the contract or could have been agreed upon by the client and the project team during the postcutover review.

FINAL BUDGET REPORT

The project manager prepared a project budget report utilizing available project-management software and/or ERP system deliverables. This report did the following:

- Identified actual project costs and compared them with baseline objectives
- Provided data for determining future product costs
- Provided information for process improvement in budget preparation and tracking
- Provided the project manager with additional training in project budget development

INTERNAL PROJECT-CLOSEOUT REVIEW

Upon completion of all deliverables, the project manager scheduled and conducted an internal project-closeout review. The nonclient members of the project team attended this review. The review was designed to provide an opportunity for the project team to identify project activities that were successful as well as areas that required improvement or change. This project review was done prior to the external project review, which included the client. Having the internal project review in advance of the client review helped ensure any unexpected problems with the internal team in front of the client would be identified prior to meeting with the client's representatives.

The project manager prepared written documentation from these meetings, which was included in the project binder. A copy of this document was sent to the Lucent Technologies Project Management District Office for review and use in process-improvement activities.

EXTERNAL PROJECT-CLOSEOUT REVIEW

The external project-closeout review was scheduled and conducted by the project manager. The client provided the project manager and project team members with an evaluation of the project team and the overall project-management process. The client's feedback provided the project team and the Lucent Technologies Project Management District with information that could enhance the project-management process and identify areas for improvement in client satisfaction.

Specific items for discussion included the following:

- Client satisfaction with the Lucent Technologies Project Management process
- Project quality controls
- The adherence to project performance criteria: specifications, schedules, cost
- The overall project quality

FINAL CLIENT ACCEPTANCE

The contract, addendums, change orders, and project documentation provided the basis for client acceptance. Specific details for acceptance were outlined in the cutover plan or in an acceptance plan prepared jointly by the project team and the client. Client acceptance was an extremely important part of the closeout process. It was an indication that the project was planned and implemented successfully to the client's satisfaction. Final client acceptance was achieved upon completion of all outstanding action items identified during the postcutover review, verified delivery of all contract specifications, or completion of negotiations with the client. Negotiations with the client and the account team were required when additional work beyond the original scope was identified or where conditions existed that prevented completion of task items.

PROJECT BILLING

Upon completion of all project deliverables and obtainment of client acceptance, the project team processed all remaining bills and invoices. The project manager's responsibility in the billing process was to ensure that the appropriate team members were assigned to process billing. Billing procedures were documented in the project binder and progress payments were tracked as a task on the network diagram if applicable. Billing procedures and documentation were included in the handback to the account team.

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Appendix 1
Project Evaluation Review Process

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Chapter 30

Project Termination: The Good, the Bad, and the Ugly

Carl L. Pritchard

Biographical Sketch . . .

Carl Pritchard is a veteran project-management lecturer, author, and instructor. As an author and researcher, he has published articles on project management maturity, the international trends in project management, advances in risk management, and the nuances of training on the Internet. His work as an instructor has taken him around the world, training with some of the leading international training organizations, as well as for private clients and the Project Management Institute. He is the U.S. correspondent for the U.K. project-management journal *Project Manager Today*. Carl has authored several texts, including *Risk Management Concepts and Guidance* (2nd Edition), *Precedence Diagramming: Successful Scheduling in the Team Environment* (2nd Edition), *How to Build the Work Breakdown Structure,* and *The Project Manager's Drill Book—A Self-Study Guide.*

The end of the project. In most project-management literature, it is documented as a thoughtful release of project resources back to the organization, a moment of closure with the project customers and a final time for capturing project lessons learned and insights. In most project realities, it is a time of trying to keep resources on hand for the final project activities (when they would rather be working on something new), negotiating with customers over whether or not the project's objectives have been achieved, and determining which documentation can be dismissed without significant impact. Termination is a time of conflict and contrast. In dealing with project termination, three basic conditions may exist. *Positive termination* occurs when the project comes to closure with a positive outcome and an upbeat relationship with the customer and stakeholders. *Negative termination* occurs when the project reaches closure at project completion

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but with less-than-positive sentiments between the project and client organizations. *Premature termination* occurs when a project is not near its planned closure, but a change in client needs, a lack of time, or a lack of funds forces the early termination of the project. In some organizations, a fourth condition, *antitermination,* can also surface, which is the failure to terminate at all.

Positive Termination

How do you know when the project is over? What are the sure signs? Those are questions that should be asked for the *first* time at the very beginning of the project. Successful, positive termination generally hinges on a project manager's ability to define the end of the project clearly through a clear, well-crafted exit strategy. It is vital to have agreement on that definition from the very beginning of the project. Ideally, there should be concurrence on the definitions of project success among the project manager, the sponsor(s), the customer(s), and any other critical organizational stakeholders. Those stakeholders may include:

- Team members
- Customers
- End users
- Subcontractors and vendors
- Management
- Project manager

Each individual in this pool has different objectives at project closeout. The team members may hope for a new opportunity to grow within the organization. Customers want their deliverables. End users want minimal change. Subcontractors and vendors may simply want to be paid. The needs are as varied as the individuals, and if the project manager can anticipate those needs early, the project will have a far greater likelihood of success.

Defining Termination Success

The definitions for success will vary from one stakeholder to the next. So project managers are obligated to ask each critical stakeholder what he or she envisions at the end of the project. Are they anticipating fanfare? Or a quiet goodbye? Do they expect the deliverables to be shipped, unpacked and set up, or just dropped on a loading dock? Failure to anticipate these needs can be dramatic and can lead to less successful termination. The questions must be asked early enough to allow the answers to be integrated into the project plan.

Generally, the questions are asked in simple pre-exit interviews (ideally, early in the project life cycle). The questions should reflect the needs of the individuals, as well as their organizations. Sample questions might include:

- When the project is over, what do you expect to see changed in the organization?
- What documentation and physical materials do you expect to have at your disposal?
- What form do you expect them to take?
- What kind of ongoing contact and support would you anticipate?
- What form will it take (e-mail, telephone, instant messaging, etc.)?
- Are their any specific behaviors or protocols you would expect us to follow at the end of the project to be in keeping with your organization or your past experience?

If these questions are asked early, and the answers are maintained for future reference, there is a far lower likelihood of the kind of discomfort that occurred in one Fortune 10 telecommunications firm.

EXAMPLE. A project manager with the firm tells the story of his delivery of final documentation to the customer. He mailed a bundle of copies of the documentation in three-ring binders to the customer site, along with a brief handwritten note. After the delivery, relations with the customer cooled noticeably. He asked the customer if there was something wrong with the documentation, but the customer deferred the issue. Finally, several weeks later, at a postproject review, the customer excoriated the project manager for "shoddy documentation." After an extensive interview, the customer revealed that he had anticipated the product documentation in a hardback binding. Even though the project manager felt the three-ring binder would allow for greater flexibility in dealing with updates and errata, the customer was unsatisfied. The documentation failed to meet expectations. Did the products and services work? Yes. Were the end users satisfied? Yes. But the customer with acceptance responsibility was disappointed. A few minutes of thoughtful discussion on expectations at closeout could have precluded a difficult experience for both the project manager and the customer.

Externally, the needs of the customers and their end users need to be considered, as well as any regulatory needs. Internally, the needs of the team members and management must be addressed.

Planning for Termination Success

Students in the United States and Australia[1] worked to develop a series of checklist items to ensure the best possible outcome in terms of addressing the body of needs both externally and internally.

EXTERNAL CHECKLIST ITEMS

- Deliverables shipped and received
- Regulatory requirements met (and documented)
- Final results document generated
- Customer sign-off/completion certificate signed
- Customer satisfaction survey developed
- Customer satisfaction survey shipped
- Customer satisfaction survey received and tallied
- External postimplementation review conducted
- Lessons learned meeting conducted
- Lessons learned documentation generated and archived
- Final timeline updated
- Project assessment document generated
- Project-completion report drafted
- Project database archived to CD
- Celebration

INTERNAL CHECKLIST ITEMS

- Time tracking report run
- Commercials/financials approved by accounting
- Internal postimplementation review conducted (and WBS closed out)
- Lessons-learned meeting conducted
- Lessons-learned documentation generated and archived
- Lessons-learned added to corporate database
- Resource bonuses/rewards paid
- Resources reassigned
- Project records archived
- Internal sponsor signed off
- Celebration

Note that on some of these items, there is clear overlap between the internal and the external. That's to be expected, as most organizations have common needs for certain archival and tracking activities. And while most of these items seem clear, simple, and well-considered, each represents a potential pitfall in project performance.

EXAMPLE. A project manager based in the greater Washington, D.C., area was working on a nationwide installation project that kept her team members on the road for weeks at a time. In the course of a single year, most of the team members had spent only a matter of days at their homes and were grateful to see the project drawing to a close. The project manager wanted to do something to thank both the team members and their spouses for successfully weathering the project and seeing it through. She planned a gala weekend for all concerned, including fine dining and hotels and a celebration in New York City. To her chagrin, team members were universally unimpressed by the gesture. They just wanted to get home and stay there for a change. Although she went out of her way to get support for the team and to recognize their achievements, she failed to recognize some of their most basic needs—those of home and hearth. Had she considered the hidden implications of her celebration strategy and the needs of the team members in that regard, should would have recognized the need to include team members in the basic exit strategy decisions, including those related to reward and recognition.

The key to precluding these kinds of disasters is the implementation of a clear exit strategy from the earliest possible point in the project. If the project manager knows when and how the project will come to a close, and the roles of *all* participants in that closure, it becomes possible to optimize the outcome for all of those participants. In addition to checklists, that means the project manager needs to include specific close-out deliverables in the work-breakdown structure (WBS) and ensure that all participants understand that their respective roles in the project do not end until they have produced those deliverables.

Lessons Learned

Perhaps no single termination deliverable has received as much attention over the past few years as the lessons-learned documentation. Lessons learned are the ‘‘documented information. . . to show how both common and uncommon events were addressed.’’[2] Knowledge management has become a critical core competency for organizations, and one aspect of knowledge management in the project environment is capturing and disseminating the lessons learned during the life of the project. At project termination, there is a sense of urgency to complete the work and shut down the project. As such, there is a temptation to give the lessons-learned documentation short shrift, as it is perceived primarily as an administrative function.

While it may be administrative, it becomes critical to the organization because of the unique nature of projects. Each project is different and thus affords the organization new opportunities to learn new skills, capabilities, and competencies. Those traits can only be learned if they are captured and shared with the rest of the organization. They can only be learned if they are catalogued for future reference.

Lessons learned need to reflect the nature of the insight garnered during the project. As such, they can reflect both positive and negative experiences—tragedies and successes, as it were. All too often, lessons learned are perceived as the bad things that occurred during the project. In fact, they can just as frequently be the tricks of the trade that were identified, or new ways of doing business that were more successful than the old. In any case, they need to be documented and stored in such a fashion that they can and will be retrieved by project managers in the future.

Capturing lessons learned is generally a team activity. Since different team members will have different perspectives on the project experience, it makes sense to engage as many different team members as possible in the activity. They should be solicited for their experiences, particularly those that may be applicable on future projects. This may include, but is not limited to,

- Customer experiences
- Process experiences
- Vendor experiences
- Personal experiences

The idea is to review any experience that, if repeated, can be handled more effectively in light of the lessons learned during the project.

EXAMPLE. A customer with the XYZ Corporation was the primary point of contact for a utility project manager during the project life cycle. The customer would call the project organization twice a day, every day, to request status. The phone calls were augmented by multiple e-mails daily, requiring the project manager's attention. At the end of the project, the project manager documented that the customer "requested and received extensive communication—at a minimum, thrice daily, through different modes." The next time a project manager had to deal with the customer, the new project manager reviewed the lessons learned (which had been posted in a searchable database by client name) and came prepared with a communications protocol to ameliorate the situation.

Lessons learned need not reflect the emotions that may inherently be enmeshed in the experiences that teach them. They should, however, incorporate sufficient detail that future project managers may take advantage of the insights that were garnered during the first experience. A high-quality lesson learned meets the following criteria:

- It is timely.
- It is detailed.
- It is relevant.
- It is in context.

Although other criteria may be applied, these will provide sufficient information to offer value to subsequent team members and project managers. Regarding being timely, it is vital that the project manager and team members develop lessons learned shortly after the lesson actually occurs. The old adage "Time heals all wounds"[3] certainly applies in the project environment. When a project is complete, it is very easy to overlook grievances that developed during implementation and forget the day-to-day nuisances that degraded project performance. Thus, the more time allowed to pass before lessons learned are developed, the lower the quality of the lessons learned.

In addition, detail is lost over time. It is very easy to forget the nuances of a customer relationship and the specifics of organizational practice, process, and policy in the days and weeks after a project is accepted. Detail is essential to high-quality lessons learned. Details about people, places, times, and issues become essential.

Details about individuals also become essential. Although the customer organization may, as a whole, be made up of qualified and talented personnel, there may be a handful of individuals whose approach to work may delay the project. Future project managers need to know who those individuals are in order to manage future projects effectively.

Although relevance may seem somewhat subjective, the project manager should be able to ask (and answer positively) this question: Could this conceivably happen again to anyone else on a similar effort, and would they care? Relevance is crucial in determining whether a lesson learned is well constructed. Although most project managers tend to be brief, there are those who feel compelled to use lessons learned as an opportunity to build extensive histories of their achievements and accomplishments and their stellar relationships with everyone involved. In essence, they find that lessons learned afford them the opportunity to boast about their accomplishments in a forum that is socially acceptable. This is neither productive nor effective. If left unattended, this type of behavior can quickly relegate lessons learned to a position of organizational insignificance.

A high-quality lesson learned is presented in context. The environment in which an action or series of actions occurs is, in many cases, as crucial as the events themselves. Behaviors that in one context would be unacceptable and deplorable can go unchallenged in another.

Lessons learned are wonderful opportunities to develop information and share personal and corporate tricks of the trade. With the current management emphasis on knowledge management, lessons learned become key components of any well-considered closeout effort.

Celebration and Acknowledgment

As mentioned earlier, celebrations and acknowledgment have potential pitfalls associated with them. Specifically, the major concern is that the project manager may celebrate achievement or recognize individuals where no appreciation is warranted. Such a mistake can send all the wrong messages to those who do serve the organization well.

Celebrations and acknowledgment, according to motivational theorist Frederick Herzberg, serve the organization and the individual best when they reflect specific needs and open new doors and opportunities. Simply to hold a celebration to mark completion on a successful project is to damn with faint praise. Instead, such events should address the individual needs of team members for recognition specific to their accomplishments.

For some team members, such recognition may come in the form of letters from the client or from senior management. For others, the appreciation needs to come from their professional peers. For still others, the appreciation may come in the form of a more desirable assignment for their next project.

Some of that recognition is driven by the project manager's capacity to serve as the public relations liaison for the project. Although many organizations have large-scale public relations mechanisms in place, project managers have not historically taken full advantage of the opportunities they afford. In some organizations where public relations is left to the individual, the project manager may feel inadequate to the PR task.

Nevertheless, project managers should at least consider the public relations options available. Public relations is nothing more than the art and science of establishing and promoting a favorable relationship with the public.[4] To generate a favorable relationship, the project manager should consider what will make the project appear to be a success and what will make the customer more satisfied with the outcome. Both can be addressed through a simple technique that also magnifies the aura of closure associated with the end of a project. That technique is a formal transition. For years, the construction industry has mastered this art, and only recently are other types of organizations seizing similar closeout opportunities.

Consider the completion of a shopping center, major highway, or Navy destroyer. They all have one element in common: ceremony. When a shopping center or highway is complete, a ribbon is cut. When a destroyer is finished, champagne is smashed across the hull as it slides down the ways. Historically, when a technology project is complete, documentation is transferred (either in a box or electronically) and team members walk quietly away. This hardly has the same panache as the other two ceremonies. Some creators of less tangible deliverables have adopted some of the ceremonial processes of their peers in heavy construction industries.

Some technology professionals have begun packaging special copies of their deliverables or framing sample components of the deliverables for presentation to the customer. The special deliverables are passed to the customer at special meetings featuring team members and related executive staff. The key is for ceremonial closure to make clear to all parties that the project is over and transition is taking place. Even if a few lingering closeout issues remain, all participants share an understanding that the project has been handed over to the customer.

Negative Termination

Not all projects end on a positive note. Closeout is a high-stress time in the life of any project and may engender some intensely negative emotions. Minor changes become major issues in terms of last-minute costs and delays. Corrective actions become more expensive and time-consuming than at midproject. A study on project communications[5] indicates that although the number of problems reported is on the decline during the acceptance phase (normally associated with closeout), still more than 10 percent of all project problems are reported during this phase. The same study reinforces the common sense notion that problems encountered and addressed at closeout are among the most expensive to rectify. In fact, project costs may escalate at a much higher rate at project acceptance than at any other point in the project.

Contract Administration

Many of the issues associated with negative termination can be tied directly to performance in contract administration. The project manager responsible for administering the contract needs to watch for the telltale signs associated with a potentially negative termination. These signs may have little to do with the quality of the project or the quality of the relationship between the project manager and the customer. They may, in fact, have more to do with the customer's internal problems or the organizational influences being exerted on the project team.[6]

No matter the cause, some measure of resolution (at least at a surface level) becomes the obligation of the project manager. If the customer or team cannot resolve these issues, the project manager, the team, and the project itself may suffer the brunt of the customer's wrath. The following are signs of a degrading potential for positive termination:

- Sudden, significant shifts in customer expectations
- Last-minute management changes in either the project or customer organization
- Hostility between personnel in the project organization and the customer organization

It could be readily argued that only the most insensitive of project managers could miss signs that are this obvious. However, project managers tend to operate with a very distinct frame of reference in their project and can easily be blinded to some of the impending crises swirling around them. Specifically, the approaching project closeout will sometimes drive project managers to believe that their projects are doing far better than the customer believes they are. The project manager may have a tendency to confuse "done" with "good."

When project closeout takes a negative turn, it directly affects the administration of the contract. The project manager must work to minimize the risks associated with customer and organizational negativity. At this point, not all the basic risk response strategies (avoidance, acceptance, mitigation, and transfer)[7] can be applied. Avoidance is rarely an option at this late stage of the process; the customer relationship is established and few actions are available that allow the project manager to simply close the project and walk away without stressing the relationship. Although acceptance remains a possibility, it can only be applied in organizations in which the customer relationship is not a high-value item. If the customer is truly valued and appreciated, accepting the risks associated with the negative termination may lead to long-term hostility and the potential to lose the relationship altogether. That leaves the project manager with mitigation and transference as the primary strategies to reverse a negative termination.

The steps outlined under positive termination afford a sound framework for projects in virtually any condition with the customer. In projects where the customer has an extremely negative attitude, however, additional effort must be applied. Some customers are already acutely aware that a negative attitude at termination works in their favor. For years, contracting officers have used the waning days of a contract as an opportunity to extract promises and guarantees from project managers that would otherwise be considered unacceptable or unworkable.

The creative project manager as contract administrator will need to invest time and energy in finding responses to minimize the impact or probability of such behaviors. That time and energy is best invested in establishing the customer's vision of success. In a negative termination environment, there may be a significant gap between the customer's vision of success and the current status of the project.

Establishing Reasonableness

At no time should the project manager be asked to commit the organization to anything outside the scope of the existing project. If the customer is making such requests without compensation or dispensation, the project will end negatively. There is no reasonable means to reconcile that gap. However, most negative termination environments stem from differing perspectives between the customer and the project organization. In this environment, the project manager must address the customer's valid concerns. But at the end of the project, those concerns can turn expensive. Correcting problems at closeout is 20 times more expensive than correcting the same problems during a project's initial design phase.[8] The project manager must select corrective actions carefully, opting for those that will do the most to influence the customer at the lowest reasonable cost.

Changing Customer Attitudes

Another issue is that of customer satisfaction. Will the change actually influence the customer toward a more positive closeout? Team members who know the customer well may be able to accurately predict the level of customer satisfaction associated with a particular change. But the best answer to this question will ultimately come from the customer.

When addressing these issues with the customer, it is best to do so from the perspective of issues resolution, rather than presenting the option itself. ''If I come up with widget enhancements, would that make a difference to you?'' is actually a far different question from ''If I put on widget process coolers, would that make a difference to you?'' The first question allows for clarification. It makes no promise to the customer and does not intimate that a specific solution is under consideration. It gives the project manager more latitude to resolve the concerns.

Project Promises

The final issue in bridging the gap and leading the way to customer acceptance is one of customer entitlement. What does the customer deserve? The customer may have a far different perspective on this issue than the project manager. The customer deserves what the project organization (and the sales organization, in some cases) has promised. However, just because the organization has signed an agreement does not mean that the promise will be kept well. The customer organization will look to the project manager to keep the project organization's promises.

The construction industry has faced this concern for decades. In closing out projects, they create a final, master list of promises, known as a ''punch list.'' That master list provides a final understanding and agreement that when these elements are completed, the project is complete and a final signature is expected. Even the most volatile relationships at termination can be soothed if all parties have a common understanding of what remains to be done to achieve customer satisfaction.

Administrative Termination

Not all of the negativity at the end of the project is rooted in the customer relationship. It is frequently grounded in the project team, as they grow weary of working the same project for an extended period of time and in engaging with the same team members. Attitude can become a major issue in closing out a project successfully. The project manager who pushes for open, positive communication heightens the probability that the team will continue to perform well over the long term (or at least through project termination).[9] This is not to imply that the project manager must take on the role of cheerleader. It is important, however, that the project manager recognize the importance of presenting the most positive face to the customer.

A project manager in the U.S. Department of the Interior once asked why some project managers in her organization were frequently perceived as successes, even though their projects had not achieved optimal results. After a lengthy discussion, it became apparent that their attitudes toward the projects were always positive and that they did not encourage or support any discussion (either in-house or at the internal customer's facility) that painted the project in a less-than-flattering light. Their projects were not ideal. They did not have all the best resources or all the best outcomes. The project managers did have a positive attitude about their efforts and shared that attitude with both the teams and the customer. Although attitude is not enough to overcome significant technical deficiency, it may be enough to hold sway over perceived deficiencies or negative customer attitudes. Customers select projects in hopes that the project will be successful. Toward that end, the more the project manager can do to envelop the project in an aura of success, the more effective the project manager will be in both negative and positive termination situations.

Most of the assumptions up to this point are based on the premise that the project will actually be taken to its logical conclusion. Some projects don't make it that far.

Premature Termination

As with conventional termination, premature termination can be either positive or negative. Most of the time, however, premature termination of a project is perceived as negative because the project was not allowed to achieve its desired goals. That inability to achieve goals can be driven by a change in needs, a lack of funds, or a lack of time. Any or all of those three qualities can effectively shut down a project before it comes to fruition.

Most project managers will attempt to preclude premature termination as they work to perpetuate the efforts to which they have been assigned. The cultural drivers behind this persistence are strong.[10] Key figures throughout history are those who persevere and succeed. Rarely do we find historically powerful people who ran away from a problem. Because of this tendency, project managers are not often the first to identify the need to prematurely terminate a project and are often the last to cling tenaciously to a sinking ship. Politically, they recognize the implications are inherently negative, and they struggle to ensure that negative does not reflect on them.

Most premature terminations are driven by the customer organization and their priorities. For a customer to take the initiative to terminate a project, there must already be recognized shortcomings in the project's ability to meet the customer's stated needs. Once again, the project manager is driven to evaluate the customer's needs and how well those needs are being met. The two criteria that are easiest to evaluate (and prioritize) are time and money.

If the customer is out of money, there is little the project manager can do to generate more funds for the customer organization. The project manager should examine the customer organization to identify areas in which the project could provide more extensive benefits to the customer. If such areas of benefit can be discerned, the customer organization may be willing to allocate supplemental funds to see the project through to completion. The project manager should also look internally to see if there are ways to complete the project more cost-effectively. A shift in resources or a change in the scope of the project may be sufficient to bring costs in line with customer expectations or capabilities.

If the customer is out of time, the project manager may consider how the project, in its existing form, can have value for the customer. In some cases, that is simply not possible. A software program with only half the code written has no salvage value and no practical use. In other cases, creativity may afford alternatives for the customer organization. A half-dug swimming pool, for example, could be converted for use as a decorative pond or a hydroponic garden. Although these uses are far afield from the customer's original objectives, they afford the opportunity to snatch a small victory from the jaws of defeat.

FACING A POTENTIALLY HOSTILE ENVIRONMENT

The greatest challenges face a project manager when customers terminate the project because they feel that needs are not being met and satisfaction is not achievable. This often evolves in a hostile environment, where relations between the customer and project organizations are severely strained. In many cases, this environment begins not during the project's implementation phase, but in the very earliest stages of project development, because customer needs are either ignored or minimized.[11] Failure to establish the proper setting at project inception is a frequent cause of premature termination. The following three issues may influence an organization and cause conflict-driven premature termination:

- Professional and organizational needs
- Product and process needs
- Personal needs

Professional and Organizational Needs

Professional and organizational issues are difficult for the project manager to influence. Unless the project manager has influence within the upper echelons of the organization, it will be challenging to change organizational approaches and methodologies. Changes to organizational culture can be swift and devastating. In 1996, two Regional Bell Operating Companies (RBOCs), Bell Atlantic and NYNEX, announced a major merger. Project organizations in both firms immediately began reassessing their efforts and their objectives. Why? Because the potential merger could significantly influence which projects would be retained and which would be terminated. Project managers outside the RBOCs took a similar approach. They evaluated Bell Atlantic and NYNEX as customers and worked to determine how these changes would influence their contracts and their relationships. Not every project maintained by both organizations would survive a merger. Some would be phased out. Others would be altered to meet the objectives of a new, larger organization. The project managers who succeed in a new environment are those who are best able to anticipate the new customers' needs and restructure the project approach(es) into alignment with those specific needs.

Product and Process Needs

The deliverables for a project may also cause premature termination. In a prototyping environment, customers often get the opportunity to examine deliverables carefully before they are built on a large scale. As a result, customers may also find fault far earlier in the process than in an effort where deliverables are handed off at completion. Thus, in the early reviews, premature termination becomes a distinct possibility. In the early 1990s, a U.S. federal government agency committed to procurement of a network of computers with the "286" chip. The procurement was based on the government's "minimum needs"[12] requirement, and the customer (the agency) didn't see a need for anything more powerful. By the time the procurement was under way, the government recognized the need to consider the 386 (or possibly even the prototype 486) computers, which were then in production. Computer technology was changing so rapidly that before projects could be implemented, customer needs could change significantly. In this type of highly volatile environment, the project manager trying to avoid premature termination takes on the role of mentor and salesperson.

The project manager becomes responsible for customer education, enlightening the customer about how a change in product needs does not necessarily predicate a change in projects. For this approach to work, however, the project manager must be intimately familiar with the capabilities of the product or process being developed, and the project manager must have a sense of where the changes are heading.

Not all deliverable-oriented terminations are driven by changes in technology. Some are the result of customer intimacy. As a customer becomes familiar with the deliverable (whether it is a product or process), the customer may become aware that the deliverable is not what was expected and will not be able to fulfill the expectations of his or her organization.

Personal Needs

A fuzzy line exists between the concerns addressed as deliverable-oriented needs and personally oriented needs. The blur is generated by most customers' and project managers' unwillingness to acknowledge the influence of personalities on what is supposed to be a relatively sterile process. Personalities make a difference. Toward that end, project managers can take two approaches: maximize or minimize. The decision in a premature termination to maximize or minimize personality issues will be largely based on whether a positive relationship has historically existed between the two parties. Table 30–1 examines specific steps a project manager may consider to preclude premature termination if personality is a major issue.

Both approaches are equally open and honest with the customer organization. Their orientations, however, are radically different. The maximized approach guides the customer toward a more personal rapport with the project organization, emphasizing areas of agreement, whereas the minimized approach guides the customer toward a technical analysis of the project organization. Even though the approach is technical, it still emphasizes areas of agreement. When there is any doubt regarding the quality of the customer-project organization relationship, project managers should strive to minimize personality issues.

As a last resort, when personalities are a key issue that cannot be resolved, and the customer has no inclination to resolve them, the project manager should consider alternative personnel. Before going this route, however, the project manager should consult with the customer, asking the operative question: Will this make a difference? The customer may see premature termination as a forgone conclusion, regardless of the actions taken by the project organization. If that is the case, there is no need to drag in a second project team to suffer through the waning hours of a project gone bad.

Closing Out in a Premature Termination Environment

No matter the causes, the steps in the closeout process remain the same whether the project is terminated in a timely fashion or prematurely. The differences with premature termination relate to the extra effort required of the project manager to ensure that all the steps are taken with the same level of commitment. Premature termination often leads project-support organizations to withdraw resources and reassign commitments before the

Table 30–1 Steps to Preclude Premature Termination

Maximize	Minimize
• Encourage one-on-one reviews of project successes to date and issues resolution in an informal environment. • Stress the familiarity of project team members with the organization, the personnel, and the culture. • Emphasize the broad, open lines of communication between the organizations. • Talk about the mutually shared vision of the future between the organizations.	• Encourage team-on-team reviews of project successes and issues resolution in a formal environment. • Stress the familiarity of the project team members with the organization, its processes, and its technical approaches. • Stress the efficiency of the meticulously crafted communications network established between organizations. • Emphasize the clear support of the customer's vision of the future.

project can be closed out properly. Even though a project is closed out before its scheduled termination, the same elements must be in place. Contracts must be signed off and accepted. Lessons learned are especially important. Customer inquiries and concerns must be resolved. Transition of materials and deliverables between organizations must still be completed. Even with premature projects, reward and recognition is vital.

In a premature closeout, reward and recognition are often difficult to achieve. Team members may feel their efforts were for naught because the customer was not able to see a finished product or process. Upper management may not feel inclined to provide any recognition because the project is perceived as less than successful. Still, there are achievements to be recognized and milestones to be marked. To retain a sense of camaraderie (and to stand a chance of recruiting team members in the future), the project manager of a prematurely closed project must identify the successes of the effort and acknowledge the team accordingly. The project manager must also be acutely aware of the team's needs (as identified in Maslow's hierarchy). For team members suffering from low self-esteem, the project manager must mark the successes of the project. For those who fear the social loss at the end of the project, the project manager must establish communication networks to maintain team communication and build the corporate grapevine. For those who are concerned about personal safety and job retention, the project manager must secure from upper management specific commitments regarding assignments and responsibilities for members of the project team.

Antitermination

Antitermination is an utter failure to terminate the project and bring it to closure. For some project managers, project organizations, and customer organizations, this is the norm. Many organizations will keep a project alive indefinitely in the vain hope that the project will somehow turn around, generate profits, achieve goals, or restore processes simply by its weight and momentum.

Most projects that achieve this status are embedded in organizational cultures and have extensive support organizations. The scope shifts often enough to prevent any kind of blame from being ascribed for poor performance or failure to meet objectives. In some organizations, project managers will willingly participate in this environment ad infinitum because they see it as a form of job security. What they may fail to recognize is that projects borne by this type of inertia are not generally perceived as opportunities for success or advancement. They are the placeholders of the corporate culture.

For the project manager seeking to bring such an effort to closure, the final project objectives must be reevaluated, communicated, and approved. Those objectives should include a commitment from all parties that further modifications to the scope and approach will not be accepted. The exit strategy must be developed, and it should emphasize that commitment. After the stage has been set to migrate such an effort to closeout, the project manager must take on that effort with singleness of purpose. Projects with a history of escalation and modification are not easy to eliminate.[13] But after a final objective has been established, standard termination practices (as outlined in this chapter) can be put in place.

The Wrap-Up

Regardless of the early successes in a project, customers, vendors, managers, and team members are most likely to remember the closeout far longer than any other stage in the process. Toward that end, the project manager must ensure that the closeout is a positive experience in terms of the deliverables, the effects on the organizations involved, and the effects on the team members. Methodically evaluating needs and addressing those needs significantly enhances the likelihood of positive closeout.

ENDNOTES

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Chapter

31

Implementing Earned-Value Project Management in Ten Easy Steps

Quentin W. Fleming and
Joel M. Koppelman

Biographical Sketch . . .

Quentin W. Fleming is an author, instructor, and project-management consultant. He is the author of eight published textbooks that have covered the varied subjects of earned-value project management, planning and scheduling, and procurement management. He has been affiliated with the University of California at Irvine (UCI) since 1995 and serves on the UCI Project Management Advisory Board. He developed two new courses for UCI, both required components of their project management certificate program.

He was one of the eight-person core team that updated the Year 2000 Edition to *A Guide to the Project Management Body of Knowledge* (*PMBOK*) for the Project Management Institute (PMI). Specifically, he was responsible for all earned-value content in the document and also the chapter covering project procurement management.

Joel M. Koppelman is co-founder, co-owner, and chief executive officer of Primavera Systems, Inc. He is a registered professional engineer and an active member of several professional societies. He is the coauthor of the PMI-published best-selling book *Earned Value Project Management,* together with Quentin Fleming.

Mr. Koppelman received the year 2002 Award of Merit from AACE (Association for the Advancement of Cost Engineering) and the year 1994 Distinguished Contributor Award from PMI (Project Management Institute) and was named to the Drexel University 100 in the year 2000. Koppelman is also a member of Drexel University's Engineering College Advisory Council.

Field Guide to Project Management, Second Edition. Edited by David I. Cleland

Earned-value project management (EVPM) is often perceived as a complicated tool. Nothing could be further from the truth. In its most basic form, earned value requires simply following fundamental project-management practices. Earned value can best be thought of as a ''resource-loaded schedule.'' You measure performance against your resource-loaded schedule.

However, earned value does require some discipline. It requires that the project objectives be well defined and that a measurable project baseline be put in place. The earned-value baseline must reflect management's expectations for the project. The baseline consists of three elements: (1) the authorized work, typically as specified in the project's master schedule, (2) the authorized time frame, also as specified in the master schedule, and (3) the authorized budget for each major task. We refer to the EVPM baseline as the *planned value.*

When employing earned value, management will focus their attention on the completed work, which is called the *earned value.* The earned value measured also consists of three elements:

1. The authorized physical work that has been completed
2. The actual time frame in which the work was completed
3. The original authorized budget for the completed tasks

An important point to understand: actual costs do not create earned value. Earned value is simply the authorized work when it has been completed, and management's original authorized budget.

Project performance relates to the earned value achieved, measuring results from as early as 15 percent up to 100 percent completion. *Earned value* is thus synonymous with *percent complete*. Both the actual schedule and the actual cost performance are tracked against the approved project baseline.

Schedule performance is considered to be the earned value achieved, less the planned value baseline. The formula for determining the schedule variance is earned value (EV) less planned value (PV) equals the schedule variance.[1] Any number, less than 1.0, reflects a behind-schedule position. The EVPM schedule variance is important to track and typically is the first indicator that performance is falling behind the approved baseline plan.

However, a more critical indicator to watch when employing earned value is the project's cost performance. Cost performance is considered to be the earned value achieved, less the actual costs spent to achieve the earned value. The formula would thus be earned value (EV) less actual costs (AC) equals the cost variance. Any cost number less than 1.0 reflects an overrun of costs for the work actually performed. Early cost overruns must be watched closely because they are typically never fully recovered by the project.

There is nothing complicated about what we have just discussed.

Use a Simple Form of Earned Value to Help Manage All Projects

It is likely that most of the projects in the world determine their cost performance using only two dimensions: the planned costs, the actual costs, and the difference between the two. Thus, if the project spends all the allotted money, it is considered to be right on target. If it spends less than its authorized budget, this is considered to be an underrun of costs. If it spends more than the allocated costs, this is an overrun of costs. What could be more absurd? This comparison is not cost performance, but rather funding performance. It measures nothing more than whether or not the budget has been spent.

What is missing in this picture is the value of the work performed for the monies spent. For example: If the project budget was \$1.0 million, \$0.9 million was spent, but only \$0.8 million of physical work was accomplished, then, respectfully, this should be called what it is: an overrun of costs. The project spent \$0.9 million to accomplish only \$0.8 million of work. The missing third dimension of most project assessments is a measure of the value of the work accomplished.

Over a century ago, the industrial engineers, led by the father of scientific management, Frederick W. Taylor, were correct in their assessment of what represented ''true'' cost performance in the American factories. To these scientific engineers, cost performance represented the difference between the work accomplished, represented by the measured earned standards, and the actual costs spent to do the work. Cost performance to Taylor et al. was never the difference between their planned standards and the actual costs.

Today, many corporate executives still do not grasp this fundamentally simple concept and are content to focus on their planned expenditures versus the actual expenditures and refer to this as representative of their cost performance. We should never confuse annual accounting with physical project performance. The accountants may elect to reset their cost accounts to zero at each year-end close. However, projects that span two or more performance periods should never, repeat never, zero out their actual performance balances. To allow this practice is to destroy one's ability to predict the final costs based on actual project performance.

The early industrial engineers created what they called their ''planned standards,'' representing the authorized physical work and the authorized budget for the physical work. However, planned standards represented only their baseline plan, not the accomplished work. It was only when such work was completed that they could determine their true cost performance.

Thus, Frederick W. Taylor and his industrial engineering associates over a century ago focused on the ''earned standards,'' which represented the physical authorized work which had been accomplished, plus the original authorized budget for the completed work. They then compared the earned standards against the actual hours expended to determine their true ''cost performance.'' It worked a century ago in the factories. The same fundamental concept also works today in the management of projects.

The Fundamentals of Earned-Value Project Management (EVPM)

The U.S. Department of Defense (DoD) was the first organization to adopt this early industrial engineering concept for use in the management of one-time-only projects. In 1962, the DoD had underway a major new development project called the Minuteman missile. This project employed thousands of people and was costing millions of taxpayer dollars. It spanned several fiscal years. The U.S. Air Force personnel who managed this project attempted to adopt this early industrial engineering concept for use on a one-time-only project. To their pleasant surprise, earned-value management worked for them. It gave them a cost and schedule performance assessment not available with any other project-management technique.

They broke their project down into discrete pieces—separate tasks—and to each task they added an authorized budget. When each task was completed, they credited completion of the authorized physical task, plus they ''earned'' their authorized task budget. They compared this completed work, which they called the earned value, against the costs actually spent to accomplish this work. The result provided an accurate reflection of their true cost performance.

Since 1962, the Department of Defense in the Pentagon has kept track of the performance of hundreds of projects, reflecting actual performance, the good, the bad, and the downright ugly. They have now analyzed over 800 separate projects. The results have been spectacular in allowing them to predict accurately the final project cost and schedule requirements based on their actual performance.

The single most important metric to track in EVPM is the cost performance index (CPI). This metric quantifies the relationship between the earned value (the physical work accomplished *plus* its authorized budget) versus the actual costs spent to accomplish the earned value. The cumulative CPI in particular has been proven to be a stable indicator of actual performance from as early as the 15 to 20 percent completion point of any project. Thus, the CPI represents an accurate reflection of true cost efficiency and can be used to predict accurately the final cost requirements for any project, even those spanning multiple years. For example, if the cumulative CPI registers a 0.80, it means that for every dollar that was spent, only 80 cents of value was earned. This condition can also be called an overrun.

But most important is the fact that the cumulative CPI can be used, starting at the 15–20 percent completion point to forecast the final project cost results with amazing accuracy. For example, if a five-year $100-million-dollar project has recorded a cumulative CPI of 0.80 at the 20 percent completion point, one can forecast the final results within a finite range. Simply take $100 million and divide it by the cumulative CPI of 0.80. You can immediately predict the final project costs at about $125 million, or a forecasted cost overrun of approximately $25 million. How good is this forecast? Empirical studies by the DoD support the position that it will be accurate within plus or minus 10% from the $125 million final predicted costs:

> DoD experience in more than 400 programs since 1977 indicates that without exception the cumulative CPI does not significantly improve during the period between 15% and 85% of contract performance; in fact, it tends to decline.[2]

More recent additions to this same DoD study have increased the totals up to over 800 projects without changing their empirical findings.

However, many projects managers today outright reject the DoD project experience, saying that it has no relevance to their smaller commercial-type projects. The authors believe that all projects possess unique characteristics, and these fundamental characteristics of projects transcend all industries. Projects are projects. In addition, many of the DOD projects included in their empirical study represent rather sophisticated and complex endeavors: stealth aircraft, smart bombs, global positioning systems, state-of-the-art software, etc. These can hardly be called simple projects.

One independent scholarly study done by the U.S. Air Force reinforced the position that the cumulative CPI can be used to predict final project costs with great accuracy:

> [T]he cumulative CPI did not change by more than 10 percent from the value at the 20 percent contract completion point.[3]

Why Bother with Earned Value on Projects?

Employing earned value on a project provides reliable cost and schedule performance data not available with any other project-management tool or technique. Rather than allowing various organizational factions to have their own set of (often self-serving) performance data, employing earned value on projects allows everyone to track from the same metrics. Without question, the CPI is the single most important indicator available to any project when employing earned value.

The CPI on a project can be compared to tracking body temperature in a human being. Departures from the normal body temperature of 98.6° reflects a potentially sick patient. Likewise, any CPI readings of under 1.0 reflect a project in immediate need of management's attention. You get an early warning signal from earned-value project management—in time to make a difference.

The CPI represents the relationship between the earned value (the authorized work which has been completed, plus management's original budget for the completed work) and the funds spent to achieve the earned value. The index is available when one takes the earned value and divides it by the actual costs. Thus, if one registers $100 in earned value and spends $100, the CPI reflects a 1.00 value. A CPI reading of 1.0 is considered to be perfect performance.

However, if one earns only $90 but spends $100, the CPI will register a 0.9 performance figure. This condition tells us that for every dollar we spent, we got only 90 cents of value. It is an overrun condition, and overruns in the early phases of a project are very serious in that they are rarely, if ever, recovered in subsequent periods. Even if later performance gets back on track, at the budgeted value, later performance typically does not compensate for the early overrun.

The significance of the CPI is that empirical studies performed by the U.S. Department of Defense have indicated that the cumulative CPI will stabilize at the 15–20 percent completion point on a project and will become progressively more stable as the project completes the authorized work. At the 20 percent completion point, the ability to recover is ±10 percent of the performance achieved. A specific example might help.

Let us assume that a $1.0 million dollar project is 20 percent complete and has achieved a cumulative CPI of 0.75—that is, for every dollar spent they realized only 75 cents of earnings. The most probable final costs projection would be $1.0 divided by 0.75 equals $1.3 million in final projected costs. This value at the 20 percent completion point has been demonstrated to be stable by ±10 percent of the projected value. Thus, the final projected costs value of $1.3 million might be as low as $1.2 million or as high as $1.5 million. Bottom line: the project has some cost problems that must be worked out. Problems do not get better with time; they only get worse.

No other project-management tool provides an accurate reading of performance at the 15–20 percent completion point in time to make a difference in the final results.

Ten Steps to Implement Earned-Value Project Management

Implementing earned value on a new project can be considered a good news, bad news scenario. The good news is that there is nothing inherently difficult about the earned-value concept. Simply by following fundamental project-management practices, anyone can employ earned value on any project.

However, the bad news is that it takes discipline to employ fundamental project-management practices in any organization. And earned value, in order to be employed, requires that fundamental project-management practices be followed. If corners are cut and certain basic requirements are bypassed for whatever reason, then earned value cannot be effectively used. At a minimum, project goals must be set, the project scope must be defined to the best of our ability, a measurable baseline plan must be put in place and tightly controlled, and measurement of actual performance must take place. These fundamental practices are often circumvented by organizations not ready to move from functional fiefdoms into management by projects.

The authors have studied the concept and have summarized the fundamental requirements necessary to implement earned-value project management. They have reduced the requirements to ten simple but critical steps:

STEP 1: YOU MUST DEFINE THE PROJECT

On any project, you must define the work to be done, if for no better reason than to know when you are done. To the extent that you can, you must define 100 percent of the scope of the project. This is true on any project, but it is particularly critical on any project in which you intend to employ earned value. With earned value, we must constantly focus on the authorized work that has been completed, plus management's official authorized budget for the completed work. We express our status as being "18 percent complete," "27 percent complete," "47 percent complete," etc. Point: if we have not defined what constitutes 100 percent of the project, how can we ever assess our percentage completion point? Answer: We can't.

Realistically, no project will ever define a new job with absolute precision. But one must make some educated assumptions about a new project in order to quantify and then decompose the work with sufficient confidence that the effort can then be planned, scheduled, and estimated with some degree of certainty. Anything less and management will be committing to a new project by providing essentially a blank check. Vague scope definition begets scope creep.

How does one define a job when often specific details are lacking? There are no absolute answers. But one of the most useful of all tools available to any project manager is the work-breakdown structure (WBS). The WBS is to the project manager what the organization chart is to the executive. A WBS allows the project manager to define a new endeavor by laying out all the assumed work within the framework of the WBS and then decomposing each element into measurable work packages. A sample WBS is displayed in Figure 31–1.

Additionally, once the WBS is assumed to constitute a reasonable portrayal of the new project, it can then be used to take the next critical steps in the project-planning process, including make-or-buy analysis, risk assessment, scheduling, estimating, and ultimately the authorization of budgets to proceed.

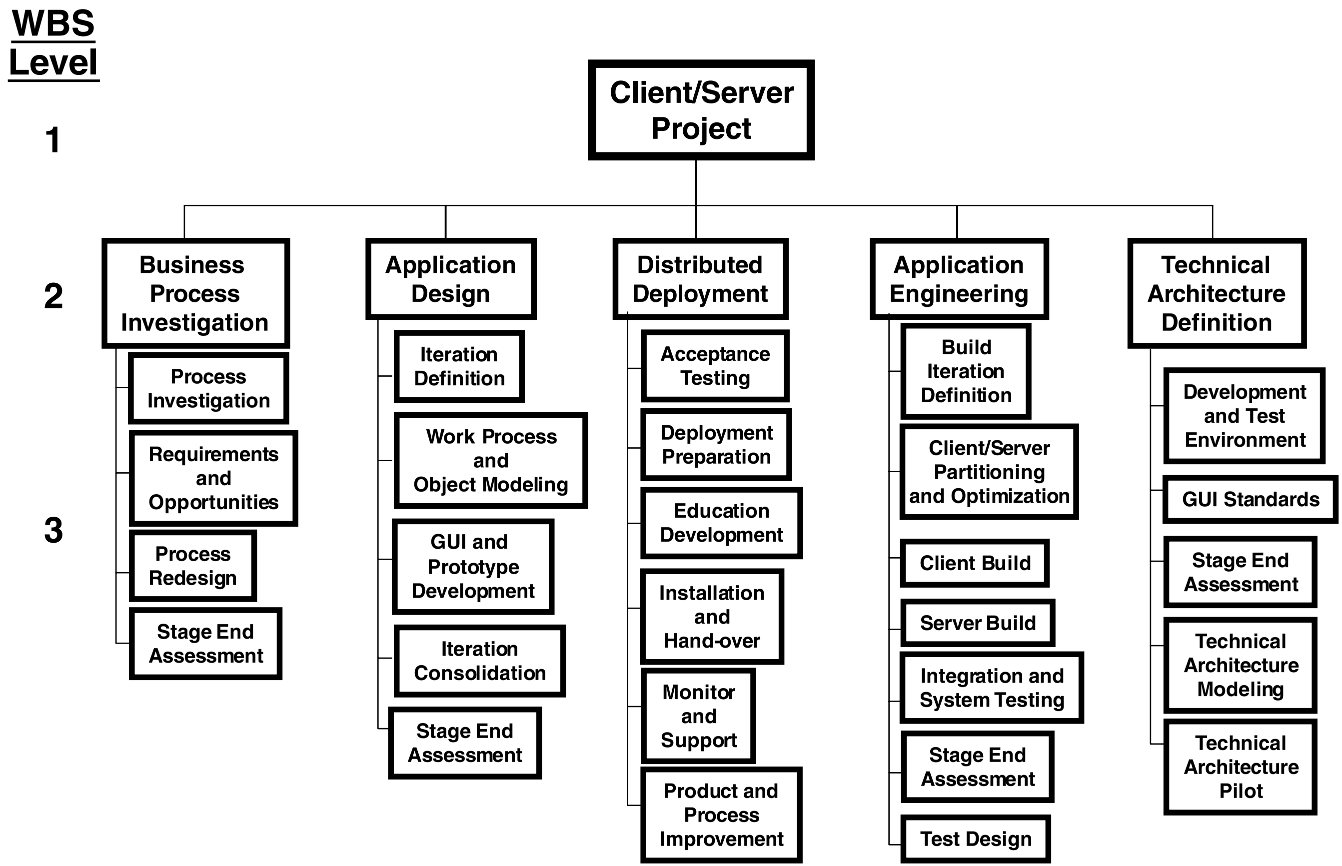

Figure 31–1 Define the Project with Use of a Work-Breakdown Structure
Source: Primavera P3 Manual)

Level 1 of the WBS represents everything the project has agreed to accomplish. All of the objectives to be met should be included in level 1. Conversely, everything the project has *not* agreed to do should lie outside level 1. If someone asks for work to be done and that work is outside of the scope definition contained in WBS level 1, it is by definition out-of-scope work. Out-of-scope work needs authorization, which may also require more budget and possibly more time, and the added work may well impact other authorized work. If one casually accepts out-of-scope work the condition is called ''scope creep,'' which must be avoided.

Level 2 of the WBS is also important in that this level reflects the management approach for the project. The project manager and typically the full project team will have collectively chosen to subdivide their project into these specific categories for purposes of management. As displayed in Figure 31–1, the project team has elected to divide their project into six discrete parts: ''Business Process Investigation,'' ''Application Design,'' ''Distributed Deployment,'' etc.

Levels 3, 4, and so forth of the WBS constitute simply a further subdivision of subordinate defined work. The two most critical levels of any WBS are thus level 1 because it represents the total project, and level 2 because it constitutes the management approach.

STEP 2: YOU MUST DETERMINE WHO WILL PERFORM THE DEFINED WORK, AND IN PARTICULAR IDENTIFY ALL MAJOR CRITICAL PROCURED WORK

It does make a difference to projects who will perform the work. Experienced workers generally work better and faster than inexperienced people, but they also cost more. Often using an experienced work force is typically a good investment. However, sometimes the project's own organization will have no experience in a particular area, perhaps in developing a new component, and the project must out of necessity send the work to another company for performance. These critical choices are called ''make-or-buy'' analysis, and determining those items which must be procured for the project is an essential extension of the scope definition process mentioned in step 1.

Why is it important to identify the work that must be procured? Simply because procurements are done under legal arrangements, formal contracts are issued, which are in effect nonforgiving. It you commit to buy something that is not what you need, or the requirements must be changed, such changes will be accommodated of course, but at a price. Sellers love to have changes in scope, because each change gives them an opportunity to ''get well'' from a tight competitive bid. Projects will find that it takes time to adequately compile a tight procurement package, which can later be enforced if need be in a court of law. The earlier the procured work is identified, and responsibilities assigned, the better such packages can be managed.

By contrast, internal budgets can be executed in a more informal way, and the fact that everyone is on the same team allows some margin for slack.

But there is no slack with the procured work. Procurements must be done properly at the start, or the project will pay a price.

Lastly, whether the project work is done by the project's own organization or procured from outside the company, the measurement and reporting of progress must take place. Inside or outside, the project must be able to measure the earned value of the work being performed.

STEP 3: YOU MUST PLAN AND SCHEDULE THE DEFINED WORK

Perhaps the single most critical tool required to implement earned value is to have a formal scheduling process in place. The project's scheduling system will portray the approved work scope, with each task carefully placed into a specific time frame for performance. In earned-value vernacular, the scheduled work (plus its authorized budget) will constitute the project's planned value. As performance then takes place on the project, that portion of the planned value that is physically completed (plus its budget) constitutes the earned value. Both the planned value and the resulting earned value emanate from the project master schedule and must use the same measurement metrics both to plan and then to measure the actual performance.

The project's formal scheduling system is thus critical to the employment of earned value because it is the vehicle that represents the project scope, the planned value, and the resulting earned value. The project master schedule is vital to earned value projects because it reflects the project manager's baseline planned value for everyone to follow.

On larger, more complex projects, a full hierarchy of project schedules may need to be put in place. Each subordinate schedule must reflect the same requirements as was defined by the project's master schedule.

Also on complex projects, there must be some method to isolate the constraints between one task and all other tasks. Typically, to satisfy this requirement some form of critical path methodology (CPM) will need to be employed. The critical path (or near critical paths) on projects must be aggressively managed and done so in conjunction with negative earned value schedule variances. A behind-schedule variance (less than 1.0 performance) indicates that the project is falling behind its baseline plan. If the late tasks are on the critical path, or they are high-risk tasks, they must be aggressively managed to successful completion.

STEP 4: YOU MUST ESTIMATE THE REQUIRED RESOURCES AND THEN FORMALLY AUTHORIZE THE BUDGETS

Once the work scope has been fully defined and subsequently planned and scheduled, the next requirement to forming an earned-value baseline is to estimate the resource requirements for all defined tasks within each level of the specified WBS elements. Each defined WBS element must have a resource value estimated to complete all of the specified work. The estimated values must be reasonable and achievable. Management will then assess the requested resources and approve a value in the form of authorized budgets. Individual budgets will not contain contingencies or management reserves. Reserves or contingencies, if they exist, must be owned by the project manager.

Remember the rule: planned value represents two things: the scheduled work, plus the authorized budget. Earned value also represents two things: the completed work, plus the same authorized budget. Thus in order to plan and then measure earned value one needs to schedule all defined tasks along with the authorized budget necessary to complete the tasks.

All authorized budgets must be achievable in order to have a viable project baseline.

STEP 5: YOU MUST DETERMINE THE METRICS NEEDED TO CONVERT PLANNED VALUE INTO EARNED VALUE

Earned value as a project-management technique focuses on the accomplished earned value. The technique represents (1) the authorized work that has been completed, plus (2) the official authorized budget for the completed work. The actual costs incurred to convert planned value into earned value have nothing to do with the measurement of earned value. Earned value, often referred to as percent complete, is simply the authorized scope that has been completed, plus the original authorized budget for that work.

Question: how does one measure the conversion of planned value into earned value? Answer: one sets up metrics in the baseline project schedules to quantify the authorized work and then the completion of the authorized work. Specific milestones or tasks with weighted values are measured as they are physically completed. Remember, earned-value project management is nothing more than managing a project with a resource-loaded schedule.

Over the years since earned value was first introduced, various methods have been devised to measure project performance. However, the most respected methods use some type of discrete measurement. Specific milestones representing points in time are assigned values; when fully completed, the assigned budgeted values are earned. Also, tasks are assigned values that can be measured as they are partially completed, at which time some value is assigned to the completed work through the reporting period.

Displayed in Figure 31–2 are four of the more respected methods to measure performance using what is called discrete measurement. Each method will need to be understood.

At the top of the figure are shown *milestones,* with each milestone assigned a weighted value, a specific budget. As the milestones are worked and partially completed, no earned value will be credited. It is only when the milestone is completely finished that the total budget is earned. Thus, milestones are sometimes referred to as 0–100 percent measurements. Weighted milestones are somewhat like an ‘‘off-on’’ switch.

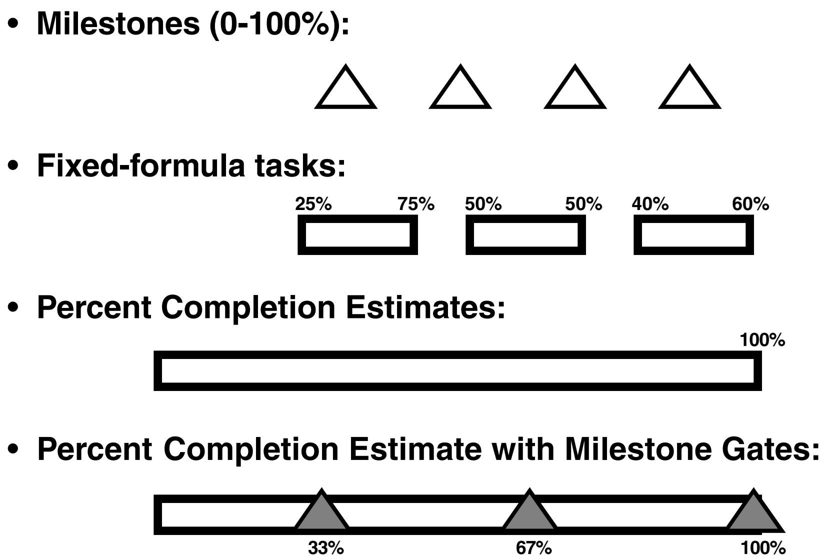

Figure 31–2 Metrics to Convert Planned Value into Earned Value

The second line in Figure 31–2 represents a measurement technique called *fixed-formula*. Work is expressed by individual tasks, with each task assigned a specific budget. When a task is legitimately started, some predefined percentage of the total budget is earned, and when the task is completed, the other predefined percentage is earned, up to 100 percent of the budget. Before work is commenced, the percentage values for starting and finishing each task are set, which must add up to 100 percent. As shown in the first task, the split is 25 percent to start and 75 percent to finish. In the middle 50 percent, 50 percent is used. At the right the split is 40 percent to start and 60 percent to finish.

When using this method, earned value is only credited with the start or finish of the task. It is thus important that all tasks span only one or two reporting periods. If measurement is on a monthly basis, the defined tasks must start in one month and finish in the same month or the succeeding month. You would not want to start a task and credit earned value, then wait several months before earning the balance of the 100 percent. Likewise, if measurement is on weekly basis, the same rule applies with fixed-formula: not more than two reporting periods per task.

The third line in Figure 31–2 represents *percentage completion estimates*. There is nothing inherently wrong with this method, but, if one wants to play games with earned-value measurement, it is typically done with subjective percentage completion estimates. With this method, a grouping of work is defined with a long task, which can span several reporting periods. As each reporting period is completed, the manager in charge of the work provides a subjective estimate of the work completed, against the total allocated budget. A 47 percent complete estimate suggests that 47 percent of the physical work has been completed, and 53 percent lies ahead.

One of the best checks on the validity of using subjective percent complete estimates is to have an aggressive and astute management that understands the earned value process. If senior management periodically reviews the status of each task and challenges percentage complete estimates that appear excessive, this subjective earned-value technique can be quite accurate. It is easy to plan and administer. However, many people have had bad experiences with percent complete estimate, where excessive estimates of performance were claimed, taking credit for work not yet performed.

To overcome the possibility of poor estimates of actual performance with subjective percentage completion measurement, the next method was devised, which possesses both the ease of administration and built-in checks and balances similar to using specified milestones. This technique, called *percent completion estimate with milestone gates,* is displayed on the bottom line of Figure 31–2. It resembles percent complete estimates, but it inserts specific tangible milestones, which serve as gates or checkpoints that cannot be passed until specific deliverables have been achieved.

In the case of this long task as shown, there are three milestones to be satisfied: at the 33 percent point, at 67 percent, and finally at 100 percent. In order to go past these three milestones, certain predefined criteria must be satisfied, example deliverables made. A deliverable can be a specific piece of hardware, a drawing, or an intellectual position such as a technical position paper, a preliminary design point, etc. In between these milestones, the manager in charge will provide their subjective estimates of the percentage completion. But they cannot go past each milestone until the specified criteria have been met.

These four methods will typically represent the most accepted methods used to measure project performance discretely. There are other methods used to measure performance that are beyond the objectives of this brief earned-value introduction. Anyone interested in the subject can do additional reading on the subject.[4]

STEP 6: YOU MUST DETERMINE THE POINTS OF MANAGEMENT CONTROL AND FORMALLY AUTHORIZE CONTROL ACCOUNT PLANS (CAPS)

Earned value requires use of an integrated project baseline, meaning that the defined work scope must include both the baseline schedule and the authorized budget. Integration takes place within each of the specified work-breakdown structure elements.

Project management must next specify their points of management focus, referred to in earned value as control account plans (CAPs). CAPS are placed at selected WBS elements and can best be thought of as subprojects, or project teams, subdivisions of the full project. The sum of the CAPS will constitute the total project baseline. The actual earned-value performance measurement will take place within each of the specified CAPs. Total project performance is simply the summation of all the detailed CAPs. CAPs can be placed at any level of the WBS.

Displayed in Figure 31–3 is the same WBS that was used earlier to define the initial project. At this point the project manager, typically supported by the full project team, will have selected level 2 of the WBS to place their points of management control, the CAPs. Each designated CAP must contain four elements: (1) a unique statement of work, (2) a schedule for performance, (3) a finite budget, and (4) someone designated with authority and responsibility for the performance of each CAP, typically called the CAP manager. Performance measurement takes place within each CAP of the project, and the sum of the CAPs will constitute the total project. The total project is simply represented by the sum of the CAPs.

On commercial type contracts, the total project baseline may sometimes include such things as indirect costs, and even profits or fee, to match the total authorized project commitment. The project baseline must thus include whatever senior management has authorized the project manager to accomplish.

Internal company projects typically do not contain indirect costs, or profits. Many (perhaps most) internal project baselines will simply represent the sum of the defined CAPs, which are made up exclusively from direct labor hours only. The authorized project baseline must constitute whatever management has decided it should be.

STEP 7: YOU MUST RECORD ALL DIRECT PROJECT COSTS CONSISTENT WITH THE AUTHORIZED BASELINE BUDGETS, IN ACCORDANCE WITH THE ORGANIZATION'S GENERAL BOOKS OF ACCOUNTS

A simple rule: Project managers must be told what they have spent on their projects. Some organizations find this basic task difficult, even impossible. How can that be? Simply because many organizations have been functionally oriented for so long that they cannot see the projects from their functions. They can tell how much money was spent by functions, engineering, test, maintenance, manufacturing, etc., but they cannot tell the project managers what they have spent. They have not made the transition to management by projects.

In order to employ earned value on a project, the actual costs must be aligned to the authorized project budgets. Remember the rule: planned value represents the authorized work plus budget, which is then converted to into completed work and the same budget to form the earned value. Earned value must then be related to the actual costs to determine the cost efficiency factor, called the cost performance index (CPI). The CPI is the single most important metric for any project employing earned value. Thus cost actuals by project, by subproject (CAPs) is an absolute requirement in order to employ earned value.

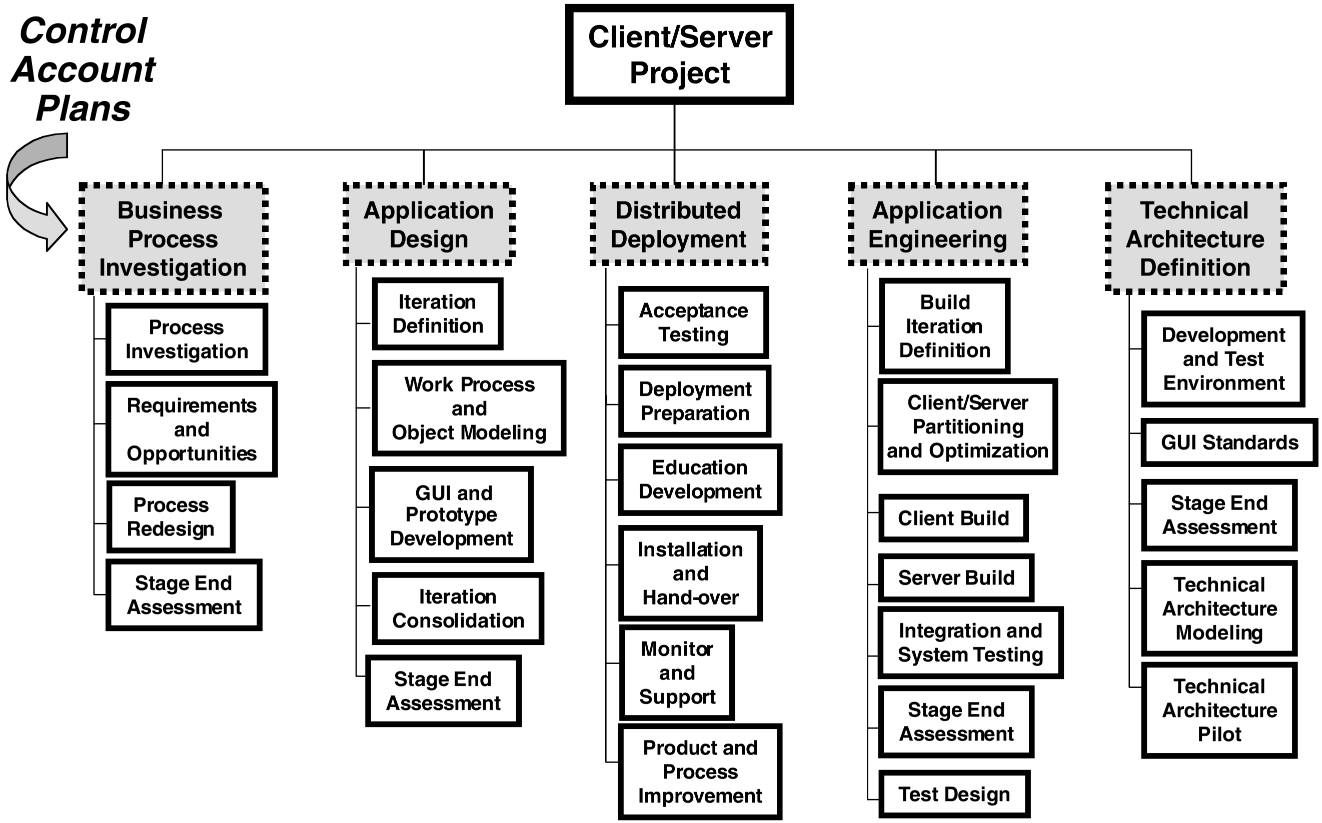

Figure 31–3 Determine Points of Management Control (CAPs)
Source: Primavera P3 Manual)

There is a trend in projects that employ earned value to measure their performance on a weekly basis. We need to understand what this means and what it does not mean. Weekly earned-value measurement means the measurement of internal direct labor hours. On a weekly basis, the company labor tapes will produce a planned value, an earned value, and actual hours for internal direct labor only. Direct labor dollars, indirect costs, purchased articles, travel, etc. are not available on a weekly basis. Weekly performance measurement takes place on the internal direct labor hours only, and this can be a major factor in effective project controls.

The requirement for accuracy in the weekly labor reports is critical. Any error factor in labor reports will invalidate their usefulness. Errors in labor can occur for a number of reasons. People charge to the wrong account numbers, they insert the wrong numbers, they continue to charge to completed projects, etc. In order to eliminate errors, some companies have put in place a direct labor-tracking system that is fully automated. Employees must type in their project codes at the start of the reporting cycle. If employees type in an incorrect labor code, the automated system immediately rejects the charge and the employee must correct the error prior to starting work. Accurate labor tapes are critical to measuring weekly earned value.

STEP 8: YOU MUST CONTINUOUSLY MONITOR THE EARNED-VALUE PERFORMANCE TO DETERMINE EXCEPTIONS TO THE BASELINE PLAN: THE SCHEDULE VARIANCES (EARNED VALUE LESS THE PLANNED VALUE) AND THE COST VARIANCES (EARNED VALUE LESS THE ACTUAL COSTS)

Projects employing earned value will need to monitor their cost and schedule results against the authorized baseline for the duration of the project. Management will focus its attention on exceptions to the baseline plan, particularly those that are beyond previously defined acceptable limits or tolerances. Earned value is a management-by-exception concept.

A negative earned-value schedule variance simply means that the value of the work performed does not match the value of the work scheduled, that is, the project is falling behind in its scheduled work plan. Each behind schedule task should be assessed as to its criticality. If the late tasks are on the critical path, or if the tasks carry a high risk to the project, then efforts must be taken to get the late tasks back on schedule. However, additional project resources should not be spent on low-risk tasks or tasks that have positive critical path float.

The single most important aspect of employing earned value is the cost-efficiency readings it provides. The difference between the value of work performed and the costs incurred to accomplish the work provides the cost efficiency factor. If the project spends more money than it receives in value, this reflects an overrun condition. Absolute overruns are typically nonrecoverable. Overruns expressed as a percentage value have been found to deteriorate unless the project takes aggressive actions to mitigate the condition.

Perhaps of greatest benefit, the earned-value cost efficiency rate has been found to be stable from the 15 percent point of a project completion. The cost efficiency factor is thus an important metric for any project manager or enterprise executive to monitor.

STEP 9: USING EARNED-VALUE METRICS, YOU MUST CONTINUOUSLY FORECAST THE FINAL REQUIRED COSTS BASED ON ACTUAL PERFORMANCE AND KEEP MANAGEMENT APPRISED SO THEY CAN TAKE CORRECTIVE ACTIONS IF NECESSARY

One of the more beneficial aspects of earned value is that it provides the capability to forecast quickly and independently the total funds required to complete a project, commonly referred to as the estimate at completion (EAC). Based on actual cost and schedule performance against the baseline plan, a project is able to estimate accurately the total funds it will require to finish the job within a finite range of values. The earned-value statistical estimates constitute a sort of sanity check against other forecasts or fixed management positions. Often management or customers will have a preconceived, unmovable notion of what final costs should be (or what they would like them to be).

If the earned-value statistical forecast of estimated final costs is greater than the official project manager's estimate to complete the project, someone needs to reconcile these professional differences of opinion.

Actual performance results on any project, good or bad, are in effect sunk costs. Such costs represent what the project has actually achieved in performance. Thus, any improvements in performance must come from the future work, tasks that lie ahead of the project's status date. Earned value allows the project manager to quantify accurately the cost and schedule performance achieved to date. And if the results achieved to date are less than those desired by management, the project can exert a more aggressive posture to manage all of the future work.

Earned value, because it allows the project to quantify accurately the value of its work it has achieved, also allows the project to quantify the value of the future work in order to stay within the objectives set for the project by management. The single most respected method to forecast the final cost results is to assume that the project will continue at its established cost efficiency rate—it will get no better or no worse. There is a scientific basis for this assumption. As mentioned above, the cumulative CPI does not typically vary by greater than 10 percent, plus or minus, once the project is 20 percent complete. Thus, the cumulative CPI is a stable metric from the 20 percent completion point and can be used to predict the final required costs.

Displayed in Figure 31–4 is a forecasting method of final required costs based on the assumption that future cost efficiency will not change significantly from results thus far achieved. For example, if the project budget is

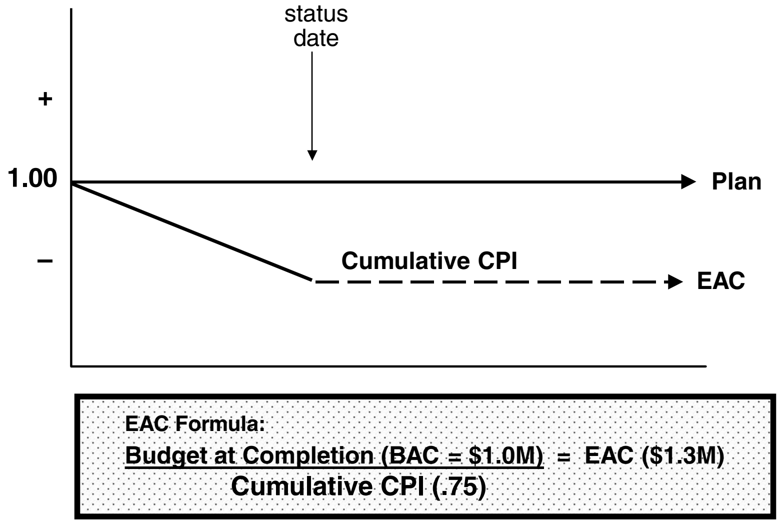

Figure 31–4 Forecasting the Final Estimate at Completion (EAC)

$1.0 million and the cumulative cost efficiency factor achieved is 0.75, then the final projected costs would thus be $1.3 million ($1.0 million divided by 0.75 efficiency factor equals approximately $1.3 million). With earned-value forecasting we are not looking for absolute precision; rather, we want to determine whether or not we have a problem. If a 30 percent overrun is a problem, then steps need to be taken immediately to figure out a way to bring the projected final costs under control.

Thus corrective actions can be taken early, as early as 20 percent through the project, to stay within the final expectations of management.

STEP 10: YOU MUST MAINTAIN THE DEFINED SCOPE BY APPROVING OR REJECTING ALL CHANGES AND THEN INCORPORATING THE APPROVED CHANGES INTO THE PROJECT BASELINE IN A TIMELY MANNER

The project performance-measurement baseline that was initially put into place at the start of the project is only as good as the management of all proposed new changes to the baseline for the duration of the project. Performance baselines quickly become invalid simply by failing to incorporate changes into the approved baseline, with the addition of or deletion of added work scope.

All new change requests of the project must be carefully addressed, either approving such changes or rejecting them. In order for the initial baseline to remain valid, each and every change must be controlled. Maintaining an approved baseline can be as challenging as the initial definition of the project scope at the start of the project.

1. Define the project scope
2. Determine who will perform the work
3. Plan and schedule the defined work
4. Estimate resources and authorize budgets
5. Define metrics to measure performance
6. Determine points of management control
7. Record costs by projects
8. Measure project performance
9. Forecast estimates at completion
10. Manage changes to the project baseline

Figure 31–5 Ten Steps to Implement Earned-Value Project Management

Summary

Earned-value project management is not a difficult concept to understand or to employ. It is certainly not as complicated a process as some have made it to be over the years. The authors have concluded that effective earned value can be achieved by simply applying ten steps, as listed above. These ten simple steps are summarized in Figure 31–5 and can be applied to any project in any industry.

As you read over these ten suggested steps, we hope you come to the conclusion that employing earned-value project management consists of nothing more than simply following fundamental best project-management processes.

ENDNOTES

1 All earned value formulas described herein are consistent with *A Guide to the Project Management Body of Knowledge* (*PMBOK*). Newtown Square, PA: Project Management Institute, 2000

2 Beach, Chester Paul, Jr., *Administrative Inquiry Memorandum on the A-12 Cancellation.* United States Department of the Navy, November 28, 1990, p. 5

3 Christensen, David S. and Heise, Scott R. *Cost performance index stability. National Contract Management Association Journal* 25(1):7–15, 1993

4 Fleming, Quentin W. and Koppelman, Joel M. *Earned Value Project Management.* Newtown Square, PA: Project Management Institute, 2000

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Chapter

32

Legal Considerations for Project Managers

Randall L. Speck

Biographical Sketch . . .

Randall L. Speck is a partner in the Washington, D.C., office of the law firm of Kaye Scholer LLP. He specializes in complex litigation and arbitration involving project-related disputes. His cases have included disputes that arose from the construction of the Trans-Alaska Pipeline, the Diablo Canyon nuclear power plant, the Seabrook nuclear power plant, the Bataan (Philippines) nuclear power plant, and from the decommissioning of the Maine Yankee and Connecticut Yankee nuclear power plants.

Project managers develop, execute, and complete their projects within a tangled framework of laws, regulations, and conventions.[1] To the hapless project manager, that jumble sometimes appears to be a virtually indecipherable maze that defies rational management. Acrimonious disputes—culminating in debilitating lawsuits or arbitrations—descend like a plague, striking down an apparently successful project in its prime. The project manager can summon his wizards (a.k.a. the dreaded lawyers) in an effort to lift this spell, but rarely does the project recover fully.

Fortunately, the adept project manager has an effective remedy. Although the specific nature of looming legal problems cannot be known at the product's inception, the project manager can rely on two facts. First, given the litigious nature of our 21st-century society (both in the United States and, increasingly, abroad), disputes are almost certain to arise in any significant project, and the parties will often seek vindication for perceived assaults on their rights. And second, for all its shortcomings, the legal system usually provides a reasonably predictable set of rules that can be identified and integrated into the project's structure. Like other serious risks to the project's success (e.g., an innovative design, ambitious schedule milestones, or first-

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of-a-kind approaches), the project manager's planning and implementation should attempt to minimize potential legal hazards.

Assessing the Legal Framework

At the inception of the project, before any substantial commitments have been made to proceed, the project manager should fully appreciate the numerous legal relationships that may require significant management attention as the project progresses. Those legal strictures may be defined by both formal and informal relationships.

Project-Specific Agreements

A binding legal document—usually a contract—defines the terms under which one organization will make its resources available to another organization for the project. Obviously, the terms of each contract should be shaped to reflect the needs and priorities of the project. The following are typical formal agreements that project managers use to define project relationships.

AGREEMENT WITH PROJECT OWNER

The most familiar project relationship is between its owner and the contractors with whom the owner engages directly to perform aspects of the work. That customary arrangement is subject to many variations, however. For example, the owner may contract with a project manager who subcontracts to others who will actually conduct the work. Alternatively, the owner may contract directly with a project-management contractor as well as with each of the other implementation contractors. Of course, each of these arrangements creates different legal obligations between the owner and contractors and among the contractors.

JOINT VENTURE

Other project-specific relationships are often equally crucial to success. For example, multiple owners frequently undertake large projects jointly. In those cases, the joint venture or partnership agreement is vital to harmonious management of the project. Without a clear understanding of each partner's role at the inception, the owners may not be able to make timely, prudent decisions in the project's best interest.

FINANCE AGREEMENT

If the project is financed externally, the project finance agreement is also significant. Because the financing institution risks its capital, it may insist on some control over a major project. For example, the financing institution may require compliance with certain scheduling milestones or may demand its consent to budget increases. In effect, the financing institution assumes some of the responsibilities of a partner in the venture, and the project manager must accommodate the financier's rights to monitor and to exercise specified controls over the project.

INSURANCE POLICIES

The project manager also minimizes the project's financial risks through insurance policies (which are also binding legal contracts) to cover potential hazards. The project manager may reduce the chances of a calamity by defining the following:

- The scope of the insurance coverage (e.g., negligence, environmental damage, and directors' and officers' liability)
- The limits of liability (e.g., the amount of deductibles)
- The parties who are responsible for insuring against particular losses (e.g., the owner or the contractor)
- The measure of damages (e.g., lost profits as well as property loss and replacement value versus actual cash value)

LICENSE FOR TECHNOLOGY

Some projects will require a license for the use of proprietary technology. Such a license agreement may limit the project manager's flexibility. For example, a license permitting use of a patented technique may include geographical restrictions. Thus, the project manager may be able to apply the technology to development of a project in the United States but may be precluded by the license from using the same approach in Europe.

Noncontractual Stakeholders

Not all of the project's legal relationships are reflected in contracts or similar documents. Some of the project's stakeholders—such as governments, end users, competitors, interest groups, investors, and employees—have their own parochial objectives and demand that the project manager adjust project goals to satisfy their expectations. Although there is typically no formal contract defining their specific roles and responsibilities for the project, the following third parties may have significant, legally protected rights that the project manager must respect.

GOVERNMENT

As a result of its power to regulate and to grant licenses or permits, the government plays a crucial role in the development and execution of many projects. That role may be as straightforward and predictable as the application for a city construction permit for an addition to a residence, or it may be as complex and uncertain as the process for obtaining U.S. Nuclear Regulatory Commission approval for license termination at a decommissioned nuclear power plant. It is the project manager's task to identify the intricacies of the government requirements and to fashion the project's planning to satisfy them.

In some instances, the government's regulatory role makes it a self-proclaimed watchdog over the project manager's performance. For instance, under both state and federal law, regulated industries may only recover their ''prudent'' expenditures from ratepayers. (In effect, the regulators act as surrogates for competitors in a monopolistic industry.) Thus, regulatory bodies sometimes conduct extensive post-hoc critiques of projects to determine whether expenditures were prudently and reasonably incurred. That evaluation is generally based on a comparison with best practices, not merely with average or minimally acceptable performance. Any project subject to such scrutiny should prepare from the earliest stages to justify every significant decision with documentation and analysis. To the extent possible, the project manager should inform government regulators of key decisions as they are made and, if possible, obtain their contemporaneous acceptance.

When there is any doubt about the interpretation of local law, the project manager, with the advice of a local lawyer, should include a provision in project contracts and other agreements specifying that those documents will be construed based on a particular state or national law whose application will produce a predictable outcome.

END USERS

The ultimate consumers of a project (e.g., the purchasers of a new drug who will pay indirectly for the cost of its development) have an obvious stake in a project's success, but they are typically unrepresented during its inception and implementation. Nevertheless, they may make demands that can ripen into legal disputes as the project progresses, and their impact should be evaluated during the feasibility phase of the project. For example, AIDS victims have organized, brought lawsuits, and sought legislation in an effort to speed the development of pharmacological treatments for HIV and to reduce the costs of those therapies. Pharmaceutical project managers who fail to take these pressures into account may not be able to recover all of their research costs as anticipated, possibly making product development less attractive or marketing more difficult.

COMPETITORS

Since the trust-busting era at the beginning of the 20th century, competitors have acquired significant rights to attack what they perceive to be anticompetitive activity. For instance, a competitor may seek to enjoin a joint-venture project that it believes will violate antitrust or price-fixing statutes. The project manager may be able to take steps during the feasibility stage to foreclose a successful challenge to the venture.

Competitors may also have rights to contest the project manager's choice among bidders, especially for government projects. Government contract awards are subject to strict regulation, and any deviation from those regulations may provide fodder for a competitor's challenge. Both the project manager and prospective contractors should take great pains to comply with all bidding strictures to foreclose disputes related to contract awards.

INTEREST GROUPS

A project often affects the community at large, and the project manager must account for that impact in assessing project feasibility. The legal mechanisms for an interest group to vent its displeasure over a project are legion. Examples are creative application of zoning regulations, rigorous scrutiny of environmental impacts, and proscriptions on development of the required infrastructure. It behooves the prudent project manager to anticipate areas of potential community opposition and to persuade antagonists to cooperate as much as possible by making reasonable accommodations. For example, a project manager was able to assuage community concerns about traffic congestion that threatened the viability of the project by agreeing to pay the city to install traffic signals. If such an accommodation strategy is not successful, the project manager should expect and plan for implementation delays by providing contingencies for belated approvals so that the resulting delay period can be used effectively. During the delay period, the project team may be able to advance a design or complete a necessary infrastructure.

INVESTORS

Major projects often assume such a conspicuous standing within a company that their success becomes material to the company's profitability. In those projects, the company's shareholders have legal rights to accurate and complete information about the project. The Securities Exchange Act of 1934, 15 U.S.C. § 78j(b), permits shareholders or the Securities and Exchange Commission to sue for damages if a company's annual reports or other public documents materially misrepresent the company's status. If a material misrepresentation about the project's progress could influence a shareholder's investment decision, it may provide grounds for litigation. The recent Sarbanes-Oxley Act and the heightened profile of corporate scandals places even greater obligations at all levels within a public company to identify and disclose material information. The project manager should take particular pains to ensure that any public representations about the project are scrupulously correct and that all necessary disclosures are made.

EMPLOYEES

Employees are hardly a fungible resource that project managers can reassign or displace with impunity. Many managers, whose spouses often have equally desirable jobs, are no longer willing to relocate simply to suit a project's needs. Collective-bargaining agreements and nondiscrimination statutes may also restrict the project manager's ability to assign particular employees to the project without the risk of a lawsuit. Employees are typically well-informed about their rights and will not hesitate to assert them. The threat of a grievance or suit, therefore, is a very real limitation in making personnel assignments.

Operating Abroad

The very fact of operating outside in a global economy carries legal implications for a wide range of project activities. For instance, personnel operating abroad will have to comply with local tax, immigration, and customs laws, but the project will usually have to make those arrangements for its employees to attract them to overseas projects. The project may also have to obtain special permits to export sensitive technology. There restricting may impose a serious impediment to the free flow of technical information that is essential in every project.

The economic and political uncertainties of operating in some countries extend to their legal systems as well. Emerging countries or countries recently wracked by domestic or international conflict frequently have not developed the sophisticated legal tradition that is necessary to support large commercial projects. As a result, a project manager may not be able to rely on the consistent, fair resolution of disputes using a still embryonic legal system. Thus, it may be preferable to seek an alternative forum to the local courts. For example, contracts may specify that disputes will be resolved through mediation or arbitration under the auspices of an international body such as the International Chamber of Commerce. Contracts may also specify that disputes will be resolved by reference to a neutral law. One of the most promising developments is the promulgation of the 1994 Unidroit Principles of International Commercial Contracts. Project managers may specify this authoritative compilation of internationally accepted concepts as a mutually acceptable law for the resolution of disputes, particularly when dealing with foreign governments that are reluctant to submit their sovereignty to any other country's national law.

Because many non-U.S. projects are conducted for government entities, U.S. project managers must also be sensitive to the requirements of the Foreign Corrupt Practices Act (FCPA), 15 U.S.C. § 78dd. This statute prohibits a U.S. company from using sales representatives or other intermediaries when there is reason to believe that such agents may transfer part of their commissions to foreign government officials in exchange for favorable treatment. In some circumstances, the FCPA may also proscribe ''grease'' payments made to obtain a license or permit. Because the FCPA is a criminal statute, it demands very serious consideration by project managers operating abroad, and project managers should be fully cognizant of its sometimes ambiguous requirements. Because of these restrictions, U.S. companies may be at a disadvantage in bidding for government projects in countries where bribes are the norm, and that fact should be considered during the feasibility phase.

Legal Issues for Project Planning

It is a truism that the quality of a project's planning often dictates its success or failure. The project manager[2] should establish at the beginning the project participants' legally enforceable rights and obligations so that they are consistent with the parties' assigned roles and responsibilities on the project.

Defining Rights and Obligations

Project managers have a variety of tools to assist them in defining and later controlling the project effort. These tools include work-breakdown structures (WBS), network schedules, linear-responsibility charts, cost estimates, technical criteria, and quality-control measures. If these tools are to be effective, however, the project manager must take steps to translate the project's objectives into the project participants' legal obligations. Both human nature and a profit-based economy ensure that the players in a project will take actions that they believe will be rewarded and will avoid actions that they expect will be penalized.

EXAMPLE. In North Carolina, an entire project to repair a multi-million-dollar wooden blimp hangar went up in flames because the repair contract did not assign responsibility for a fire watch. If the contract had expressly assigned responsibility to a welding subcontractor for establishing a fire watch to prevent incipient sparks from igniting nearby flammable materials, the subcontractor would have instituted the fire watch.

By including such contract language, the project manager would have accomplished the following:

1. Identified the need for a fire watch
2. Assigned responsibility for it to the welding subcontractor
3. Communicated that assignment to the welding subcontractor in the most forceful terms available—a contract condition that specified rewards and penalties

For the North Carolina blimp hangar repair, however, the contract was silent about this responsibility. The welding subcontractor may have legitimately assumed (consistent with its economic interests) that a fire watch was the general contractor's assignment. Because of this ambiguity, both contractors seemed to have neglected to take this necessary fire prevention step—with the consequence that a stray spark smoldered unattended until after all the workers had left and the project literally went up in flames.

Contracts to Fit the Plan

Formal contractual obligations are the project manager's most effective mechanisms for communicating and enforcing project responsibilities. In fact, because contractual language creates legally enforceable obligations, the parties will almost always follow the letter of the contract rather than a tacit assumption that the parties neglected to include in the written agreement. Many agreements even contain a boilerplate "integration" clause providing that the contract represents the parties' entire agreement and cannot be changed or modified except by a written document signed by both parties. Such a provision places a premium on drafting a complete, precise agreement that reflects the way the project will actually be managed and implemented. With a clearly written agreement, the parties ensure a mutual understanding of their respective duties.

During the planning phase of a project, the proficient project manager will develop a detailed definition of the project in terms of its expected scope, cost, schedule, and technical performance. As a part of that process, the project manager will also allocate responsibility among the project's participants and assign authority over aspects of the work, in accordance with the project's WBS. It may be appropriate to incorporate a linear-responsibility chart, for example, as an integral component of the formal agreement to ensure that the parties are aware of their obligations and that the assumption of those duties can be enforced.

Contracts to Ensure Project Control

Given the variations in project requirements, it is impossible to construct a contracting template that will fit every project. As a general rule, however, anything that is important to the project's success—particularly the mechanisms for exercising control—should be reflected in its legal documentation.

For example, first and foremost, the project's contracts and agreements should affirm the project manager's authority. This designation may take a variety of forms, including a provision permitting the project manager to direct a contractor's work or a joint-venture agreement designating the project manager as the owner's sole representative. There should be no ambiguity over who is in charge.

The project's legal documentation should also anticipate changes in roles and responsibilities over the course of the project. For example, during the design phase of a construction project, it is appropriate for the architect or engineer to have primary responsibility. Once the design has moved to the field, however, the construction contractor should ordinarily take the lead, and the architect/engineer should assume a more supportive role. That planned evolution of roles should be reflected in the contract so that when this change occurs, all the parties will support a smooth transition.

If intermediate schedule milestones are significant (as they usually are to maintain appropriate control), they should be explicitly included as a part of the contract. It may not be enough, however, merely to tie progress payments to successful completion of broadly defined milestones. Each triggering event should be defined precisely and objectively so that there can be no doubt whether it has been achieved. The rewards or penalties associated with the milestone should make its attainment worthwhile. If regulatory or owner approval is necessary or desirable at a particular stage in the project, the required documentation for that approval should be expressly specified in the contracts.

EXAMPLE. If the project contract provides only lump-sum penalties for missing critical milestones, the owner will lose all leverage to enforce the schedule once the milestone is missed and the full penalty incurred. A more effective contractual incentive provides graduated and increasingly generous penalties for missing a critical milestone. Such a contractual payment structure keeps the contractor focused on the proper project objectives.

It is sometimes tempting at the inception of a project, when planning is not yet complete, to leave parts of the contractual relationships ambiguous, with the expectation that they can be defined more precisely as the project progresses. However, if a plan is not developed enough to define responsibilities, this may be a warning sign that it is premature to establish binding legal commitments.

EXAMPLE. If the owner is unable to identify subsurface conditions that a contractor may encounter in building a foundation, and therefore the parties cannot specify the cost or schedule that will be used to control the work, it may be appropriate to postpone contracting until the owner conducts further geological studies.

Resolving Uncertainty

Despite reasonable planning, occasionally some significant uncertainty cannot be firmed up until the project proceeds. In that case, the contract should spell out a method for resolving the uncertainty and fixing control criteria once the scope becomes clearer. In the foundation example, for instance, the parties might agree on cost and progress unit rates for various types of materials that could be encountered and on an objective test to identify the material type. Thus, the project could proceed based on an understanding about how the parties will deal with evolving information.

Performance Measures

One of the project manager's primary tasks is to strike a balance among the project's schedule, cost, and quality goals. That objective can be promoted during the planning phase by establishing appropriate performance measures and creating effective contractual mechanisms that will facilitate the level of monitoring and control needed on the project. The contract structure itself can either assist or frustrate the project manager in controlling the project. There are four basic types of contracts (along with many hybrid variations), each of which has implications for the project manager's ability to direct and control the work and for the parties' legal duties and liabilities.

FIXED-PRICE CONTRACTS

In this contract, the contractor agrees to perform a specified scope of work for a specified price within a specified schedule. The owner assumes the risk that the scope of work may change, thus requiring negotiated changes in the cost and schedule. The contractor assumes the risk that it has underestimated the cost or time required to complete the defined scope of work. This contracting form is appropriate when project planning has produced a reliable scope of work that can be accurately bid. It would be inappropriate (and much more expensive), however, if the project has not been sufficiently defined and the contractor must include a substantial contingency to cover the risk that its cost and schedule estimates might be mistaken or when the contractor seriously underestimates the cost of the work and defaults when it is unable to perform for the agreed price.

In a fixed-price contract, the owner delegates the responsibility for cost and schedule control to the contractor. Thus, it would be improper under this contracting scheme—and a possible breach of the contract—for the owner's project manager to attempt to exercise day-to-day direction or cost and schedule control over the contractor's work. Of course, the owner should always retain control over the quality of the work, even under a fixed-price contract.

COST-REIMBURSABLE CONTRACTS

This form of contract falls at the other end of the spectrum from fixed-price contracts. Because the scope of work is not well defined, the owner assumes all of the risk that cost and schedule will exceed estimates. The owner reimburses the contractor for all of its costs plus an allocation (often a percentage) to cover its overhead and profit. The contractor has little financial incentive to minimize costs or even to perform efficiently. However, most contractors are motivated to perform in order to protect their reputations. Even if the contract is fully reimbursable, it is sometimes possible to fix the contractor's fee, thereby providing a specific financial incentive to complete the project sooner.

In effect, the owner simply rents the contractor's resources for the project. Thus, under most cost-reimbursable contracts, the owner must assume responsibility for directing and controlling key aspects of the work and must include explicit reporting and monitoring requirements in the contract (even to the point of access to the contractor's books to confirm its underlying costs).

UNIT-PRICE CONTRACTS

This contract type combines elements of both fixed-price and reimbursable contracts. The owner assumes all risk of changes in the amount of work to be performed, and the contractor assumes the risk that the cost of performing a unit of work (or the amount of time required to complete a unit of work) may be greater than estimated. This contract is best suited to a project in which the type of work is well defined and can be reliably estimated (e.g., hauling a ton of concrete to a landfill), but the total quantity of the work (and thus its total cost or duration) is uncertain. This contract should provide for the owner's project manager to direct the work and to monitor and control quantities and progress rates. The contractor's project manager retains control, however, over the allocation of resources (i.e., the costs) to complete a unit of work.

TARGET-PRICE CONTRACTS

Under this form of contract, the parties establish cost and schedule goals with accompanying rewards and penalties. The parties recognize that there are some uncertainties in scope, cost, and schedule, but they agree to share those risks. A target price may provide for the contractor to be reimbursed for its costs but to receive a bonus if final costs are below agreed-upon estimates. A target schedule may be structured so that when the contractor completes the work on the proposed date, it receives a specified payment, but if it finishes before or after that date, it will receive a bonus or pay a penalty, respectively.

This contract form attempts to unify the parties' incentives, but more than any other contracting relationship, it creates a virtual partnership. Because both the owner and the contractor have a common stake in the outcome, they must share direction, monitoring, and control. Without clearly defined roles and responsibilities (and usually a history of working well together), a target-price contract may spawn serious conflicts over the basic question of who is in charge.

Dispute Resolution

Disputes are a fact of project life, but their resolution can be planned to avoid significant disruption or unsatisfactory project outcomes. A project manager may choose among four primary dispute resolution approaches: mediation, arbitration, litigation, or a standing dispute resolution board—each of which may be tailored to meet project needs. Regardless of the approach chosen, however, the project manager should use the planning phase to devise and agree on a particular method for resolving disputes.

Mediation

Mediation is a nonadjudicative process that requires parties to analyze their differences and, with the assistance of a neutral third party, attempt in good faith to resolve them. The parties are not bound to accept any proposed resolution, however, and mediation is the least coercive dispute resolution mechanism. Thus, in order to succeed, mediation requires a firm commitment by both parties to the process and a skillful mediator who can guide them to a mutually acceptable solution. It is best suited to resolve disputes between project participants who have a continuing relationship (and, therefore, have incentives to work out their short-term differences to achieve long-term harmony).

Although mediation does not bind the parties to a particular outcome, it should be a mandatory step in the contractual dispute-resolution process. The following contract provision is typically used to obligate the parties to mediate their disputes:

> All disputes arising in connection with or related to this Agreement (including its formation and validity) that cannot be settled within 30 days by good-faith negotiations between the parties shall be submitted to [*a specified mediator or organization*] for nonbinding mediation.

Mediation can be structured to reach a quick end point—either satisfactory resolution or an unsettled dispute that must be resolved by another means. For example, the contract may also specify the following:

- The period within which one party must notify the other that it seeks mediation
- A representative with authority to bind the party to be made available for the mediation by each party
- A specified period within which the mediation will be completed (e.g., 30 days) unless the parties agree in writing to continue within which the mediation will be completed
- Sharing of the costs of the mediation by the parties

Arbitration

Arbitration provides for an impartial, binding adjudication of a dispute without resort to more formal court procedures. Arbitration has been touted as a faster, cheaper, simpler means of resolving disputes, but it does not always live up to that billing. In theory, arbitration should be an improvement over traditional litigation because the parties cannot compel extensive discovery of each other's documents or witnesses, and arbitration hearing procedures are generally streamlined. In practice, however, for major disputes where the stakes are high and the issues are hotly contested, arbitration can prove to be as lengthy and expensive as litigation.

Moreover, the arbitrators' decision is final for all practical purposes. Even if the arbitrators make serious factual or legal mistakes, their award will generally be affirmed without a substantive review by the courts. That means that for significant, complex disputes, one or both of the parties may prefer to have disagreements resolved by a court, where there are greater safeguards against an erroneous outcome. Because of these drawbacks, project managers should be cautious in committing to arbitrate significant disputes on major projects.

Nevertheless, some projects are particularly suited to arbitration. Arbitration is virtually the norm in international projects, for instance, because neither party is willing to submit disputes to the other's (presumptively biased) courts. Routine disputes are also prime candidates for arbitration because they can be resolved quickly, with little need for discovery or for sophisticated analysis.

A project manager can adapt arbitration to the needs of the project (e.g., by adjusting the number of arbitrators or by specifying the types of disputes that will be arbitrated). The following contract language is typically used to designate arbitration as the dispute-resolution mechanism of last resort:

> All disputes arising in connection with or related to this Agreement (including its formation and validity) shall be finally settled under the rules of the [*specified arbitration organization, e.g., the American Arbitration Association or, for international contracts, the International Chamber of Commerce*] by three arbitrators. Each party shall select one arbitrator within 30 days and the third arbitrator shall be selected jointly by the two arbitrators, or, in the event of their failure to agree within 30 days, by [t*he specified arbitration organization*] in accordance with its rules. The arbitration shall take place in [*a specified city*].

The arbitration agreement may also provide the following:

- The costs of the arbitration will be shared by the parties or borne by the losing party.
- The remedies available in binding arbitration will be limited to selecting from among the parties' last-submitted positions (a format commonly known as "baseball arbitration," in which the arbitrator may only choose between the parties' final offers).
- Any demand for arbitration must be submitted within one year of such action's accrual or it will be forever barred. (In effect, this sets a statute of limitations without regard to any state or national law.)

Such a broad arbitration agreement will be binding on the parties for all of their disputes and may even continue to apply after expiration of the underlying contract. Under the Federal Arbitration Act, 9 U.S.C. § 1 *et seq.*, U.S. courts must enforce such an agreement and will not permit a party to bring suit in U.S. courts to adjudicate an arbitrable dispute. Thus, before including an arbitration clause, a project manager should be certain that arbitration is the appropriate forum for resolving the project's potential disputes.

Litigation

Litigation is much maligned as a tool for resolving project disputes, but it remains effective if used judiciously and efficiently. It should be the forum of last resort, however, after informal negotiations and mediation have failed. When at least one of the parties is unwilling to relinquish its rights to a thorough hearing, litigation may be the only available means for resolving disputes. If managed efficiently, litigation may actually be cheaper than arbitration because the parties do not pay the courts for their adjudicative services. In contrast, the parties must pay the arbitrators, and the administrative fee for arbitration is frequently significant.

Standing Dispute-Resolution Board

For large, time-sensitive projects, it is particularly important to resolve disputes as they arise and to prevent ongoing conflicts from having an impact on the work. That objective can sometimes be achieved by establishing a standing board at the beginning of the project to evaluate and decide disputes on a realtime basis. This standing board is usually part of the contractual relationship.

The details can vary greatly, but, typically, disputes that cannot be resolved by the parties within a short time are presented to a standing board of neutral experts (e.g., engineers, accountants, lawyers) who have acquired some familiarity with the project. Using expedited procedures, the parties submit their positions, and the board issues its decision (which may be binding, as in arbitration, or merely advisory, as in mediation).

This approach permits very rapid resolution as controversies arise, before memories of the events become stale and before the parties' views become rigidly fixed. Such a board requires a substantial investment in both time and money, however, and is normally practical only on very large projects with durations measured in years.

Project Implementation

The project manager's legitimate focus during project implementation must be on completion of the project to meet cost, schedule, and quality objectives. As a result, the legal ramifications of project actions often get less attention. Nevertheless, because legal disputes can transform a successful project into a failure, the project manager should take judicious steps during the project to mitigate or avoid adverse legal consequences. In most instances, that simply means implementing reasonable project-management techniques.

Communication Among Project Participants

Disputes arise most often as a result of inadequate communication. For example, failure to give the construction contractor timely notice of a design change will usually disrupt and delay the work, thus precipitating a claim. If a project participant has been given the information required to manage the work effectively, however, the participant most likely will have no reason to complain. Thus, as a general proposition, the project manager should ensure that each project participant with potential legal rights (e.g., contractors, subcontractors, vendors, lenders, partners, regulators, interest groups, investors, etc.) is apprised of project developments that affect those rights.

There are several caveats to this general rule, however. First, the project manager should be cautious in communicating raw internal projections or goals that might be misunderstood or misused by outsiders. For example, to motivate managers to attain maximum performance, a project manager may set ambitious internal schedule goals that are just out of reach. If those goals are distributed to outside contractors without explanation, a contractor may alter its behavior based on that projected (but aggressive) plan. When the goal is not met, the contractor may claim that it was misled to its detriment.

Second, some information is confidential and should not be shared with outsiders. For instance, legal advice obtained from counsel is privileged and should not be divulged to others. Indeed, partial disclosure of that legal advice could result in a waiver for all communications with counsel on that same subject. Similarly, the fact that parties work together on a project (even as partners or joint venturers) does not mean that they can divulge trade secrets or other business confidences without risking a broader disclosure. Absent an agreement by the parties to maintain confidentiality or to return confidential data, whatever information is disclosed to third parties during the project including trade secrets may become part of the public domain after the project is completed.

Third, the project manager's most candid written communications (e.g., confidential reports to management or uncomplimentary admonitions to project staff) may become the fodder for an antagonist's litigation strategy. Although such blunt, sometimes overstated documents may be appropriate in context, they may have to be produced to an adversary in a decidedly hostile arbitration or litigation setting. Thus, project managers should avoid committing to paper comments that could later be embarrassing or troublesome to explain.

Record Keeping

Because most legal questions turn on the underlying facts, it is crucial that the project manager preserve a documented history (not merely records of the final results) demonstrating the project's performance on the key parameters of schedule, cost, and quality. It is often difficult to anticipate which project decisions will later be the subject of a legal controversy. Thus, a prudent manager should compile a complete record of performance as the project develops, rather than relying on an after-the-fact reconstruction.

Some project decisions should raise red flags as the potential topic of later disputes, however, and those decisions warrant more careful documentation. Project disputes arise most frequently over the cause and effect of delays. To be able to respond to such claims, the project manager should compile a comprehensive dossier for each significant deviation from plan (e.g., a delay that affects key schedule milestones). That factual dossier should include at least the following materials:

- The root cause of the deviation
- The cost, schedule, and quality impact of the deviation on the project
- The expected costs and benefits of various recovery measures that were considered
- The justification for the recovery effort that was chosen
- The results of the recovery steps that were taken
- Identification of the project personnel who have the most firsthand knowledge about the deviation

Of course, such a rigorous analysis facilitates the project manager's response to the delay, but a thoroughly documented synopsis of the reasoning at the time will provide the most persuasive evidence if the delay precipitates a legal dispute.

Adjusting the Contract to Change

Change is endemic to all projects, and when conditions change unexpectedly during project implementation, the project manager should promptly adjust the legal documentation to reflect those new circumstances. In a rapidly developing project, the project manager may mistakenly assume that the parties can continue to work under a now-obsolete contract and that modifications can be made after the fact to reflect the reality of the project. This is a risky approach and should be avoided, if possible.

The project manager typically tracks and controls design or criteria changes through a formal configuration-management system, and that same structure should be used to ensure that the formal contract language reflects a common understanding of the parties' evolving responsibilities. The project manager should implement mechanisms that do the following:

- Authorize changes.
- Communicate changes to the appropriate parties.
- Modify the applicable contract documents as necessary.

Handling Potential Claims

A project's success is not assured until all potential disputes have been resolved. Too many project managers have reached the assumed end of a project believing they had met their cost, schedule, and quality objectives, only to see those accomplishments tarnished by the protracted, expensive defense of legal claims that swallowed most of their expected gains. Conversely, project managers who fell short of their goals may be able to recoup some or all of their losses through affirmative claims if the actions of others contributed to those losses. The project manager's job is not complete until possible claims arising during the project have been resolved.

Near the end of the project, the project manager should evaluate both affirmative and defensive claims that might be brought. The usual project controls should have already identified the causes of significant deviations from plan, and those are the likely sources for claims. The next step is to prepare a thorough analysis of the claim (or defenses to the claim) accompanied by detailed documentation. This analysis should be rigorous and objective. At this stage, the project manager needs a dispassionate evaluation, not an adversarial argument.

Most disputes can and should be resolved through project-closeout negotiations. If those negotiations are successful, the parties should execute formal releases to ensure that no further allegations will be raised. If productive negotiations continue but do not yield a final resolution, the parties may enter a *tolling* or *stand-still* agreement to avoid the expense and acrimony that would be generated by a suit or arbitration. A tolling agreement suspends the running of any statute of limitations and permits the parties to continue fruitful negotiations. Even if the parties had not previously contracted to resolve disputes by mediation, they may at any time agree to use a mediator in an effort to bridge the remaining differences.

If informal efforts at resolution are unsuccessful, the parties may invoke their agreed-upon dispute-resolution mechanisms. The resulting arbitration or litigation should be treated as another project and should be planned, staffed, and implemented with the same care that would be accorded to any project of similar size and complexity. As with any other project, the manager in charge of the litigation project should insist on budgets, schedules, and controls from the lawyers. Regular reassessments should identify strengths or weaknesses and dictate strategy (e.g., press ahead or attempt settlement). With application of appropriate project-management tools, litigation or arbitration can be managed successfully to achieve realistic goals.

Managing Legal Components

A project's legal components are no different from its other aspects that must be planned, managed, and controlled. A project manager does not hesitate to apply her or his skills and relevant expertise to control risks related to technology, financing, or human resources. The same enthusiasm and expertise can manage project legal issues successfully. The skilled project manager's customary tools provide the most effective prophylactic to avoid myriad legal woes that can afflict a project.

ENDNOTES

1 Because of the variations among projects and the difference in laws from jurisdiction, this chapter provides a general overview and does not purport to provide legal advice for any specific project. For particular legal advice, a project manager should consult counsel retained for that purpose.

2 Organizations may define the project manager's role broadly or narrowly. This chapter focuses on essential project-management functions, whether they are performed by the designated project manager or by other managers.

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Unidroit Principles of International Commercial Contracts

SECTION V

Team Management

Chapter

33

New Ways to Use Project Teams

David I. Cleland

Biographical Sketch . . .

Dr. David I. Cleland, is Professor Emeritus in the School of Engineering, University of Pittsburgh, Pittsburgh, PA. He is a Fellow of the Project Management Institute (PMI) and has received PMI's Distinguished Contribution to Project Management Award three times. Dr. Cleland has been described as ''The Father of Project Management'' and has been honored through the establishment of the annual David I. Cleland Excellence in Project Management Literature Award sponsored by PMI. He is the author/editor of 36 books in the fields of Project Management and Engineering Management. His current research interests are in the evolution of project management and the strategic context of projects in the management of enterprises.

The use of teams has expanded to meet many strategic and operational purposes in the enterprise.[1] Teams have been called the common denominator of organizational change because they are a medium for cross-functional and cross-organizational integration of resources to accomplish a specific purpose. For example, concurrent engineering teams may be composed of stakeholders from the original equipment manufacturers (OEMS), suppliers, unions, and community represenaties. Many stakeholders, some of whom have business in the global marketplace, are linked operationally and strategically through teams. Different types of teams are listed in Table 33–1.

Corporations can use teams to respond to inevitable changes they face today. Research by Jerry Jasinowski and Robert Hamrin uncovered how U.S. industry regrouped in the mid-1980s and staged a remarkable rally. They describe the strategies of 50 real-life U.S. company success stories and how people in these companies created success. ''Teamwork is the single most

Table 33–1 Classification of Teams

Type	Output/Contribution	Time Frame
Reengineering teams	Business process changes	Ad hoc
Crisis-management teams	Manage organizational crisis	Ad hoc
Product/process development teams	Concurrent product/process development	Ad hoc
Self-managed production teams	Manage and execute production work	Ongoing
Task forces	Evaluate/resolve organizational problems/opportunities	Ad hoc
Benchmarking teams	Evaluate competitors/best in the industry performance	Ongoing
Facilities construction Project team	Design/develop/construct facilities/equipment	Ad hoc
Quality teams	Develop/implement/total quality initiatives	Ongoing
General purpose Project teams	Develop/implement new initiatives in enterprise	Ad hoc
Audit teams	Evaluate organizational efficiency and effectiveness	Ad hoc
Plural executive teams	Integrate senior level management decisions	Ongoing
New business Development teams	Development of new business ventures	Ad hoc

This classification is based on the one given by Cleland, David I. Leadership and the project management body of knowledge. *International Journal of Project Management*, April 1995, pp. 83–88.

prevalent characteristic found in our fifty success stories,'' according to Jasinowski and Hamrin.[2]

The basic paths to success are releasing the creativity and power of workers, pleasing customers, finding new markets, and focusing on continuous improvement. These are the elements that teamwork has to offer. Whenever teamwork is applied properly, the performance of the company improves, usually quickly and significantly.[3] A brief description of different types of teams follows.

Reengineering Teams

These teams are used to bring about a fundamental rethinking and radical redesign of business processes to achieve extraordinary improvements in critical contemporary measures of performance such as cost, quality, service, and speed. Much attention is being given to the use of reengineering teams today—yet their ability to produce real results is sometimes questioned. The guru of the reengineering movement, Michael Hammer, openly admitted that 70 percent of such efforts fail.[4] Nevertheless, such teams have produced impressive results.

EXAMPLE. During one of the largest process-reengineering projects ever undertaken, GTE telephone operations management was stunned to find out that the administrative bureaucracy of the compoany was reducing productivity by as much as 50 percent. As part of its reengineering effort, GTE examined its own processes and compared them with processes used by 80 companies in a wide variety of industries. Reengineering teams then created new concepts, approaches, policies, and procedures for the new processes. The following specific goals were set for the reengineering teams:

1. Double revenues while cutting costs in half
2. Cut cycle time in half
3. Reduce product roll-out time by three quarters
4. Cut systems development time in half

These goals provided the motivation to make marked improvements in the company's process management. The findings from the reengineering were put into practice.

AT&T Global Business Communications Systems, which makes and installs private branch exchanges on the customer's premises, did the following in its two-year reengineering effort:

1. Rewrote job descriptions for hundreds of people
2. Developed new recognition and rewards systems
3. Reconfigured its computer systems
4. Initiated massive retraining programs
5. Made extensive changes in financial reporting, proposal writing, and contracts

The company also made major changes in its relationships with suppliers, its manufacturing processes, and its shipping, installation, and billing practices.[5]

Crisis-Management Teams

These teams are used to deal with any potential crisis that may arise in the organization's activities. Aircraft crashes, oil spills, fires, tornatoes, hostage situations, product-liability suits, loss of key personnel, and earthquakes are a few of the almost endless list of potential crises that can have an impact on an enterprise. When such crises emerge, the appointment of a team can serve to bring a focus to the use of resources, maintain damage control, and develop and implement remedial strategies.[6] When the crisis has a public relations content, how well the team deals with the public and the media is important.

Product, Service, and Process-Development Teams

These organizational units, often called concurrent or simultaneous-engineering teams, provide for concurrent design and development of organizational products, services, and processes. Processes may include manufacturing, marketing, purchasing, after-sales services, and engineering. The purpose of these teams is to develop products and services of higher quality with lower costs, earlier commercialization, greater profitability, and enhanced customer satisfaction.

EXAMPLE. Chrysler used a concurrent-engineering team to design and develop the Neon, a small car that proved Detroit could bring forth a competitive small car. The Neon team mobilized 600 engineers, team members from other disciplines, 289 suppliers, and hundreds of blue-collar workers to meet the goal of delivering the new model in a speedy 42 months, and for much less than any recent small car had cost at that time.[7]

Self-Managed Production Teams (SMPTs)

SMPTs provide improved quality and productivity in manufacturing and production operations. These teams are unlike the traditional project teams, which are multidisciplinary and cut across many different organizational boundaries. SMPTs are made up of members from the same work area of the organization, and they typically have broad responsibilities and authority for planning, organizing, monitoring and controlling the use of organizational resources to produce a product or service. Members of these teams, facilitated by a team leader, make and implement decisions in such matters as task assignments, work scheduling, work design, training, equipment selection, maintenance, problem solving, and worker counseling and discipline. In some cases, these teams are given the auhority to hire and fire members and assess merit evaluations, promotions, and pay raises.

EXAMPLE. At the Lord Corporation plant in Dayton, Ohio, self-managed work teams were the real power behind a corporate strategy to empower the people. In the old days, there were six layers of management. After the initiation and maturity of self-directed teams in 1990, there were just the plant manager and seven self-managed work teams. Moreover, the plant's performance between 1986 and 1990 improved in the following ways:

- Productivity was up 30 percent and absenteeism was down 75 percent.
- Typical setup time was down more than 75 percent.
- No lost-time accidents occurred for six years.
- Scrap costs fell 85 percent.
- Manufacturing cycle time for one product was reduced from 75 days to 7 days.
- Work in process was reduced by 75 percent.[8]

Task Forces

These are ad-hoc groups used to solve short-term organizational problems or exploit opportunities for the enterprise. Usually the solutions or approaches to problems or opportunities require cutting across organizational boundaries. For example, a major food processor used several task forces to study and recommend remedial strategies for improving the performance of the company in such areas as purchsing practices, overhead costs, corporate downsizing, and restructuring. Task forces have been used for ad-hoc work for many years. Today their use continues; they are easily formed and disbanded when the problem or opportunity in which they were appointed no longer exists.

EXAMPLE. A procurement task force at H. J. Heinz Company was appointed to find and work out partnerships of the most efficient suppliers around the world and consolidate purchasing across all of the company's affiliates. This team saved Heinz over $100 million on an annualized basis. The team's efforts with suppliers in value-engineering packaging and raw materials provided additional opportunities for cost reductions in the years ahead. The pace of the task force was remarkable: it took less than four months from the time the task-force team was launched until the contracts with suppliers were signed. Traditionally, the company had negotiated purchasing agreements on an annual basis. The long-term contracts gave the suppliers security to work with the task-force team on value-engineering processes and generate savings for both sides of the relationship. The cost savings are due to reduced product costs in the suppliers' factories and in the Heinz production facilities.[9]

Benchmarking Teams

Benchmarking is the ongoing strategy of measuring organizational products, services, and processes against the most formidable competitors and industry leaders. Benchmarking results in improved performance standards leading to improved capabilities.

EXAMPLE. Union Carbide's Robert Kennedy used benchmarking to find successful businesses, determine what made them successful, and then translate their successful strategy to his own company. Reengineering strategies at Union Carbide were complemented by benchmarking teams to scrape $400 million out of its costs in just three years. The benchmarking team at Union Carbide looked to L. L. Bean for learning how it runs a global customer service operation out of one center in Maine. By copying L. L. Bean, Union Carbide teams were able to consolidate seven regional customer service offices, which handled shipping orders for solvents and coatings, into one center in Houston, Texas. By giving employees more responsibility and permitting them to redesign their work, 30 percent fewer employees were able to do the same work—including the analysis of processes to reduce paperwork to less than half. For lessons on global distribution, Union Carbide looked to Federal Express, and for trackng inventory via computer, Union Carbide borrowed from retailers such as Wal-Mart.[10]

Quality Teams

Quality management is accomplished through the use of quality teams that use cross-functional organizational designs to integrate quality-improvement efforts. The use of quality teams to develop and implement total quality management (TQM) has gained considerable acceptance in contemporary organizations. Quality teams, properly organized and managed, provide meaningful opportunities for workers to get involved in improving organizational performance.

EXAMPLE. The Allen Bradley plant in Twinsburg, Ohio, makes circuit boards, programmable controllers, and other electronic devices. Employees had to cope with a pile of manuals, work orders, and memos, most written in ''engineeringese.'' Frustrated with the blizzard of paperwork, workers resorted to their own methods of doing things—like taping up crude crib sheets on their work benches. The plant manager pulled seven assemblers off the floor, some for as long as seven months, and put them on teams with engineers and supervisors. Their task was to devise procedures comprehensible to everyone. Now paper and envelopes have been replaced by electronic mail, which delivers new instructions and purges the old ones.[11]

Certainly part of the reason that such teams produce results is the interdisciplinary focus that they bring to the enterprise. There is considerable literature in the area of TQM to include how quality teams can be used to improve products, services, and processes.

The primary means that Motorola uses to meet its goal of Six-Sigma Quality (3.4 defects per million) is a dedication to employee empowerment that is focused on teamwork and extensive training and education. In developing and implementing a successful quality program at Motorola, several key observations have been noted: workers' knowledge and skills improved; workers learned how to function as teams; and the company learned how to be the best in the class of manufacturing and manufacturing technology.

Audit Teams

These teams evaluate the competency of organizations, programs, projects, and functions to deliver quality products and processes. Projects in the public domain are usually audited to ascertain the prudency with which public funds have been used.

EXAMPLE. On a water-pollution-abatemant project in a large city in the United States, a team was appointed to conduct an audit of the project prior to the initiation of detailed planning to turn the project results over to the user. This audit disclosed several sewage plant configuration changes that needed to be carried out. In addition, several contract amendments called for modifications that were unduly delayed. The late modifications could have had an adverse impact on the operational availability of the water-pollution-abatement system. By discovering the delay in these changes through the audit, the construction-project team was able to initiate remedial strategies to get the project back on schedule and meet its operational date.

Plural Executive Teams

These teams consist of senior-level executives who work together to design and execute major strategies that will prepare the enterprise for its long-range future. The use of such teams provides for a top-level synergy in the strategic management of the organization. When the plural-executive-team members maintain surveillance over the operation of other teams in the company, considerable insight is available about how well the company is preparing for and dealing with the inevitable changes facing organizational products, services, processes, and resource utilization.

Various names are given to the plural-executive team in the United States, including Office of the President, Office of the Chairman, and Office of the Chief Executive. Many large corporations use the plural-executive team as a means of bringing together senior people to deal with key operational and strategic issues.

New-Business-Development Teams

These teams are used to explore the design and development of new business ventures for the organization. Such teams arise from the strategic planning effort that is carried out by the company. The work of these teams involves the assessment and development of new business areas, as contrasted with teams dedicated to a specific program or project within a new business area.

EXAMPLE. At the Rubbermaid Company, a new product is introduced frequently. Teams play a vital role in making the company a new-product-generating machine. Dozens of business teams, which are the key organizational units, work at developing new products. Every team, every year, is charged with reinventing what they have, everybody at every level is encouraged to innovate. The business teams are the basic business units and are the real drivers of innovation. Each product line has a business team that is managed by a core of representatives, one each from marketing, manufacturing, finance, and research and development.

New team models are coming forth and changing traditional roles of managers and supervisors. The use of project teams has changed the way in which organization strategies are designed and executed and has brought forth new management and organizational philosophies—such as that of *teamocracy*.

Teamocracy

We are entering the age of teamocracy, during which a change in the leadership and management of organizations will have a profound impact on how value is delivered to customers. The forces unleashed by teamocracy will have an impact on conceptualizing, designing, producing, marketing, and supporting product after-sales logistics. The move to teamocracy is nothing short of an intellectual revolution for which there is no precedent in the history of management.

I have coined the term *teamocracy* to describe the condition of organizations that are characterized by teams as the basic organizational design for bringing about a focus for cross-functional and cross-organizational work in the enterprise. In a democracy, the team is the basic social unit based upon maximum empowerment, leading to acceptance of responsibility and accountability by the organizational members. Teamocracy is the result of converting the traditional bureaucratic hierarchy. Instead of the cumulative power of each organizational level rising through an organizational pyramid, a network of authority and responsibility is widespread and cuts through the length and breadth of the organization. In teamocracy, new power foci emerge, reflecting empowerment, dedication, trust, loyalty, and commitment embodied in a team organizational design in which the team leads and manages itself within the larger strategic management context of the enterprise.

The design of a teamocracy has the following five elements:

1. Strategic management of the organizational unit as if its future mattered
2. Operations that produce, in an efficient manner, current products and services
3. Decentralized units such as profit centers
4. Functional entities
5. Teams

Within these elements, decisions are shared, results are communal, and rewards are divided. Workplace communities in teamocracy accommodate self-managed teams as well as the more traditional configuration of the enterprise.

The hallmark of teamocracy is that customer value is created principally through the efforts of teams. Customer value is sustained by organizational infrastructures to provide operational and strategic guidance, resources, empowerment, and performance standards. The teamocracy is dynamic and responds to the need to bring about continuous improvement, and sometimes dramatic changes in products, services, and organizational processes. The characteristics of the teamocracy include the following:

- Everyone has the opportunity to be a leader and a manager.
- Trust, respect, loyalty, conviction, and commitment permeate the culture.
- Everyone knows what is going on because there is widespread sharing of information.
- All employees want to be responsible for quality work and to be proud of that work.
- Team members subordinate their egos and needs to meet the needs of the team.
- Team leadership is shared; management of the team's resources are also shared.
- Interpersonal networks strengthen both individual and team behavior.
- Assumption is widespread that every product, service, organizational process can be continuously improved.
- Setbacks in efficiency and effectiveness provide new challenges for doing better and moving ahead through improvement strategies.
- Individual status and pride are enhanced through the sense of belonging and freedom that people feel when working together as equals rather than as subordinates.

Because leadership and managerial activities are widely dispersed in the teamocracy, foresight and vision, two important responsibilities of leaders and managers, are shared throughout the enterprise. Leadership comes less from an appointed position and more from the motivation that team members feel from within. Leadership is a fluid concept, and people exercise leadership at appropriate moments. Senior leaders and managers try less to extend their authority from the top and more to facilitate the cooperative effort of many people at many levels in the organization.

In the democracy, self-managed work teams choose their leaders, who function as facilitators. Team members negotiate their individual and collective roles and assign duties and responsibilities. Everyone has the opportunity to be a facilitator. Customers and suppliers become contributing members of the teams, and the teams work at spreading a clear perspective of what it takes to create value for customers. Barriers between team members are reduced,a greater interpersonal compatibility exists, individual and team objectives and goals are better understood, and the team by its own functioning helps to develop the individual and the team for enhanced productive performance.

Any bureaucracy has the potential to become a teamocracy if the leaders and managers are willing to change. In demonstrating that willingness to change, clear strategies need to be developed and executed throughout the organization, extending to key stakeholders such as customers and suppliers. People who do not change are becoming an endangered species.

Traditional, authoritative managers and supervisors are endangered if they do not change their ways of working and their ''I'm-in-charge'' approaches to their duties. Team leaders and team members are performing many of the traditional duties of these former in-charge people. When empowerment is widely carried out by trained and competent people, both direct and indirect changes are seen. These changes have an impact on the role of traditional managers.

Direct Changes

Some of the direct changes that teams have facilitated include the following:

- Team members plan the work and assignment of the tasks for the team.
- Team members evaluate individual and team performance in doing the work.
- Team members play a role in developing strategies for individual and team awards.
- Peers counsel poor team performers.
- Team members participate in key decisions involving the workbeing carried out by the team.
- Members of the team organize their individual and collective roles.
- Teams assume responsibility for the quality of the work, team productivity, and efficiency in the use of resources.
- Teams develop initiatives to improve the quality and quantity of the output.
- Teams seek better ways of doing the work, and in so doing, discover creative and innovative means of preparing for the team's and the organization's future.

Indirect Changes

The indirect changes of teams are subtle yet real. For team members, these include the following:

- Team members have more interesting work.
- Team members have a greater sense of control over individual, team, and enterprise destiny.
- Team members have greater esprit de corps and pride.
- Greater financial rewards arise out of improved delivery of products and services to customers.

- Team members have a greater feeling of individual worth in being able to contribute to useful purposes that are realizable and measurable.
- Team members have more fun working.

The use of teams as instruments of enterprise strategy has helped change the theory and practice of management. The teams influence the culture and the culture influences the teams. Both the teams and the culture influence the thinking of everyone in the organiztion. In turn, the enterprise culture influences all of the people. Senior management needs to recognize these changes, understand them, and develop a strategy as to how the knowledge, skills, and attitudes of the people have to be adjusted as they perform their roles.

Role Changes

The transition from the traditional manager and supervisory roles to the facilitative, coaching, mentoring, and resource support roles found in the team-driven organizations is difficult. For those traditional managers and supervisors, the transition can be very threatening because of the following:

- The sense of loss of status or power—even the job
- A fear of the unknown resulting from a lack of understanding of the reverberations set in motion by the use of self-directed teams
- Confusion because the role of the team leader is not defined and sometimes not understood
- Fear of personal obsolescence and changes resulting in the need to gain new knowledge, skills, and attitudes.

Continued Growth

Teams will likely grow in use in the next decade because of the explosive growth in information, which enables employees to know so much more about the technical and managerial nature of their work than their managers could possibly understand. As highly educated, self-motivated, and self-directed specialists work together, their managers begin to know less of what the specialists are really doing. Managers become increasingly dependent on the specialized employees to make and implement decisions on the technical side of their work.

As more expensive, exotic equipment and other resources are used in the workplace, such as the computer and technical information systems, the costs are so high that people have to be able to work together and make real-time decisions and interventions on their own. The technology involved is so complex that only the specialists fully understand how to choose and use that technology to produce results that have value to the customers and other stakeholders. They must solve technical and organizational interfacing problems without having to ''check with the boss.''

Competitive pressures are causing enterprises to turn to teams to get the work done sooner and at lower cost because teams can reduce the need for traditional middle- and first-level managers. A point often missed in considering the use of teams is how the leadership of the team is diffused among the team members. When such teams take on more of the functions of self-management, the manager and leadership functions do not disappear; rather, a moving leadership pattern emerges. Members of the team emerge as leaders as they are needed, when their particular technical work tasks are developed and integrated into the overall team effort.

Team Benefits

Experience has shown that the use of teams has helped to facilitate the introduction of new ideas in products, services, and organizational processes. People who previously worked alone can now gain new knowledge and learn new skills while serving as contributing members of a team. Working on the team tends to reinforce the workers' abilities, as well as provide an opportunity for synergistic thinking and action not usually available when the team members worked alone, out of the team environment. Communication ties are enhanced, and when technological challenges emerge, the entire team can deal with those challenges and develop team-based remedial strategies.

Participation on a team usually means that the team members learn additional skills through trade-off of job duties. By developing multiskilled capabilities, team members can perform many different types of duties while working on the teams and learn additional skills working on other teams. One important result of all this is to reduce the number of job classifications, thus simplifying the hiring and assignment of people in their work. The benefits produced by teams are many. Table 33–2 indicates some of the results experienced by contemporary organizations.

In a team situation, employees feel that their opinions are valued and that they are trusted in having access to key information on the performance of the enterprise. People are treated as thinking adults. The cultural ambience of the enterprise encourages creativity and innovation—it's acceptable to make mistakes on the road to positive results. Everyone in the organizaion tends to have a clear and closer view of suppliers and customers. The special perks, such as reserved parking places and executive dining rooms, that were formerly provided to senior and special people, tend to be eliminated, thus adding to the culture of equality. Relationships among people in different specialties and at different organizational levels tend to improve as everyone recognizes that there is a high degree of interdependency among people.

When people work in teams, leaders can come from any place and from anyone in the organization as people make the correct choices in improving

Table 33–2 Team Results

• Lower costs	• Improved production, efficiency, and effectivness
• Higher quality	• Greater learning
• Manageable strategic initiatives	• More teamwork
• Interdisciplinary focus	• Leader and manager development
• Feeling of contribution	• Self-destiny
• Improved career development	• More skills
• More enjoyment	• Identification with organizational purposes
• More creativity, which leads to innovation	• Job enrichmant
• Greater participation	• More fun
• Greater profitability	• Less parochialism
• Interpersonal empathy	• Better communication
• Fewer managers	• Greater sharing of information
• Changed role of managers	• Greater organizational synergy
• Less bureaucracy	• Enlightened adversary viewpoints
• Enhanced responsibility and accountability	• Empowerment
• Greater harmony of individual and organizational unit objectives and goals	• Improved culture
• Less command and control	• More consensus and consent
• Improved competition	• Improved organizational products and services
• Improved morale	• Improved organizational processes
• More association with winners	• More candid debate
• Cross-functional fertilization	• Systems thinking
• Self-management	• Greater pride
• Improved labor-management relationships	• Greater dissemination of organizational performance information
• Flatter hierarhy	• Shared interests

Source: Cleland, David I. *The Strategic Management of Teams.* New York: John Wiley & Sons, 1996, p. 131

the use of resources in creative and innovative ways. The essence of strategic thinking can be shared by all members of the enterprise. This is accomplished with ongoing questioning of their status quo, and a belief that thinking about and working with ideas for the future can help to influence the future according to what is best for the organization.

ENDNOTES

1 Portions of this chapter have been drawn from Cleland, David. *The Strategic Management of Teams.* New York: John Wiley & Sons, 1996

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Chapter 34

Energizing Project Teams

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Gary Englehardt, and
John Tuman, Jr.

Biographical Sketch . . .

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Mr. Tuman is an active member of the Project Management Institute (PMI). He is the founder and past president of the Keystone Chapter of PMI and he has served on the publication board of the *Project Management Journal* and the *PMI-Net Magazine.* In addition, he is a member and a regular contributor to the International Project Management Association (IPMA).

Mr. Tuman has given numerous presentations and seminars on management issues and problems in the United States, England, Europe, Africa, Asia and Russia. He is a contributing author to several textbooks on project management and he has published many technical papers and articles on management methods, systems, and trends.

Introduction

Modern corporations use project teams to accomplish strategic initiatives. However, far too many project teams fail to satisfy management's expectations. Some teams simply lack the skills, tools, or processes to match the challenges of the project. In other cases, teams may have become stale or jaded. In the worst case, there may not be a team at all but simply a collection of contributors content to work on individual tasks with little regard for the overall project schedule, budget, or goal. This chapter will discuss the authors' experience over the past 20 years in working to energize project teams, enhance their capabilities, and optimize their performance. Our experience will help you to assess the current state of your team and develop programs to energize your team. This chapter presents techniques and examples of how we have aligned project teams and their management sponsors, developed processes and procedures to meet specific project challenges, and created a knowledge base that provides the foundation for the next generation of project team participants.

Background

For most of the 20th century, corporate organizations were vertical structures configured on the basis of subdivision of work and specialization. Command and control was the dominant management style; senior management personnel developed the strategy and plans, gave directions, evaluated results, took corrective action, and made adjustment as needed. Subordinates and specialists were expected to carry out management's plans and directions within their defined area of responsibility. As subordinates gained experience and demonstrated their competence, they could advance up the corporate structure to assume more decision-making responsibilities. The advantage of this business model is that it was efficient—participants learned to do their jobs well before advancing to more responsibilities—and it promoted stability—the organization would develop a culture that almost everyone understood and believed in. However, this business model had one major characteristic that rendered it impotent in a global economy—it was slow. Communications across department boundaries was poor, decision-making was not at the level where the work was being done, and work tended to be done in serial fashion. Typically, marketing and/or sales would get the work, engineering would design the product, production would build the product, and operations and maintenance would service the product and the customer. This type of organization could not respond effectively to rapidly changing markets and global competition. The situation became painfully clear in the 1970s and 1980s as American business lost its international dominance to the Japanese.

As a result, many U.S. corporations embraced project management and the team approach to getting work done. Multidiscipline teams were created to cut through the corporate bureaucracy, make plans, and accomplish tasks concurrently. Organizational structures were flattened and decision-making was moved down to the level where the work was being done. Dramatic improvements were made in a number of industries, including aerospace, automotive, construction, telecommunications, electric utilities, chemical, pharmaceutical, and others. Soon, virtually every organization of any size was using some type of team approach to address its business needs. Today, project management and the team approach to fulfilling corporate objectives is the accepted mode of operation. Unfortunately, for every successful team there are at least twice that number of unsuccessful teams. A number of studies have reported project failures up to 60 percent and more. Most of these failures have little to do with the technology involved in the project or the challenge of the undertaking. In our experience, most failures are the direct result of non-productive teams, who are poorly positioned and sponsored.

Why Teams Fail

In our work with clients, we evaluate their project teams and classify them as either a high-performance team or a non-productive team. High-performance teams consistently accomplish their project objectives as planned, on time, within budget, without mishap and without excuses. Non-productive teams typically overrun their budget, miss their schedule, and always have a good reason why the project objective was not quite met. We believe that in today's highly competitive world, senior management cannot accept anything less than a high-performance team. No executive of any organization sets out to create or sponsor non-productive teams, so why then do we see so many failed projects?

Non-productive teams come about for a number of reasons; and tend to fall into three distinct categories: teams that are inexperienced and/or lack the appropriate skills; teams that are stale, jaded, or poorly motivated; and teams that are fragmented or totally lacking in coherence. We will examine each of these three types of teams and identify their characteristics, the reasons they came about, and identify the programs that we initiate to address their problems and energize them into high-performance teams.

Inexperienced Project Teams

One of the most distinguishing characteristics of project teams lacking in experience and skills is the quality and degree of project planning they produce. Teams that lack project experience and/or project-management skills will typically have at best the most basic of project plans. These types of teams typically do not understand the value of planning. Most consider planning a bureaucratic function that gets in the way of doing the real work. These teams rush into a project undertaking assuming they know what needs to be done and spend most of their time and energies fighting fires and resolving problems and conflicts through out the life of the project. Inexperienced project teams are consistently plagued by problems and bad luck; and, without fail, always have a good excuse why things are going so poorly.

Inexperienced project teams tend to come about because corporations have not invested in the training and recruiting necessary to build a professional project-management capability. Far too often, senior management commits to a strategic initiative assuming that they can take specialists and functional organization personnel and have them perform in an entirely new organizational paradigm.

Stale or Jaded Teams

These teams are typically composed of people who have been around for quite some time. They have seen it all and they have done it all. They know their own capabilities and jobs inside out and everything seems to be routine; the challenge and the excitement are gone. These teams have fallen into a comfortable, well-worn groove. Thing get done but the sense of urgency is gone and, as a result, commitments begin to slip, errors begin to show up more frequently, and things get a bit sloppy. Yet no one gets excited because everyone has been through this before and they know the job will get done. The problem is that the organization begins to accept the inefficiencies that stale or jaded teams generate and the resulting impact of increased cost is not noticed until it becomes a major problem. When senior management becomes aware that cost has spiraled upward changes will be made.

We find that stale or jaded teams exist because the corporation has become static, or at best is experiencing only moderate growth. Opportunities for promotion are few and far between and new personnel are not being hired. Hence, there is no infusion of new blood or new ideas into the organization and existing personnel are biding their time until retirement or the next buy-out program. In this type of environment, there is little incentive to try anything new and the organization as a whole stops learning. In many cases, we are called upon to work on this problem when management realizes that the situation has gotten out of hand and their own performance is being questioned.

Fragmented Teams

Fragmented teams are not teams at all but merely a collection of specialists and contributors who have been assigned to a project. This is probably the worst type of team because it combines all the bad characteristics of the other two types of teams. We find that fragmented teams tend to be a collection of inexperienced personnel, jaded personnel, and organizational misfits. These teams may have some highly competent and motivated people who work very hard, but their efforts are thwarted due to the negative performance of other team members. After a while, the high performers will either try to remove themselves from the project or, if that's not possible, they will check out, ignore other team members as much as possible, and focus on their specialized area. These teams are doomed to failure.

By their very nature, fragmented teams cannot work in unison to accomplish a complex undertaking. Planning will be incomplete, tasks will not be completed as scheduled, important tasks will be over looked, costs will begin to spiral, conflicts will develop, and the team will disintegrate into fault-finding, blame-fixing, excuse-making, and search for the guilty.

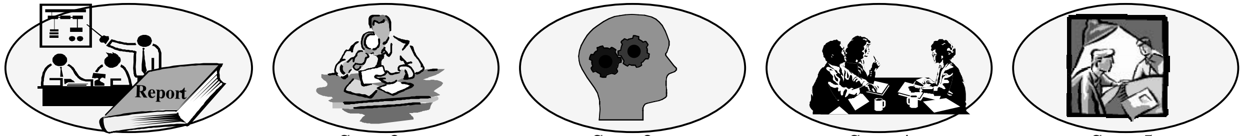
We find that these teams come about in organizations that have been traumatized by downsizing, mergers, or poorly conceived restructuring. In many cases, these organizations have significantly reduced staff, retired older workers, outsourced traditional functions, and in general significantly altered the established organizational culture. For many employees in these organizations, careers have been significantly disrupted and workloads dramatically increased. In addition, management is called upon to do more with smaller staff while witnessing the departure of some of their most seasoned personnel.

In this type of environment, department heads and functional managers at all levels will not assign their most valued staff members to a project. Department managers and functional managers are, as a rule, evaluated on the performance of their department and not the performance of a project. As a result, when project teams are being organized, functional managers will assign their least experienced personnel or the misfits. Projects become the dumping ground for the organization's poorest performers. When this happens, is there any hope for the success of the project?

A Program for Energizing Project Teams

In working with project teams in the United States and overseas, we have evolved a highly effective and successful program for rebuilding and energizing project teams into high-performance contributors for the corporation. Our program involves five distinct steps: process assessment, program design, program implementation, program evaluation and modifications, and knowledge base creation (see Figure 34–1).

1. ***Process assessment.*** In most of our consulting assignments, we are not brought into the picture until management has become frustrated with conditions; things have gotten so bad that the problem can't be ignored any longer. This means that the situation is confusing, complex, and distorted to everyone, both inside and outside the project. Our initial mission is to bring a fresh and unbiased prospective to the problem and evaluate objectively and accurately the real reasons for the team's poor performance. We have developed a series of diagnostic instruments that enable us to evaluate the team's culture, organization, skills, roles and responsibilities, processes, procedures, systems, and tools. We review the project plans, schedules, and budgets that have been developed and assess how well they are being used to manage the project. We examine the leadership and initiative that exists and consider how effective this is in moving the team through all the problems and stresses that exist in any project. Finally, we try to determine how realistic the project is in terms of the capabilities of the project team and the organization as a whole. In more than one instance, we have seen demoralized project teams struggle to accomplish some corporate initiative that was totally unrealistic. It is not that unusual for senior executives to launch some grandiose scheme because it sounds great but is well beyond the capabilities of the organization. At the conclusion of the problem-analysis phase, we will develop a series of recommendations for resolving the problems. If management decides to move forward, we will design a program that deals with the specific problems that impede the team's performance.
2. ***Program design.*** Over the years we have developed a number of programs to enhance project team performance. It is important to design and implement a program that not only addresses the shortcomings of the team but also is delivered in a way that fits the culture and self-image of the organization as a whole. Programs that work well for a Southern electric utility company may not be as effective for a New England software company or a West Coast aerospace company.
3. ***Program implementation.*** Substantial improvement to a project team's performance requires management commitment and resources (time and money). Significant changes in attitudes, skills, processes, and procedures cannot be accomplished by a few team-



Step 1
Process Assessment

- Meet with project sponsor.
- Identify study participants.
- Hold kick-off meeting.
- Conduct interviews with project team.
- Review current organizational structure, skill levels, and training programs.
- Review current project tools, systems, processes, and procedures.
- Review current processes for planning, scheduling, cost estimating, budgeting, and reporting.
- Review lessons-learned process.
- Review team meeting practices.
- Review processes for monitoring, assessing, and reporting project progress.
- Submit final report and recommendations.

Step 2
Program Design

Design client's programs:

- •Project-management training
- •Individual mentoring programs
- •Project-simulation programs
- •Integration workshops
- •Challenge workshops
- •Project environment process
- •Other specialized programs

Review designs with sponsor.

Conduct program walk-through.

Make modifications as needed.

Finalize all programs.

Develop implementation plan.

Develop implementation schedule.

Select workshop locations.

Notify participants.

Step 3
Program Implementation

Implement programs and make improvements in:

- •Project objective and scope definition
- •Project close-out criteria
- •Project motivation
- •Project assumptions and risks
- •Project strategy
- •Project estimates and budgets
- •Project networks and schedules
- •Work-breakdown structure
- •Responsibility matrix
- •Project monitoring, assessment, reporting, and communications
- •Project corrective action
- •Project performance assessment and reporting
- •Project lessons learned
- •Project meetings
- •Assessment and management of personnel workload
- •Project organizational structure
- •Roles and responsibilities
- •Personnel development and training

Step 4
Program Evaluation and Modification

- Evaluate project team strengths and weaknesses.
- Evaluate performance improvement trends.
- Identify areas of concern.
- Recommend program modifications.
- Recommend additional initiatives as needed.
- Make program modifications and/or additions.
- Reevaluate program effectiveness and team performance.

Step 5
Knowledge Base Creation

- Create lessons-learned database.
- Implement processes and procedures to continually harvest lessons learned information.
- Review and synthesize lessons learned information.
- Create knowledge base for future projects.
- Expert review and critique knowledge base.
- Implement knowledge base into formal project-planning process.

Figure 34–1 A Program for Energizing Project Teams

building sessions or a weekend retreat. The types of programs we design and implement call for hard work by team members and sustained sponsorship by management. A description of some of these programs is given in the next section.

4. ***Program evaluation and modifications.*** Team performance is measured at regular intervals to assess the effectiveness of the program and determine the modifications that should be made. The goal is to put into place a process that the organization as a whole can use to build long-term professional project-management capability. The process should enable the corporation to organize high-performance project teams quickly that can respond to any strategic initiative that senior management will launch. This is vitally important because far too often we have seen corporations spend considerable time and money to address a specific project team's problems only to disband the team after the project is completed and not transfer that knowledge and experience into future projects.
5. ***Knowledge base creation.*** The final step in our process is the building of a knowledge base of lessons learned good ideas and practices that evolve over the life of the project. This knowledge base is put in place early in the project. Information is collected throughout every step of the project life cycle. The final step involves a comprehensive review of the information collected and a sifting and sorting of the information to provide the most useful and compact repository of project experience and facts. The knowledge base becomes the mentor or expert to aid future project teams in organizing and planning their project.

Energizing Project Teams

Energized project teams achieve their goals in ways that contrast sharply with dysfunctional teams. As we noted earlier, superficial attempts at perking up low-performing teams using strategies such as team-building or increasing management oversight provides little long-term improvement and addresses only the symptoms, not the root of the problem. The foundation for the programs we design and deliver to create and energize project teams involves the following three key activities:

- Align project teams and management sponsors.
- Develop a project-environment-specific process.
- Create a knowledge base for future teams.

Align Project Teams and Management Sponsors

Effective and efficient project teams do not exist without sponsors who are sincerely committed to the success of the team and visibly demonstrate that commitment. The sponsor's role is to set the team goals and vision, encourage and support the team, and remove roadblocks. This is not possible if the team and the sponsor are not in alignment on the goals and vision of the project and do not have a clear understanding of the status of the project. Similarly, project team members who cannot communicate the project vision and status are rarely effective in completing their deliverables and understanding their impact on the overall project team. If you have ever been an instructor, you know that to teach someone else you need to thoroughly know the content that you will be sharing. This is also true of project work. The better the team members know the work and exhibit that knowledge through communication, the more effective and efficient they will be in executing the project plan.

The project team and its sponsor need a vehicle to seal their understanding and commitment to the project. That vehicle is the project plan; it becomes the project team's written contract and obligates the team throughout the life of the project. That same plan is also the sponsor's and the team's written contract with senior management and provides clearly defined commitments, accountabilities, and responsibilities for all project participants.

Inexperienced project teams may need training on how to develop an effective project plan. Stale or jaded teams may have to revisit their project plan in concert with their sponsor to ensure that the plan is still viable and all parties are committed to the plan. Fragmented teams may have to start from scratch to rebuild their project plan. This may require a combination of training, mentoring, and outside support to create the psychological contracting needed to get the project team and sponsor in complete alignment.

Develop a Project-Environment-Specific Process

The typical project environment is turbulent, chaotic, and beset with unexpected events and problems. A project team with a well-defined process can work through all the phases of their project by building on past experience; avoiding the reinvention of the wheel and wasting energy on endless problem-solving. A well-defined project process provides the following benefits:

- Eliminates the distractions of an unfocused work effort
- Establishes a common vocabulary
- Provides a disciplined, structured approach
- Ensures better communication across the team, with all the stakeholders
- Improves schedule predictability
- Lowers cost, shortens schedules, and improves quality
- Ensures greater team effectiveness and higher morale
- Supports an environment for superior project decision-making

- Lowers overall risk and promotes better risk management
- Provides greater customer/client satisfaction

The foundation of our process (see Figure 34–2) is team-based planning and interaction. Traditionally, a single individual or a small group expert in the technical aspects of the project usually performs project planning. At the conclusion of the planning phase a schedule is created, a collection of individuals is assembled and anointed as a team, and the schedule is issued to them. Each task is assigned an owner and target completion date. The project manager then sets out to manage the team, resolving conflicts and keeping management and clients/customers informed of project progress and problems. Rarely does this produce an energized project team that is committed to the scope, schedule, budget, or quality of the work they have been asked to perform. Usually this technique produces a grouping of individual contributors who work in a silo fashion on their portion of the project; hence, the organization creates a fragmented team that is disaster-prone from the very start of the project. Teamwork and the synergies associated with working on a common goal, sharing of knowledge and mutual learning, and leveraging of team expertise across the organization can only be achieved when those who will do the work plan the work; this is what team-based planning is all about. The key elements in our team-based planning process are as follows:

DEVELOP, COMMUNICATE, AND CRITIQUE THE PROJECT PLAN

The foundation of a highly motivated project team is a plan that each team member understands, helps to create, and owns. Rather than have experts create the perfect plan for the project and then hand it off to the team who will execute the work, what is needed is a structured way to gather together those who will be performing the work and providing the deliverables.

We have learned that the most effective way to create the project plan and get team buy- in is to plan the total project by way of a series of workshops. These project-planning workshops are well-structured activities that require all of the project team members (including suppliers and vendors) to focus on one goal. That goal is to develop the best project plan possible. The workshop is an activity that is sponsored by the team's administrative management and kicked off by the project team sponsor. It may become apparent during this focused workshop that there are skill gaps, resource issues, or varying opinions on how the work should be executed. Holding this workshop at the beginning of the planning phase allows the project manager and sponsor to identify and resolve gaps in skills, processes, procedures, systems, tools, and issues and to find practical solutions to the team's problems. Project-planning workshops pay handsome dividends by generating a project plan that positions the team for the highest probability of success while reducing the cost associated with schedule delays, cost overruns, problem resolution, internal conflicts, and missed market opportunities.

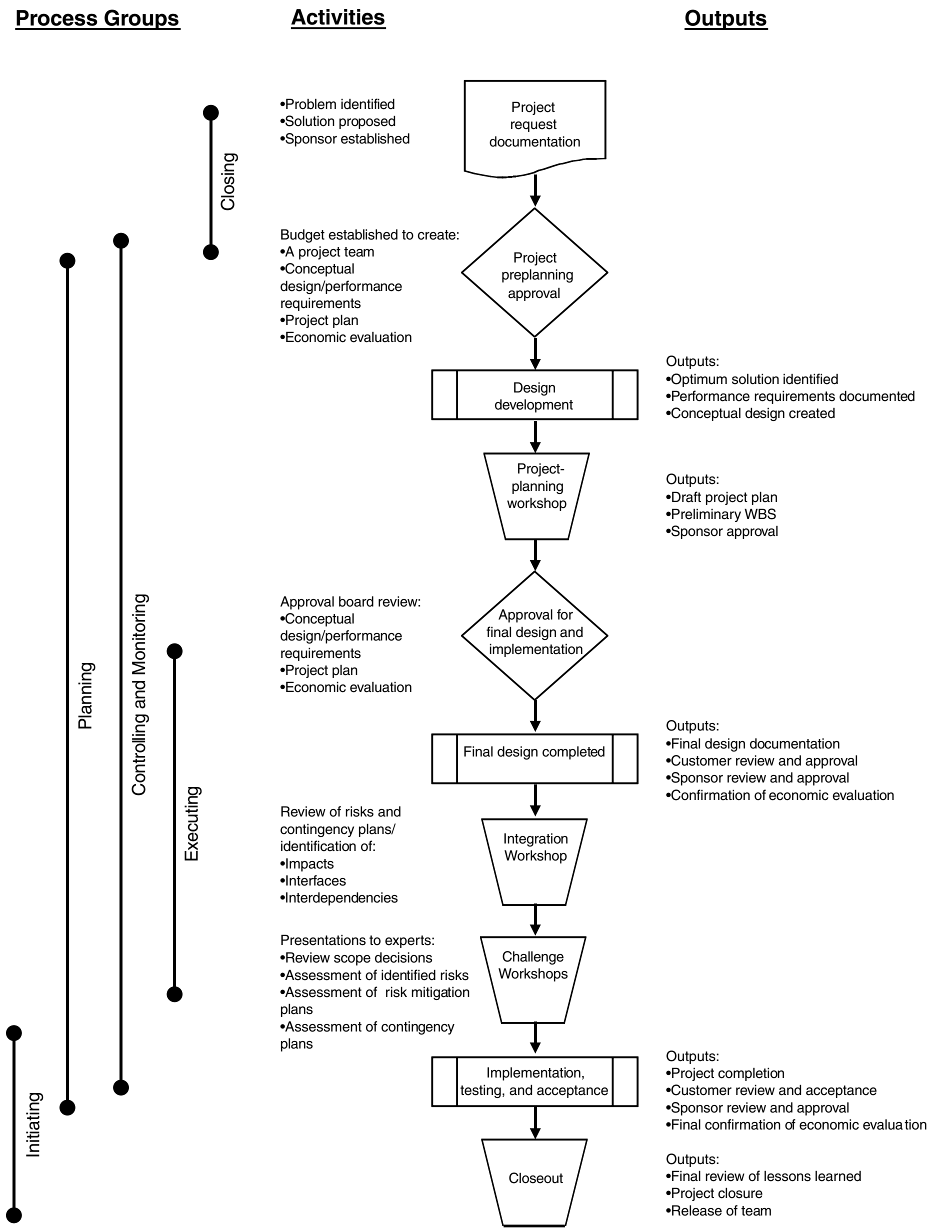


Figure 34–2 Project Process Flow

Team-based planning requires time, effort, and sponsorship. Many team members will find it tempting to jump directly into doing the work rather than to do the planning. The project manager must set the expectation that planning is a critical part of the project work and that every hour invested at the beginning in the planning process will pay dividends as the project progresses. This plan is the team's contract with management and will be signed off by not only the team, but also by its sponsor, clients/customers, and other entities as required by the project environment (regulatory, safety, engineering management, etc.). The project plan is a living document that this team will return to again and again to guide it to the successful completion of its goals. It is intended to describe the basis of the agreement between the project team and the project sponsor as well as provide a roadmap for the execution of the project by the team. Most teams claim to have a project plan, but in our experience what is referenced as the project plan is little more than a Gantt chart depicting tasks and dates. It is little wonder that there is so much confusion and misunderstanding among the team members on most projects. The plan is the key to achieving goal-aligned behavior, one of the essential characteristics that successful teams exhibit. A comprehensive project plan will address multiple facets of project execution and drive behaviors that are incorporated into the daily way of life for the project team.

At a minimum, the project team, project manager, and project sponsor must work together and agree on all the elements of the project plan. The final project plan must be signed by the project team and thus becomes the written contract between the team, the sponsor, and senior management. Figure 34–3 shows the important elements of a good project plan.

DEVELOP AND EFFECTIVELY APPLY THE WORK-BREAKDOWN STRUCTURE

The work-breakdown structure (WBS) is the workhorse of project planning (see Figure 34–4). It is the tool of choice for teams to use to identify and track the appropriate tasks to ensure successful completion of the project goals. It provides a common understanding of the project scope, helps the project manager and team members obtain buy-in to the project, and ensures that nothing is forgotten. An additional strength of this tool is that it captures the work at the appropriate level of detail for the project team to manage. This tool provides a structured way for teams to identify the:

- Work to be done
- Resources required
- Project cost
- Potential risks

The project team has the opportunity and the responsibility to obtain input and feedback on the WBS from others in the organization. As we know, the WBS serves many needs. For example, identification of duration, cost, and responsible person associated with each task and activity can provide an

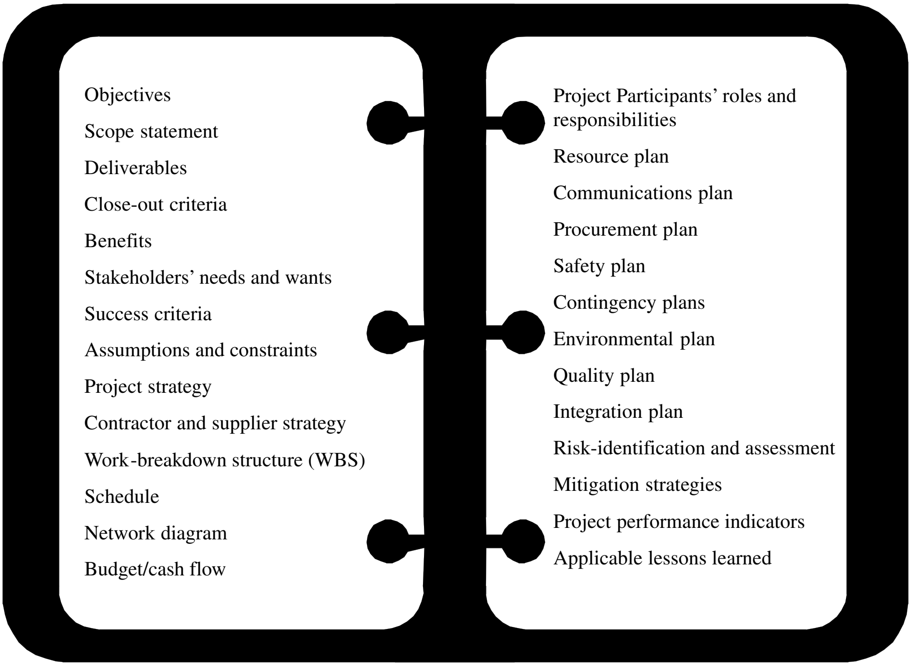


Figure 34–3 Elements of the Project Plan

easily understood graphic for communication purposes. Once all work tasks are defined, the team is well positioned to establish the duration and logical sequence (network diagram) of the work; in addition, total-staffing requirements can be realistically determined because the team will have a good picture of the total project. From an analysis of each task and the threats to successful completion of that task, a risk matrix can be assembled identifying the most significant project threats, the risk-mitigation strategy, and the contingency plan.

OBTAINING EXPERTISE THROUGH INTEGRATION AND CHALLENGE WORKSHOPS

Projects are rarely conducted in a vacuum. Often other project work is occurring at the same physical location or on the same system at the same time. As an example, during annual outages at power-generation plants or oil refineries, construction work for a whole host of projects may be going on while maintenance and upgrade activities are being performed. Thus, the WBS provides a mechanism to understand the impact of one project's work on other teams and their work. A review of the WBS with representatives from other projects provides a way to communicate clearly what will be done and presents an opportunity for other teams to point out activities or tasks that may cause interferences or negative impacts. A technique that we

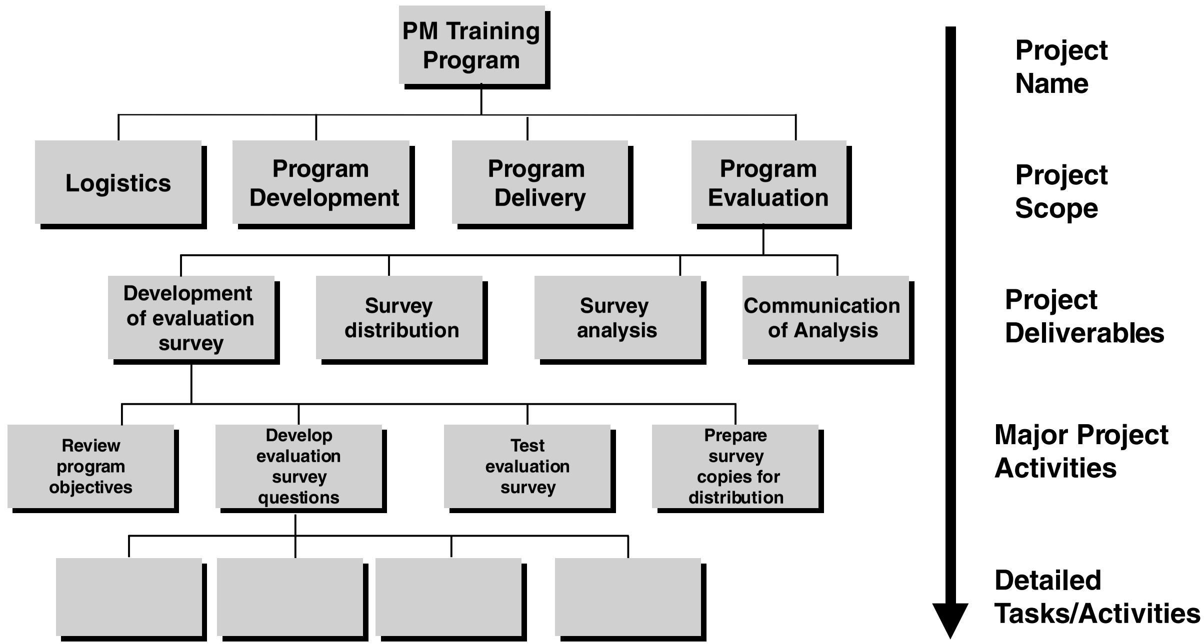


Figure 34–4 Work Breakdown Structure

use to identify interfaces, impacts, and dependencies on other projects or operational work is to hold an integration workshop.

Integration Workshop

During the integration workshop, members of the project team review their work-breakdown structure with other project teams or operational employees working in the same areas or systems. Each project is color-coded. The session begins with workshop participants marking other projects' WBS with colored pens to identify tasks or activities where they believe there are potential conflicts or where they have questions.

The project manager then reviews the scope and deliverables of the project with the assembled participants and answers any questions associated with the numbers marked on the WBS. Project-specific risks, mitigation strategies, and contingency plans are also reviewed with the workshop participants.

The integration workshop provides a constructive, nonthreatening forum for the project team to ask the workshop participants for feedback, to share their prior experiences and benefit from other teams' lessons learned. It also provides an opportunity to refine the risk-management plan based on the outcomes of the session.

Even the best of teams bring only its own experience and skills to the project. For many of today's complex projects, more is required. One of the best ways to bring additional expertise to the project team and leverage the experience and skill of experts who are not on the team is via a series of what we term challenge workshops.

Challenge Workshops

These sessions raise the energy level of the project team by providing a forum to share their thinking, obtain insights and innovations from other interested parties, and receive suggestions and feedback in a nonthreatening environment. A typical challenge workshop might have the entire project team in attendance while the project manager presents key portions of the project plan and the WBS to an assembled panel of experienced managers or technical experts. The entire project team answers questions and everyone participates in the dialogue. A well-facilitated and orchestrated session has a collegial atmosphere and results in improvements to the project team's plan. This forum provides an effective mechanism for an organization to leverage the knowledge of its brightest and most experienced members and allows the in-person dissemination of lessons learned.

FORMAL SIGN-OFF OF THE PROJECT PLAN BY THE TEAM AND SPONSOR

Project plan sign-off should be a positive emotional event. The project team has grappled with not only planning the project but also coming to terms with the team personalities, skills, and resources available to them. The plan has been communicated to the sponsor, stakeholders, and others in the organization to obtain their buy-in and commitment. A sense of accomplishment and impending success should pervade the signing ceremony. Energized project teams approach the signing as another of the project's important challenges, not as a routine event. They recognize the power of the plan to guide the execution of the work and provide the team with support and commitment.

We recommend that the project plan sign-off occur as soon as possible after the integration workshop and that each signer privately review the plan and follow up on any still unanswered questions. A team celebration after the sign-off ceremony provides visible recognition of the work accomplished to date.

OBTAINING AND GUARANTEEING CONTINUOUS AND VISIBLE MANAGEMENT SPONSORSHIP

Not only does the team have a responsibility to establish goals and objectives, but it also needs to take steps to obtain and guarantee its sponsorship in the organization. How can project managers and teams obtain what they need from their sponsors? Often just by asking. Ask sponsors to do the following:

- Commit to provide time for the team to plan.
- Commit to obtain the resources necessary for planning.
- Influence other managers in the organization to provide scarce resources.
- Actively participate in the planning workshops.
- Sign the project plan and voice belief in the plan.
- Remain positively involved after the planning, integration, and challenge workshops.

Sponsors who are sincerely committed to the project goals will understand that being actively engaged with the project team will ensure positive results for the team, the project and the total organization.

A proactive project manager who wants to ensure a high level of team energy may also choose to provide the team sponsor with a list of rules for sponsors to live by that will encourage sponsor commitment. These rules, or suggestions, to the sponsor would address the following:

- Reinforce your vision to the team on a regular basis.
- Ask the team what they need, why, and when.
- Challenge the assumptions of the team.
- Actively voice confidence in the plan; say, "It's our plan!"
- Ensure that the team's client/customers understand the plan and its deliverables.
- Review project plans, not just Gantt charts and cost reports.
- Be directly involved in activity assessment.

- When the project is off track, challenge the team to recover to the original plan.
- Remove barriers at the management level.

GOAL-ALIGNED BEHAVIOR

The final step in developing a process to meet the challenge of the project environment is to develop expectations of behavior for the team. Goal-aligned behavior provides the standards of conduct for the team to follow throughout all the trials and tribulations of the project. Goal-aligned behaviors must be incorporated into the project team's everyday mode of operation and thinking and will do much to improve teamwork and communications, as well as reduce stress and conflict. The development of goal-aligned behaviors should take place early in the planning process. You might think of these as rules energized project teams live by; at a minimum, they would deal with the following:

- Develop a common picture of the work.
- Identify, plan, and execute the right work to achieve the project goals.
- Be accountable for planning, executing, and tracking assigned work.
- Communicate any unambiguous aspect of the project's scope and impact.
- Use defined project-management vocabulary.
- Commit to keeping the project plan a living contractual agreement between the team and its sponsor.
- Use the project plan as a decision-making aid and a guide for individual team members' decision-making.
- Exhibit flexibility in sharing of resources (manpower, tools, space).
- Participate in and encourage open communication with a feedback loop.
- Understand and support the need for increased visibility of work scope, activity and cost tracking, and quality controlling.
- Be open to the views and expertise of others; incorporate others' views and expertise into assigned work.
- Learn and communicate lessons throughout the life of the project.

Energized project teams have high standards and expect others on the team to share their standards. Establishing a baseline for the way the team will operate sends a clear message to the team and allows those who cannot live by the standards to make alternative choices.

Creating a Knowledge Base for Future Teams

No matter how talented a project team may be, it cannot possess all the experience gained by others that have done similar projects. No matter how many mistakes a project team has made, it can always learn from the mistakes of others.

The challenge in creating a knowledge base is threefold:

- When is the best time for the team to seek knowledge and lessons learned from other projects?
- Where can members go to get such information?
- What is the best way for teams to capture and archive their learning for the benefit of future teams?

When seeking and applying knowledge and lessons learned from other projects, what has often been said is true: timing is everything. Teams that wait until they have invested significant time, money, and planning in a project before seeking lessons learned information usually discover that making the necessary changes has too much impact on the budget or schedule to be feasible. The best time to apply lessons learned information is early, as soon as the project scope has been defined.

Where can lessons learned be located? If your company has a lessons-learned repository, this question is easy to answer. Our experience has been that most companies have multiple unadvertised lessons-learned repositories that are rarely accessed. Ask around—you may be surprised what surfaces. Professional organizations are a good source of lessons-learned information. Several large functional organizations have placed lessons learned on the Internet for others to use, including the National Endowment for the Arts, Department of Energy (DOE), NASA, and the Center for Army Lessons Learned.

The most effective way to capture lessons learned is to identify and record lessons learned as a part of routine project meetings. Waiting until the end of the project to capture lessons learned results in lost lessons and opportunities. By the end of the project, most people have forgotten all but the most striking insights that they had during the project, so many of the lessons will be lost. Capturing lessons during project meetings harvests a rich source of information when it is fresh. Waiting until the end of the project to gather lessons learned across the team does a disservice to the team. It denies team members the opportunity to apply others' lessons to their ongoing project work.

Various methods and strategies exist for organizing and archiving lessons learned. Most companies employ an electronic database. Lessons can be organized by systems, platform, or specific pieces of equipment. An almost universal problem is the complexity of the lessons-learned database and supporting processes. When the system/process is difficult or cumbersome to use, the invariable result is that people do not input their lessons or input them inappropriately and do not use the database when beginning new projects. A way to take further advantage of the workhorse of project planning is to employ the work-breakdown structure as the framework for capturing and archiving lessons learned. Future teams need only look for similar WBS elements to identify applicable lessons learned.

Conclusion

As long as companies use teams to accomplish work, productive project teams will determine the success of corporate initiatives. How project teams learn and are sponsored, how expectations are communicated and how project managers and sponsors ensure the correct skills, tools, and processes are in place will make not only the project teams successful, but the overall organization as well. Enthusiastic, activated, alert, dynamic—these are the synonyms associated with the word ''energized.'' Energized project teams give a corporation the competitive edge.

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Chapter

35

Concurrent Product-Development Teams

Preston G. Smith

Biographical Sketch . . .

Preston G. Smith, as a principal with the consultancy New Product Dynamics, has specialized in rapid product development for nearly 20 years and has helped dozens of companies in 20 countries to adopt the techniques described in this chapter. His book *Developing Products in Half the Time* and his article ''Leading Dispersed Teams'' have been instrumental in helping many teams to bring their new products to market faster and more effectively. Preston has also served 20 years as an engineer and manager in both small and large companies. He holds an engineering Ph.D. from Stanford University and is a Certified Management Consultant.

Despite the lip service paid to teams in recent years, many product-development teams fail to live up to expectations, actually performing more poorly than their members would have on their own. This chapter addresses concurrent product-development teams, which are among the most demanding of teams due the innovative nature of their task and the need for true commitment across organizational boundaries. Concurrent development is intended to develop simultaneously both the product and its manufacturing process while maintaining a true life-cycle perspective from conception to disposal, including awareness of quality, cost, schedule, and user requirements.

Although other types of projects often do not have such demanding team requirements, managers of other projects can learn from concurrent development teams, even though they may not choose to employ all of their features.

Earmarks of Effective Teams

The reader should note the relationship between Chapter 20, Building a High Performance Team and this chapter on Concurrent Product-Development Teams.

Effective concurrent-development teams typically exhibit the following characteristics:

- They include no more than ten members.
- Members choose to serve on the team.
- Members serve from the beginning to the end of the project.
- Members participate on the team full time.
- Members report solely to the team leader, and the leader reports to general management.
- Key functions—at least marketing, engineering, and manufacturing—are included on the team.
- Members are co-located within conversational distance of each other.

Few teams achieve all these characteristics, but teams that work well satisfy many of them and know where they fall short on the others so they can compensate. Let's consider each of these characteristics.

A small team (fewer than ten) strengthens commitment and eases communication. Not only is it difficult to communicate in a large group, but it is also difficult to accommodate everyone's opinion and reach agreement. Note that the requirement for full-time membership naturally keeps the team small. If size is still a problem, the techniques of incremental innovation or product architecture can be used to divide the work among smaller teams, as discussed in Chapter 8 of Smith and Reinertsen.[1]

A few organizations are able to arrange for most members to join the team of their choice, but this is an impractical constraint for most organizations. Clearly, this improves motivation. Consequently, at a minimum, ensure that no team members are on a team with whose objectives they do not agree, because disagreement between an individual's goals and the team's goals greatly destroys motivation to achieve team objectives.

End-to-end continuity overcomes the communication and accountability gaps that follow from passing the project "over the wall" to the next group. Full-time involvement also clarifies accountability while simultaneously clearing people's slates so that they can concentrate heavily on this one project.

Reporting relationships are crucial because to make fast, cross-functional business decisions, the team must regard itself as an empowered business unit, not just a group of functional representatives or a band of engineers.

Being co-located is another technique that greatly accelerates and raises the reliability of communication and decision-making. I cover this important topic in detail later.

Each organization will have different difficulties in satisfying the characteristics that will make the team effective, but the biggest difficulties often provide the greatest opportunity for improvement. Therefore, consider even the characteristics that present the greatest challenge if you wish to make substantial improvement.

TEAMS VERSUS GROUPS

Team is an overused term in business today, so it has lost its meaning. Have you ever contacted a business to be told, ''Our customer service team will consider your request and contact you''? This is how they avoid responsibility for acting. Sending your request to this ''team'' is as good as killing it.

Katzenbach and Smith[2] take the term *team* quite seriously, and we can learn from them. As shown in Figure 35–1, they distinguish three types of teams. The simplest is the effective group, and this is where most teams are today. They apply the basic skills of effective meetings, action items, and representation from various functions. Such teams are easy to initiate and maintain, but they provide little performance boost.

Next, Katzenbach and Smith define a single-leader discipline, which is what many companies employ when they need more performance than an effective group can provide. In the single-leader discipline, the leader makes the decisions, usually after consulting with team members, and the leader is responsible for the team's performance.

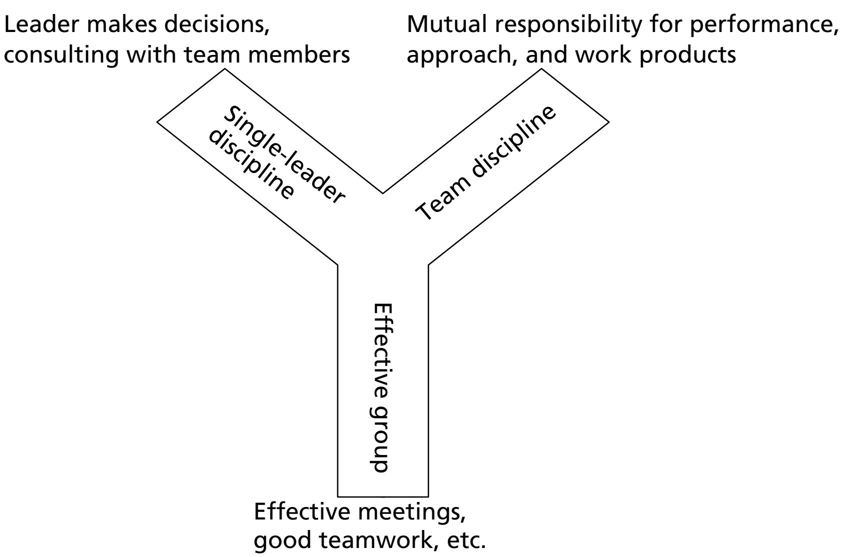

Figure 35–1 Three Team Options. The team discipline option provides the most powerful performance, but it requires significant effort to arrange. In contrast, the effective group is easy to set up but provides little performance gain. The single-leader discipline is in between

Adapted from *The Discipline of Teams* by Jon R. Katzenbach and Douglas K. Smith; © 2001 by Jon R. Katzenbach and Douglas K. Smith. Used with permission of Jon R. Katzenbach, Senior Partner of Katzenbach Partners LLC

Finally, there is the team discipline, in which the team holds itself mutually accountable for results. Work products, such as the project's work-breakdown structure, are considered jointly owned by the team, and team leadership is likely to shift as the project progresses. Members' responsibilities may shift as well as the project's demands shift. No member of the team can fail, because only the team can fail.

The team discipline can provide a high level of performance, but it is also demanding in setup and maintenance. It can be uncomfortable for its members because they become responsible for each other's shortcomings and cannot isolate their specific responsibilities. This arrangement can be very powerful, and it fits many concurrent development projects well, because of their innovative and cross-functional demands. However, few concurrent development groups have taken this step so far.

TEAMS AND MEETINGS

Teams often become associated with meetings. Some teams form to solve problems or make specific decisions. For these teams, the team's work can be done in meetings. However, a development team's job is to do things, such as design, analysis, customer visits, prototype building, and testing. These tasks are not done in meetings. So if team members think of their roles as holding meetings, little will get done, people will arrive at meetings unprepared, and progress will be slow. A development team should not define itself through its meetings, but rather as a group that completes the value-added tasks that breathe life into a new product.

Staffing a Team

Often, the team leader and the project manager are the same person. These two roles fit well together, and they provide some latitude in choosing a title that reflects the desired emphasis. The title should answer the following questions: Are we looking for leadership or management? Is the object of this attention the project or the team?

It is when the project manager and the team leader are different people that difficulties can arise. If the project manager reports to the team leader and has little authority, this role can degrade into one of an administrator. The project manager keeps the schedule and budget up to date but has little power to take action on the information he or she maintains. On the other hand, sometimes an executive who spends little time with the team holds the team leader role. Then there is an ineffective absentee-landlord situation.

The choice of team leader is the most important one management will make in the life of the project. A project to develop even a simple new product will have to overcome many obstacles because of the product's innovative nature. A weak leader will be unable to deal with the hurdles, so management will be drawn in, which simply is a slow way to run a project.

Rapid progress depends on a readily available leader/manager with a can-do attitude who takes charge when difficulties arise. A part-time project manager or team leader is not sufficient. If management assigns anyone to the project full-time, it should be the leader.

The team leader should be considered first as a general manager, not a functional expert. The real skill needed is to integrate the marketing, engineering, manufacturing, and other departmental viewpoints into a solid business direction. If the leader is viewed as, say, primarily an engineer, then functional managers of marketing and other departments will feel obliged to get involved to protect their interests. This outside managerial involvement undermines the very advantage that a cross-functional team can provide, which is fast, effective action on cross-functional issues.

TEAM-LEADER SKILLS

Two groups of essential skills underlie this general management capability: product-vision skills and people skills. A popular definition of leadership is the ability to transform vision into results. If this is the case, then to get a winning new product to market, the leader must have a broad, integrated, and focused vision of the product and be able to communicate this vision to others.

The need for people skills is probably obvious, but most of these skills stem from innate ability or long-term development; seldom can they be trained in as needed. Such skills include the ability to do the following:

- Incorporate diverse views, especially from quieter people or on unpopular subjects.
- Resolve conflict.
- Develop members' skills and their confidence in them.
- Intrinsically motivate members.
- Move ahead with little or unclear authority.
- Obtain the human and other resources needed.
- Protect the team from outside distractions.
- Maintain a relaxed atmosphere under stressful conditions and employ humor effectively.

Clearly, the leader needs a working knowledge of the technologies and other professional disciplines involved in the project, but in-depth knowledge can get in the way by encouraging micromanagement. The team will also need conventional project-management skills, such as an ability to run effective meetings, schedule and monitor progress, draft and manage a budget, and comply with the corporate procedures regarding product development. Such skills are usually secondary in importance and can be learned on the job when necessary. The practice that many companies have of always selecting team leaders from a certain department, such as engineering, simply places a misguided restriction on the search for a good leader. Engineers do not have a corner on the crucial vision or people skills.

TEAM MEMBERS

Effective team members have qualities remarkably like those of good leaders, according to Kelley.[3] In particular, members should be self-starters who can work without supervision. Another essential attribute is a willingness to think independently and support contrary views when necessary. Groupthink is particularly destructive in a close-knit team whose job is to innovate.

In selecting members, the leader naturally makes sure to incorporate the key disciplines and professional skills—the so-called hard skills. However, there is another set of critical soft skills that is just as important to have available within the team. These skills include problem-solving, idea-generation, conflict-resolution, and negotiation. Perform a crosscheck to ensure that such skills are available from someone on the team, in addition to the hard skills they contribute.

HEAVY EARLY STAFFING

A common mistake made in staffing a team is not getting key players on board soon enough. Early staffing can be weak as new members finish prior commitments so that they can join the team. The team then gets off to a shaky and slow start, which puts it in a catch-up situation from the outset. When the late members do join, they are at a disadvantage because they have not participated in the preparatory activities and early decisions. And the team is at a disadvantage too, as they have not bought into critical early decisions the team has made. These decisions include the product's definition, team work methods, and project schedule and deliverables.

For concurrent development, late arrival of downstream players, such as those from manufacturing or field service, simply perpetuates a situation in which products are not designed for manufacturability or serviceability. The only way to break this repeating cycle of unmanufacturable products is to have the downstream functions involved at the outset.

THE POWER OF GENERALISTS

Ever since Frederick W. Taylor and Henry Ford, U.S. industry has encouraged labor specialization. In many cases, this is with good reason. Individuals feel good and can command better pay by doing something specific a bit better than others. In addition, organizational design is cleaner because one can put people in definite pigeonholes and put precise labels on the organization chart.

Unfortunately, specialists create a host of problems on a product-development team. It is difficult to keep them gainfully occupied full time on the project, so they come and go from the project as it needs their specific expertise. This creates scheduling, availability, and delay problems, which ultimately stretch the schedule. The specialists often feel little commitment to the project at hand. They are unlikely to understand well the project objectives, such as the product attributes the customer values most. Nor are they apt to comprehend how their work must fit with downstream activities, such as manufacturing, distribution, and promotion.

Thus, on balance, a development team can move faster and produce products that satisfy customers better by using a few generalists working full time throughout the project. Clearly, there is a limit to how far one can go with generalists, because a company's competitive edge often depends on the distinct competencies that specialists provide. Yet most firms would be much better served by shifting toward generalists on development teams. Ultimately, this requires favoring generalists through recruiting, compensation, training, recognition, and promotion. Until these long-term measures create more generalists, team leaders should seek generalists—or those willing to try wearing different hats—when recruiting team members.

Note that such generalists fit perfectly with the team discipline style suggested in connection with Figure 35–1 for the highest level of team performance.

OUTSIDE DEVELOPMENT PARTNERS

Many companies, especially automobile manufacturers, are providing substantial roles for suppliers on their concurrent-development teams. Supplier involvement is important in three situations. First is when the supplier's lead time is long or unpredictable, which can delay the whole project. Second is when the supplier's ability to manufacture the parts reliably and with high yields depends on the design that the team supplies. Third is when the supplier holds a special knowledge of a product technology that is critical to success.

In these cases, a supplier should be a substantial member of the team. The critical item to manage here is getting the supplier personnel involved early, when they can contribute to shaping the critical early decisions that will add value to the product. It is virtually impossible to get the supplier involved too early. Once the supplier is on board, project managers should keep in touch with that person on an ongoing basis (weekly), even when there are no important issues to discuss. This will keep the project manager up to date on the supplier's workload and thus the supplier's ability to respond when needed by the team.

Substantial supplier involvement means that the supplier spends time on-site with the team, often co-located. Clearly, the supplier should receive equitable compensation for this, perhaps with upfront payments for his or her time, rather than having compensation amortized in the piece-part price later. This type of in-depth involvement carries its price, so project managers will want to select carefully the few suppliers whose contribution will warrant this special treatment.

Some firms have pushed beyond involving suppliers to include other product-development organizations that develop specific portions of the product for them. The same type of early, ongoing involvement is needed here. In addition, the project will be much easier to manage if the portions of the product developed by others are cleanly separable via the product's architecture. For instance, having a development partner responsible for the electrical system of an automobile is a poor choice, because the electrical system interacts with the rest of the car in a multitude of ways. Outsourcing development of the instrument cluster would be much better, since it has a cleanly definable interface. See Chapter 6 of Smith and Reinertsen for more on this.

MOTIVATING THE TEAM

This is a highly controversial subject with few clear answers. It is also an important subject, for it relates directly to individual and team effectiveness. Following are a few guidelines that apply especially to concurrent engineering teams.

Think beyond financial rewards. Although coffee mugs and T-shirts may have seen their day, there are many other options available to the creative team leader. For example, consider a photo of the team in the annual report, lunch with the executive sponsor, or a holiday weekend.

A preoccupation with financial motivation usually indicates something askew in the basic compensation system that patchwork rewards will not correct. People deserve fair compensation for the work done regardless of whether they are on a team.

Project managers should think carefully about the change in behavior they desire and plan motivation and rewards to encourage it. For example, recognizing individuals, only the team leader, or a core part of the team does not encourage teamwork.

Project managers should not depend heavily on rewards or other types of extrinsic motivation for obtaining results. There are just too many ways in which they can backfire. People will resist attempts to be controlled by rewards or money. Kohn[4] provides plenty of evidence against the use of extrinsic motivators.

Organizing the Team

Although there as many types of organizational structures as there are organizations, most of them fall somewhere on a spectrum from a functional organization (Figure 35–2) in which each person reports to a functional manager to the separate team (Figure 35–3), in which individuals involved in the project report directly to the team leader, who in turn reports to a general manager. Between these two extremes lie a range of options (matrix organizations) in which an individual reports simultaneously to a functional manager and a team leader. They are characterized by whether they are more like Figure 35–2 or Figure 35–3, that is, whether the functional bonds or the team bonds are stronger. See Chapter 16.

ORGANIZATIONAL OPTIONS

Each of these forms has its strengths and weaknesses. The functional form is popular in industry because it has provided functional strength and expertise for years. However, in the functional form, communication and

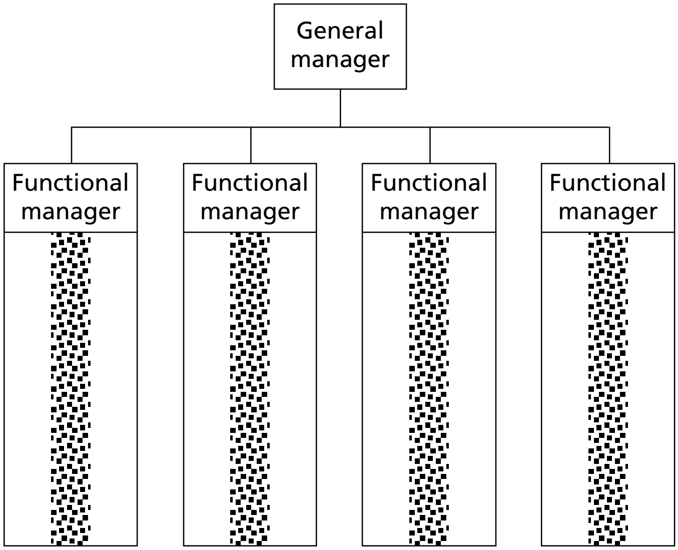

Figure 35–2 A Functional Organization, in Which All Individuals Are in Functional Departments, Which in Turn Report to a General Manager. For product development, the functions might be engineering, marketing, purchasing, and finance

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decision-making tend to flow through the functional heads. This simply is not very effective for the heavy load of cross-functional communication entailed in concurrent development. Decisions are made both better and faster with a more horizontal form, as the horizontal conduit in Figure 35–3 suggests.

Consequently, there is no one best form, and the one to use depends on the prime objectives of the particular project. Some projects developing highly innovative products can benefit greatly from the horizontal flow prevalent in the more autonomous forms. They are willing to tolerate the shortcomings of poorer functional coherence. For example, they may allow designers on every project team to select a different type of fastener, which ultimately causes factory complications. In contrast, for a more routine product-upgrade project, the balance can be completely different, which suggests a more functional organizational form. The most effective teams design their organization to fit the job rather than just adopting the company standard.

Once you select your organizational form, you should identify its weaknesses and be sensitive to them. For example, if you choose the separate team and proliferation of fasteners is likely to be a problem, put some type of fastener standards or coordinating mechanism in place to deal with this weakness.

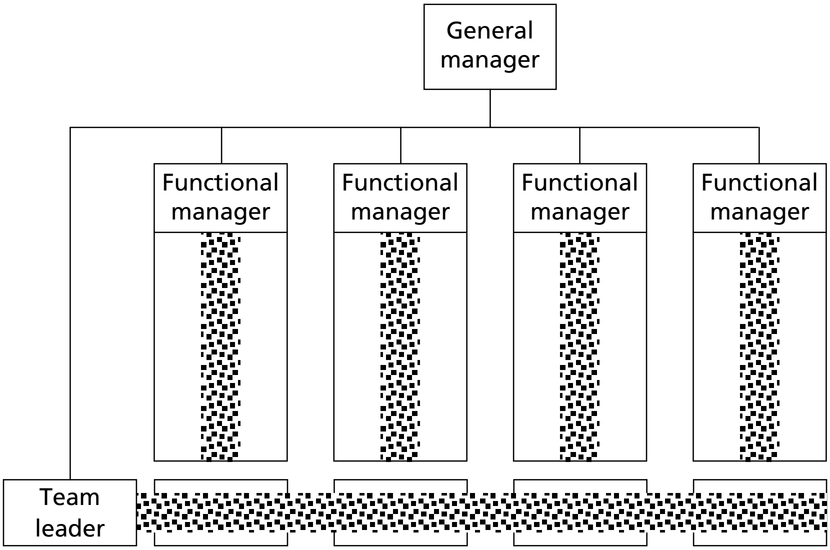

Figure 35–3 A Separate Team Organization, in Which Members of the Team All Report Directly to a Team Leader. There may be several of these teams, and their members are drawn from the functions for the duration of the project

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As companies remove layers from their hierarchies, they generally move toward more horizontal forms, which is generally in the right direction for development teams. However, this shift is not likely to be fast enough for the needs of an innovative development project. Thus, a concurrent development team may be in the position of pioneering new organizational forms in a company.

CO-LOCATION AND DISPERSED TEAMS

Most organizations pay a great deal of attention to the organizational structure issues just covered. Just as important—but generally receiving far less attention—is the geographical structure of the team, that is, exactly where its members are located.

Cross-functional communication, problem-solving, and decision-making are essential core activities in concurrent development. There are two ways to facilitate these activities: by organization or by location. Two individuals in the same department, even if they are not located together, are more likely to talk to each other. And two people located together are more likely to talk, even if they report to different bosses.

Locating the team close together is called co-location. We have found it to be a very powerful enabler of successful teams. To be most effective, three characteristics are highly desirable:

- All members should be co-located, including engineering, marketing, manufacturing, purchasing, and any others who play a key role.
- They should all be located within earshot—roughly 10 meters (30 feet).
- Line-of-sight arrangement should be used (partitions below seated eye level).

The oft-cited research of Allen[5] (see his Chapter 8) supports this strict interpretation.

Although Allen's research is often cited to encourage teams to co-locate, we have found that this is a very personal thing, so the research is not convincing. The strongest evidence for co-locating comes from those who have actually done it. They unanimously appreciate its power to enhance communication. There is no substitute for the way it clarifies and speeds up communication. However, those who have not experienced it can cite countless reasons why it will not work. Therefore, I strongly encourage you to give it a serious test following the three bullets above.

Notice that I did not say that co-location was enjoyable—only highly effective. There are some real difficulties in implementing it, including

- Lack of sufficient open floor space
- Concerns about distractions or lack of privacy
- Functional bosses worried about losing control of ''their'' people
- Perceived lack of status
- Lack of a permanent office home

Consequently, even if you do successfully co-locate a team and they agree on its value, you will have to watch that co-location doesn't gradually revert to a more comfortable arrangement.

Since the 1990s, another blow has been struck against co-location: the availability of many electronic communication tools: e-mail, faxes, voicemail, phone conferencing, Internet conferencing, shared databases, and videoconferencing. Some people call this ''virtual'' co-location, but I consider these tools only as aids to communication that sometimes help but often hinder real communication, especially the type of complex, full-bodied communication that is often characteristic of concurrent development. For example, phone tag, a byproduct of voicemail—and its e-mail equivalent—is not a way to make fast, effective decisions when collaboration is needed.

In addition to the availability of such tools, other business trends have caused teams to disperse geographically: offshore manufacturing, global markets, acquisition of operations in other regions, and relocation out of expensive areas or into ones that are more pleasant. Consequently, highly dispersed team membership has become an obstacle for today's product-development teams. Smith and Blanck[6] discuss several things you can do to make the most of a dispersed team, including:

- Don't give up on co-location but apply as many of its characteristics as you can by using partial co-location.

- If the team can get together at any point during the project, try hard to do it at the beginning, for many reasons.
- Establish jointly agreed-to protocols for effectively using tools such as e-mail.
- Through training, sensitize your team to its cultural differences (national, organizational, and functional differences in values. styles, and approaches)
- Pay attention and object when you see your team being dispersed even further.

ESTABLISHING THE TEAM'S AUTHORITY

Most of the approaches and techniques suggested above are aimed at improving communication and decision-making within the team, which is vital for concurrent development. However, there is one more, often-overlooked item that needs careful attention: how much and what kinds of authority does the team have to operate? Without clarity here, time will be lost as issues are resolved, and the team is likely to be reluctant to move in areas where management believes the team does have authority.

Table 35–1 shows a sampling of the areas of authority exercised by someone in an organization developing a typical product.

Before using this list, adapt it to your development system, adding and deleting items to suit your organization and changing the terminology to your terms. This list is useful in two ways. First, recognize that management, the team, or some perhaps vague combination has authority in each of these areas. It behooves you to clarify in advance who has authority in each area. Second, the team can use this as a prompt list to identify those few areas where it does not have authority now but would greatly benefit from having such authority. Then it can approach management to obtain this type of authority. Note that more authority for the team is not necessarily better, because with each item of authority comes responsibility and extra work.

You can also provide team authority on a more global level. One approach is by using development agreements between the team and management. As explained in Chapter 14 of Smith and Reinertsen, these are essentially contracts between the team and management that specify the team's and management's authority and obligations in a mutually binding way. For instance, the agreement might state that the team shall deliver a product with a certain five features and at a certain unit cost by March 15, whereas management shall make a certain number of employees and an R&D lab available full time from September 1 to March 15.

A similar and more recent approach is the bounding box, essentially a management-by-exceptions technique in which certain critical parameters of the project, such as profit margin, project budget, product-performance level, and launch date, are negotiated as the bounding box. Then the team is free to move ahead unimpeded as long as it stays within the box. Management regularly checks that the team remains within bounds, and it is

Table 35–1 Areas of Authority

Financial Control	Manage outside contractors
Prepare project expense budget	Select vendors and suppliers
Modify project expense budget	Manage vendors and suppliers
Prepare project capital budget	Operational Control
Modify project capital budget	Select product features
Use project capital budget	Modify product features
Authorize travel	Determine product architecture
Pay for manufacturing variances	Set reuse objectives
Establish delegation limits	Make reuse decisions
Cancel project	Make design outsourcing decisions
Management of People	Prepare project schedule
Prepare staffing plan	Modify project schedule
Modify staffing plan	Select development location
Select team members	Determine layout of team work area
Hire team members	Determine agenda of team meetings
Remove team members	Select development methods
Evaluate team member performance	Modify development methods
Determine team member compensation	Select engineering tools
Determine team member bonuses	Select test procedures
Provide recognition to team members	Modify test procedures
Management of External Relationships	Determine test criteria
Select key business partners	Set documentation standards
Manage key business partners	Select manufacturing site
Select key technology partners	Select manufacturing processes
Manage key technology partners	Set quality standards
Select outside contractors	Set manufacturing yield targets
	Set management reporting requirements

also the team's responsibility to notify management quickly if it finds that it is leaving the box. If the team leaves the box, then a management review considers whether the project should continue, and if so, the box's limits are reset. One parameter that must be determined, according to company's tolerance for risk, is the margin the team is allowed around the perimeter of the box. If it is set too tightly, then out-of-bounds reviews occur frequently, but if it is set too loosely, the team can wander far from the goal before being detected. Typically, margins are set looser for more experienced teams and for projects with a lower level of risk, in other words, with teams that management is more comfortable letting run on their own.

Another consideration is the interplay that bounding box may have with any phased development process used, such as the stages-and-gates process described by Cooper.[7] At a minimum, bounding box is an effective way for management to monitor progress between gate reviews without meddling in the team's business. In more powerful implementations, the bounding box replaces the reviews at the end of the phases, and the team runs through much or all of the project without management reviews as long as it remains within the box. In this case, the team maintains a great deal of authority while the project meets its objectives without delay for reviews.

Bounding box is likely to work best if the organization is able to cleverly set only a few boundaries that focus attention on critical success factors for the project, rather than dozens of secondary factors that—while seemingly beneficial—may distract the team and management from the essence of project success. For instance, the Hewlett-Packard team developing HP's first DeskJet printer was given three boundaries for the project: letter-quality printing, prints on regular copier paper, and priced under U.S. $1000.

Conclusion

Teams vary greatly in their performance capability, and projects vary greatly in their need for a high-performance team. Higher performance can be costly when it is not needed. Concurrent-development teams often benefit from employing the more powerful types described in this chapter, and the chapter may also be helpful to those wishing to increase the performance of teams for other applications.

I have provided a broad variety of tools and approaches. Keep the objective and special characteristics of your project in mind as you select the tools and approaches to apply. This implies that there is no universal way of setting up a team; it all depends on what you want to achieve and under what circumstances. Don't be afraid to experiment with different techniques on different projects until you find ones that work for you. Whatever you use will have to fit your organization's culture—although you can shift this to an extent—so the ''right'' solution for you will be different than the ''right'' one for another organization, even for the same project.

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Chapter

36

Self-Managed Production Teams

Karen M. Bursic

Biographical Sketch . . . **Karen M. Bursic** is an Adjunct Assistant Professor in the Department of Industrial Engineering at the University of Pittsburgh, where she teaches courses in probability and statistics, engineering economics, and project management. She received her B.S., M.S., and Ph.D. in Industrial Engineering from the University of Pittsburgh. Previously, she was a senior consultant at Ernst and Young (in Operations and Quality) and was a production supervisor and industrial engineer for General Motors Corporation. Dr. Bursic has done research and published work in the areas of engineering and project management as well as engineering education. She is a registered Professional Engineer and a member of the Institute of Industrial Engineers and the American Society for Engineering Education.

Introduction

Self-managed production teams (also known as semiautonomous, self-regulating, or self-directed work teams) replace the traditional hierarchical manufacturing organizational structure. These teams are more firmly rooted into the organizational design and are a sophisticated, structured technique to facilitate employee involvement, empowerment, and job enrichment in a manufacturing environment. Production teams are composed of all workers from a particular work area or work cell who have broad responsibilities beyond those commonly given to other kinds of teams (such as problem-solving teams, quality-improvement teams, task forces, product design teams, or project-management teams). Membership on the team is normally not voluntary—it is a requirement of the job. Production team members have a high degree of autonomy and authority to manage day-to-day activities, including task assignments, work scheduling, training, work methods, quality control, maintenance, problem-solving, and even hiring or purchasing. In general, the employees are given most of the planning, organizing, motivating, directing, and controlling responsibilities formerly assigned to first-line supervisors or foremen. Team members may rotate job assignments and be paid for the various skills they master, and are often evaluated based on group rather than individual performance. This kind of organizational design allows for shared responsibility, authority, and accountability for decisions and results.

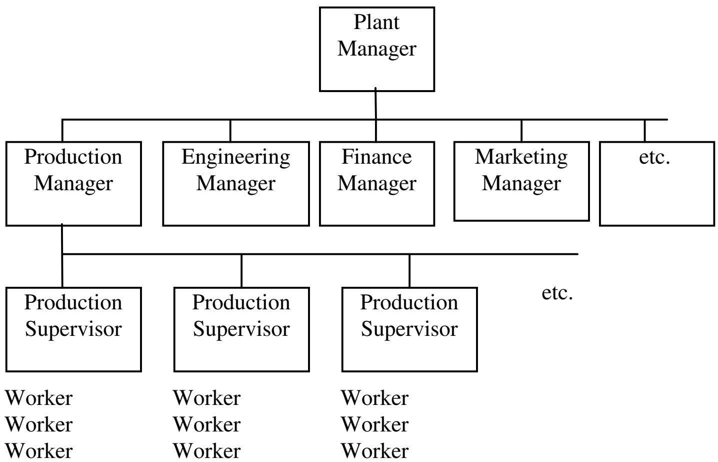
Self-managed production teams create a departure from the traditional hierarchical organizational structure and movement toward a flatter organization with less management layers. Figure 36–1 displays this change in the organizational structure. In the traditional organization, individual employees work in the plant (perhaps on an assembly line or assigned to a particular work area) and report to a production supervisor. There may exist separate supervisors for operators, maintenance personnel, and inspectors. The supervisors in turn report to a superintendent or departmental manager and the chain of command continues up to the plant manager. In the production team structure, groups of individuals that include machine operators, skilled tradesman, maintenance personnel, inspectors, and so forth work together in teams to produce the needed products. The teams report directly to the head of production or other high-level position. This structure reduces the number of management layers and gives employees direct responsibility to produce a product, and therefore facilitates employee empowerment. These kinds of teams contribute to the trend in industry today to decentralize authority and extend decision-making capability to nonmanagement and lower-management employees.

The objectives of this chapter are to present some examples of the use of self-managed production teams, describe the common strategies used to ensure the success of these teams, and provide some management tips for effective implementation.

Industrial Examples

Teams have been used in industry in many forms for a number of years. Operations research teams date back to the 1940s, and project-management teams have been popular since the 1960s. But teamwork did not become a central issue for U.S. manufacturing until the introduction of Japanese-style quality circles in the 1970s. Since that time, the use of teams as a tool to solve problems has dramatically increased. Today, it is not a matter of whether teams are used, but how effective they are at improving performance in the organization. According to the 1999 *Industry Week* Census of Manufacturers, 68 percent of small-company plants use teams;[1] and 72 percent of Fortune 1,000 companies had at least one self-managed team.[2] Although many companies have been very successful with self-managed production teams, the challenges of implementation can be significant. They

The Traditional Organizational Structure:



The Self-Managed Production Team Organizational Structure:

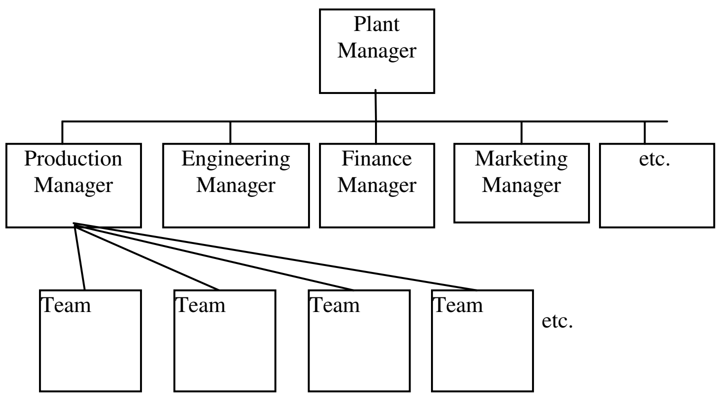


Figure 36–1 Traditional versus Self-Managed Production Team Organizational Structures

typically involve expensive training, long implementation times, and a threat to management's power structure.[3]

Volvo Car Corporation has been using production teams since the 1970s. In its Kalmar, Sweden, plant, 20 to 25 employees work in teams to complete major segments of the automobile, such as electrical systems or instrumentation.[4] Each team functions autonomously and is therefore responsible for a whole piece of work. Volvo completely replaced the traditional assembly line with production teams in its Uddevalla plant in the 1980s. The teams manage themselves by handling scheduling, quality control, and hiring.

Volvo has eliminated first-line supervisors at the plant and maintains only two tiers of managers. The teams are responsible for building four cars per shift in their own work area. Team members are trained to do all assembly jobs and rotate jobs every three hours on average. Morale is high at the plant, and absenteeism has been dramatically reduced.[5] Volvo was an innovator in the use of production team concepts, and many companies have followed its lead.

Since its inception, New United Motors Manufacturing, Inc. (NUMMI), a joint venture between General Motors and Toyota located in Fremont, California, has employed production teams. Teams are made up of four to six people, including a UAW team leader. Three to five teams form a group that is led by a nonunion leader having traditional supervisory responsibilities. The group and team leaders work together with team members to determine workloads and job allocations. Jobs are rotated to the extent possible (model and technology changes may require people to learn new skills). Work teams share meeting areas on the production floor where charts are kept that contain information on quality, job allocation, and so forth.[6] Operators have the authority and responsibility to stop the production process if it is out of control or a problem occurs. Some are convinced that the plant is one of the most efficient automobile assembly plants in the United States.[7] Others disagree and insist that the stress caused by working in such an environment is inhumane.[8] Still, the plant continues to operate successfully using production teams and has received a number of awards, including the JD Powers Silver Award as one of the top North American automotive assembly plants.[9]

The use of production teams is certainly not limited to automobile manufacturers or strictly assembly operations. Another U.S.–Japanese joint venture, the I/N Tek and I/N Kote steel plants, located in Indiana, also uses production teams. This joint venture between Inland Steel Company and Nippon Steel Corporation, which began in the late 1980s, is a highly automated continuous production operation. Employees for these plants are carefully recruited and trained specifically to work in teams.[10] A human resources consulting firm is retained to help recruit all levels of managers and hourly employees through an extensive selection process. Employees then receive technical as well as social training before the plants start-up. Managers at the plants work only the day shift five days per week. Other shifts run quite successfully without managers, who are called in only if employees cannot solve a problem on their own. Union personnel receive financial, operational, quality, and customer performance reports. Teams have high levels of autonomy to run the operations. Their responsibilities include allocating tasks, inputting into planning and scheduling of work, and setting quality standards. Workers rotate jobs within their teams, and team members have the ability to stop operations if necessary.

The use of production teams is also not limited to foreign companies or joint ventures. Digital Equipment Corporation has used production teams in some of its manufacturing operations. Its Enfield, Connecticut, plant was designed and built with a number of human resource and organizational development issues in mind—including production teams. The plant opened in 1981 with only two levels of management and work teams of twelve to eighteen people responsible for every aspect of producing its products. The plant had some initial problems, brought on, in part, by a lack of understanding about the amount of training that would be needed, but eventually was a very successful venture for Digital.[11] More recently, self-managed teams have been a contributor to the image turnaround and production improvements at Harley-Davidson.[12] Its Kansas City, Missouri, plant that opened in 1998 is organized around self-managed work teams carrying out key business processes. Union and salaried employees work jointly, and there are no individual offices in the facility. Customer satisfaction with the Sportster model produced at the plant has reportedly improved by 200 percent.

For a number of years, *Industry Week* magazine has profiled the winners of its Best Plants awards and has also drawn conclusions about the commonalties among these plants. High-performance work organizations (HPWOs) that are characterized by multiskilled work teams and authority decentralized to front-line workers are common at many of the winning plants.[13] All of the ten North American winners in 2002 use teams in some form (www.industryweek.com).

Teamwork is a significant contributor to the success of Dana Corp.'s plant in Stockton, California, a 2002 Best Plant winner. The plant produces frames for the Toyota Tacoma pickup, which is produced at NUMMI. Managers at the plant firmly believe that the operators on the production floor know the most about their processes.[14] Employees are referred to as "teammates" and take ownership of their work. Their autonomy extends to the hiring process. Dana Corp. believes that "to be successful takes effective teamwork" (www.industryweek.com). Team members also play a role in hiring as well as skills certification and performance reviews at DST Output's printing operation in El Dorado Hills, California, another of the 2002 Best Plant winners.[15] Forty percent of this plant's work teams are self-directed and production employees get an average of 80 hours per year in training so that they are multi-skilled team members. Another of the 2002 winners, Honeywell's Warren, Illinois, plant, produces electromechanical snap-action switches. In the early 1990s, management at the plant realized that they needed to make major changes in the face of serious foreign competition.[16] They instituted a number of changes, including automation, quality programs, and an empowered workforce that uses production teams. Team members are cross-trained and rotate jobs regularly so that all production employees can perform the tasks required to produce the switches. Employees are compensated and rewarded based on customer satisfaction and goals. Goals are posted, tracked, and tied to plant, divisional, and corporate goals. As a result of the changes, the plant has reduced customer reject rates, increased annual unit per employee, and reduced inventory.

Strategies for Successful Self-Managed Production Teams

There are a variety of reasons why the companies described in this chapter and others like them have been successful at implementing self-managed teams. The following paragraphs detail a number of common strategies that organizations report as contributing to the success of their self-managed production teams. Certainly this list is not exhaustive, and a team program will not necessarily succeed simply because all of these strategies are implemented. These strategies, however, are known to contribute to successful teams. The descriptions have been customized to the use of production teams in particular, but can be adapted to other teams as well, including project-management teams.

SENIOR MANAGEMENT SUPPORT

This factor is absolutely critical to the success of any kind of team, including production teams. It requires commitment of both financial and physical resources, as well as allowing employees time off from other responsibilities to participate in team meetings and presentations. It also means management must be willing to share vital organizational information that the teams will require to make decisions. One way to demonstrate commitment is to assign each team a sponsor from senior management, someone who can help break down barriers for the team. This worked effectively for an insurance company using quality-improvement teams. If a team was having difficulty getting other people committed to implementing their solutions to problems, they sought out intervention from the top-management sponsor. Organizations that are very successful with teams have leaders who are seriously committed to the team concept and believe that it is the only way to succeed.[17]

INTERDISCIPLINARY AND DIVERSE

Interdisciplinary means that the team consists of members from two or more disciplines or functions of the organization. On a production team, this might include several types of skilled trades, quality inspectors, machine operators, supervisors (or ‘‘team leaders’’), and other necessary personnel. The members should represent all organizational functions that are needed to solve problems or run the day-to-day operations. One team spent a significant amount of time clearing up a serious misconception because it had no team member representing the distribution function. The team also had difficulty in getting its solution accepted.[18] Rather than permanently increasing the size of a team, some team members might be used on an ad hoc basis. For example, an industrial engineer might only be needed if the team is developing new work methods.

Diversity in team members is also critical for coming up with creative solutions to problems. Parker found that diversity in team member style is critical to the success of a team.[19] A team is strengthened when it includes a member who is task-focused, a member who is focused on the goal, a member who is process-focused, and a member who questions the team's direction. At the same time, diversity may sometimes cause other difficulties for the team that a leader or facilitator will have to address through conflict resolution. Team members should have some training in group processes and consensus-based decision-making to manage conflict.

INTEGRATED AND CONTINUOUS

If teams are to be successful in the long term, they must be fully integrated into the organizational design. Because teams are a departure from the traditional hierarchy, they require that everyone understand how the teams are embodied into the organizational structure. This will ensure the continuation of teams even in times of management and/or employee turnover. Responsibilities that belonged to first-line supervisors and are now being transferred to the teams must be clearly defined. BP Norge, the Norwegian division of British Petroleum, found that ''integration and institutionalization'' was a key phase in the success of its teams.[20]

EDUCATION AND TRAINING

One early survey found that 92 percent of U.S. team members receive some type of training,[21] and this trend continues today. Regardless of whether teams are used, training in job and technical skills is more critical than ever in today's highly automated factories. However, training for members of self-managed production teams must also include:

- Team dynamics and team building (e.g., team skills, meeting skills, administrative skills, and knowledge of the phases of a team's life cycle)
- Problem-solving tools (e.g., brainstorming, nominal group technique, process flow diagrams, Pareto charts, statistical process control, etc.)
- Interpersonal skills (e.g., conflict resolution, negotiating)
- Communication skills

Training is recognized as one of the challenges of implementing self-managed teams.[22] It is important to recognize that all of this training can be overwhelming, especially if it is given all at once. Skills that are not used immediately will probably not be retained. One approach, termed ''just-in time training,'' provides training to employees in specific skills as team members need them. For example, training in communication skills may be provided as teams are preparing for presentations to senior management.

EFFECTIVE LEADERSHIP

The team leader's primary role is that of task management—making sure objectives and goals are met and managing *content*. The leader of a production team will undoubtedly handle some of the responsibilities that may formerly have been held by the first-line supervisor. Thus, the leader must be someone who is highly motivated and committed to the team as well as someone who knows the production process well. In addition, the leader must be able to work with other managers and leaders who may feel that their power and control are threatened by the self-managed teams.

EFFECTIVE FACILITATION

One of the roles that is vital to any kind of team is that of a facilitator. The facilitator's primary responsibility is to manage the team *process*. When faced with a problem to solve, the facilitator should keep the team focused on the problem and moving along each step of the problem-solving process. In addition, a good facilitator will ensure that everyone truly participates in the team process and contributes to the team's ability to function. The facilitator must be skilled in interpersonal relations and conflict resolution. The leader role clearly differs from the role of a facilitator, although some leaders are able to orchestrate both roles simultaneously.

CLEAR TEAM MISSION, OBJECTIVES, AND GOALS

By definition, a team must have a common purpose; otherwise one simply has a group of people who happen to work together (perhaps under the new label of ''team''). The mission must be specific and clear. Telling a team to ''fix the accounting system'' is like telling it to ''eliminate world hunger;'' teams need a specific definition of the problem they are addressing.[23] Team members must understand why teams are being formed and introduced into the organizational design. The early communication process is critical to a team's start-up.

Production team members must buy into the mission and its supporting objectives and goals. A common reason cited for team failure is the lack of focus on a mission to which the team and management are committed.[24] Although the mission itself may be defined before the team is formed, team members should be actively involved in developing objectives and goals to support the mission. If, for example, the mission is to produce high-quality products that satisfy customer requirements, team members should be involved in setting the goals that will meet these requirements and in determining strategies for obtaining the goals. These objectives and goals should help clarify the needs of the team's customers and stakeholders.

TEAM CHARTERING

Team chartering is the process by which a number of the above strategies are established. Chartering involves selecting team members, defining the team's mission, holding kick-off meetings, providing initial training, and selecting the team's leader and facilitator. All of these tasks must be completed before the team will begin to function effectively. These were some of the steps taken by BP Norge in the successful implementation of its teams.[25] It has been recommended that team members be provided with training as a group and thus begin working as a team immediately.[26] One of the characteristics of successful team programs is careful attention to the chartering process.

CLEAR TEAM ROLES AND RESPONSIBILITIES
Although each individual has specific skills and knowledge that he or she contributes to the production process, objectives cannot be met without an interdisciplinary team approach. Team members should understand their roles, what tasks and responsibilities are theirs, and how they can make a contribution. Although members of high-profile teams such as successful professional sports teams, medical trauma teams, and the U.S. Navy SEALs may have large egos, they tend to check those egos at the door when working with their teams. Teamwork, not individual success, is the focus for these teams even though each member has a clear role and particular responsibilities. The same holds for production and other industrial teams.

BALANCE OF AUTHORITY, RESPONSIBILITY, AND ACCOUNTABILITY
By definition, teams and their members must be empowered not only to set objectives and goals and to solve problems, but also to make decisions about work methods, job assignments, and implementation of solutions to problems. One of the biggest mistakes management can make is to give teams responsibility and accountability for their tasks yet not give them the authority to act on their decisions. This balance of power is critical to the success of production teams. Some of the most effective production teams are given complete control of a process, including the power to hire, fire, and conduct performance reviews.

The Benefits of the Use of Teams

Evidence of the benefits of the use of self-managed production teams has been clearly documented in the literature.[27] Teams typically develop better solutions to problems than individuals. Since they include diversity in discipline and perspective, teams are better at generating a number of options and exploring the advantages and disadvantages of those options. This leads to improved decision-making and implementation. Teams bring together the people who will have to implement new ideas and systems once these decisions are made. They will therefore be more committed to these decisions and less resistant to change. Other benefits include enhanced skills and flexibility in the workforce.

Harley-Davidson attributed increases in both productivity and customer satisfaction and significant quality improvements to the use of self-managed teams.[28] At Eaton Corporation's Aeroquip Global Hose Division in Arkansas (a 1999 winner of *Industry Week's* Best Plant awards), 100 percent of employees are on empowered work teams. Improvements such as reduced response time to customer concerns, productivity increases, and accident rate reductions have been attributed, in part, to the company's use of teams.[29] The Electrical Distribution and Control Division of General Electric has seen productivity and quality increases, in part due to the use of production teams.[30] Keithly Instruments reported a 90 percent increase in productivity and 75 percent reduction in absenteeism as a result of the use of production teams.[31] Volvo also saw its absenteeism reduced dramatically after its full implementation of production teams at its Uddevalla plant.[32] Other companies such as Monsanto, John Hopkins Hospital, Logan Aluminum, Hallmark, and Liberty Mutual have reported productivity increases, quality improvements, reduced turnover and absenteeism, and reduction in design and process times.[33] In sum, increased job satisfaction and motivation, increased customer satisfaction, reduced absenteeism, improved productivity and quality, improved decision-making and implementation, and increased organizational flexibility have all been reported as benefits of the use of production and other kinds of teams.

Tips for Creating Successful Self-Managed Teams

Aside from the obvious need to pay attention to the strategies previously cited, a number of management tips are critical to obtaining the benefits of self-managed production teams. A study conducted by a cultural anthropologist and marketing researcher in 1994 and sponsored by the American Society for Quality Control, Disney, General Motors, Kellogg's, and Kodak revealed three important findings that play a role in why teams fail. These findings are based on traditional American values and culture that are slow and difficult to change. Therefore, the results of this study likely still hold true today. The findings include employees' need to know what's in it for them, people's previous unpleasant experiences with teams, and the individualistic nature of the American culture.[34]

When asked to participate on a team, employees will nearly always want to know what's in it for them. That is, how does being a member of a team benefit them personally? If this is not clear to team members, then the team will have commitment problems. Good facilitators and leaders can demonstrate what's in it for individuals by emphasizing a number of personal benefits. Yandrick noted that these might include the team members' feeling of being effective and making a meaningful contribution to work (greater pride in one's work), impacting the productivity and quality of the organization; and gaining increased autonomy for more independent decision making.[35] This will lead to greater empowerment within the workforce. These intrinsic benefits can lead to extrinsic rewards for individuals. Management must demonstrate that the benefits cited previously will naturally lead to increased job security for all employees. Employees will also have greater opportunities to learn new skills, including problem-solving techniques, job skills, and interpersonal and communications skills. Those who take advantage of these learning opportunities can then take advantage of career advancement opportunities.

People's previous experiences with teams may have been negative, and thus they may naturally be apprehensive about or resistant to joining a team. For example, sports teams in grade school are often a negative team experience for an individual with poor athletic skills. Many people have been on teams (or committees) that have simply not accomplished anything. One of the ways to deal with this issue is to ensure early success with small problems before dealing with larger ones. Consider a team that spends time solving the problem of poor-quality food in the plant cafeteria. Although it may not be making a significant contribution to customer satisfaction, it could give the team early encouragement of their capabilities to solve problems, make decisions, and work together. Early successes are key in overcoming the negative implications often associated with teams.

One of the major difficulties with teams in the United States is that the American culture goes against certain attributes called for in teams. In particular, many Americans have a strong need to have individual success at something. Witness the individual accolades that go to star players of professional sports teams. Sacrificing for the good of the team is not something Americans are predisposed to do. They also don't like to be forced to join a team. This resistance must be overcome if a team is to be successful. One of the ways to deal with this issue is to ensure that individuals as well as the team are recognized for contributions. This can be done by allowing each team member to play a particular role and to make some type of contribution to problems that are solved and decisions that are made.

Another important team-management tip is to build trust among team members. If teams are to succeed, the team members must trust each other as well as their leaders and facilitators. Commitments and responsibilities for action items must be kept; otherwise this trust will suffer. A good team leader will follow up with team members to ensure their tasks are being completed. A facilitator who understands group dynamics should also be able to assist in building trust among team members. In addition to trusting each other, the team must have trust in senior management. Continuous senior-management support (through sharing information and providing resources) contributes to employees' trust in management's commitment to the team.

Finally, if production teams are to be implemented in an existing plant, management must find ways to overcome the inevitable resistance to change. One approach is to focus on the benefits to individual employees, such as those described in this chapter. In addition, management should provide real examples of the success of team structures at other organizations and include employees and any labor unions in the design and implementation of the new organizational structure.

The Future of Teams

Teams have become a permanent part of the way many organizations operate. Although teams have existed for some time, we haven't always understood why they succeed and why they fail. There is now an abundance of information about when and how to introduce teams effectively into an organization. The literature published on teams and the experiences of the many organizations that employ self-managed production and other types of teams provide the foundation of understanding required to integrate teams successfully into any organizational design. The benefits these organizations have gained from the use of teams ensure that manufacturing organizations will continue to see an increase in the use of self-managed production teams.

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