The World of Appropriate Technology: A Quantitative Analysis

by Nicolas Jequier and Gerard Blanc

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THE WORLD OF APPROPRIATE TECHNOLOGY

A quantitative analysis

by
Nicolas Jéquier
and Gérard Blanc

DEVELOPMENT CENTRE
OF THE ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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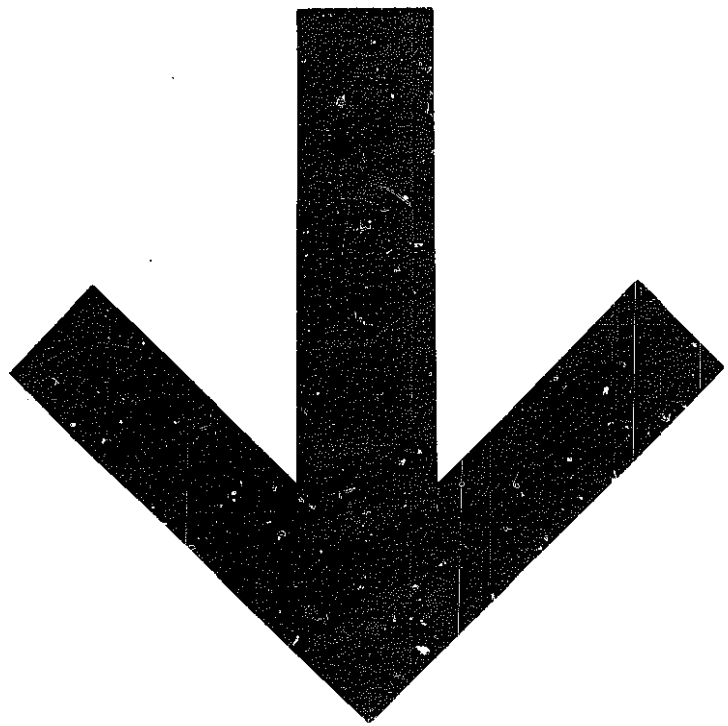
UNE ANALYSE QUANTITATIVE



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PREFACE

by

Tomohiko KOBAYASHI,

Acting President of the OECD Development Centre

In 1979, the OECD Development Centre published an *Appropriate Technology Directory* which described the activities of 277 organisations working in the field of appropriate technology throughout the world. The authors of this Directory, Nicolas Jéquier and Gérard Blanc, were encouraged to exploit the statistical information gathered in the course of this work.

What started as a cursory exercise soon turned into an in-depth study, the results of which are sometimes rather unexpected. It suggests very clearly that appropriate technology, despite the difficult problems it faces, is a serious technological option for both industrialized and developing countries. It also shows, among other things that the research and development effort (measured in man-months) of developing countries in the field of appropriate technology is larger than that of the industrialized countries. Developing countries exchange research results with one another, thereby helping to promote a true South-South co-operation, and their research is also of direct benefit to several appropriate technology organisations in the industrialized world.

Nicolas Jéquier and Gérard Blanc make a number of observations about the appropriate technology movement, which turns out to be considerably more complex and diverse than generally suspected. Their exploitation of hitherto unavailable statistical information gives us a better understanding of the appropriate technology movement. It also raises a number of questions concerning the transition from pilot scale experiments to the large scale diffusion of innovation. On the basis of their analysis, the authors suggest a number of solutions for improving the effectiveness of work in the field of appropriate technology.

Chapter 1

INTRODUCTION AND SUMMARY

This book represents a systematic attempt to provide a global picture of appropriate technology activities throughout the world (1). In the last ten years, following the pioneering work of organisations such as the Intermediate Technology Development Group (ITDG) in the United Kingdom and Volunteers in Technical Assistance (VITA) in the United States, hundreds of new institutions have been set up in industrialized and developing countries to develop and promote new technologies which are less costly, simpler, better adapted to the local environment or smaller in scale than the 'mainstream' technologies which form the backbone of today's productive system in agriculture, industry and the service sector. Alongside these specialized appropriate technology (AT) organisations, a number of international agencies, industrial firms and established research centres have set up their own 'AT units' or else have so fully espoused the principles and objectives of the AT 'movement' as to become major AT innovators in their own right.

The number of organisations involved in one way or another in the development and promotion of appropriate technology is considerable, and still growing rapidly. In 1977, the number of such organisations identified in the preparation of OECD's *Appropriate Technology Directory* (2) amounted to 680, and by 1980, it had grown to over 1,000 (3). What started in the late 1960's as a rather marginal movement pioneered by a few lone innovators has now clearly become a 'growth industry' in its own right. But perhaps even more significant than the large number of organisations involved is the fact that appropriate technology, once derided as a rather pointless diversion from the real issues of industrialization and economic growth, is now increasingly recognized as a serious if still incomplete technological option for both industrialized and developing nations.

(Continued on page 12)

(1) For a definition of 'appropriate technology' and similar terms, see the box on next page.
(2) N. Jéquier and G. Blanc, *Appropriate Technology Directory*, OECD, Paris, 1979.
(3) This figure is based on the data collected in preparation for a Volume 2 to the *Appropriate Technology Directory*.

A FEW DEFINITIONS

Alternative technology is the term used to describe new types of equipment or new organisational forms which represent a viable alternative to the existing 'main-stream' technologies of today. Examples: 'self-help' housing schemes instead of conventional urban development programmes, or small-scale organic farming instead of large-scale, energy-intensive cultivation techniques.

Appropriate technology (AT) is now recognized as the generic term for a wide range of technologies characterized by any one or several of the following features: low investment cost per work-place, low capital investment per unit of output, organisational simplicity, high adaptability to a particular social or cultural environment, sparing use of natural resources, low cost of final product or high potential for employment.

Capital-saving technology (CST) or light-capital technology (LCT), a concept pioneered by Congressman Clarence D. Long of the U.S. House of Representatives and now widely used by the U.S. Agency of International Development, is a technology characterized primarily by its low cost in capital and the small size of the investment needed to create a job. Building roads with efficient labour-intensive methods embodies light capital technologies; building them with bulldozers and scrapers does not.

Community technology (CT), a term widely used in the American counterculture and by such writers as Karl Hess, is a small-scale technology which does not require a complex infrastructure, which is specifically tailored to the needs and capabilities of small urban or rural communities, and which seeks to foster community participation in the decision-making processes. Examples: small-scale cooperative industrial activities or decentralized water supply and waste disposal systems.

Environmentally sound and appropriate technology (ESAT), a concept developed by the United Nations Environment Programme and Amulya K. Reddy of India, is an appropriate technology which is particularly well adapted to the local social and economic environment, and which uses renewable rather than non-renewable resources. Examples of ESAT's in the energy field: bio-gas plants or bio-mass conversion systems.

Hardware, a term borrowed from the computer industry and now widely used by the AT community, is the physical embodiment of technology: tools, implements, machines, devices and equipments.

Intermediate technology (IT) is a technology which stands halfway between traditional and modern technology. Intermediateness is a relative notion: in Black Africa, the ox-drawn plough is an intermediate technology (more sophisticated than the traditional hoe, but less

complex than the tractor) but in South-East Asia, it can be considered as a traditional technology. The concept of intermediate technology was developed by E.F. Schumacher, author of the best-selling book *Small is Beautiful*.

Low-cost technology (LCT) is a technology whose main feature is the low cost of the final product or service, or the low cost of the investment required to provide this product or service. Example: stabilisation ponds for sewage treatment.

Socially appropriate technology (SAT) is a technology which is likely to have beneficial effects on income distribution, employment, work satisfaction, health and social relations. Example: a vaccine against malaria or schistosomiasis.

Soft technology (ST): a technology which is well adapted to the local cultural and social environment, which uses renewable rather than non-renewable resources, and which does as little damage as possible to the surrounding eco-system. Examples: windmills, small hydropower plants.

Software: the non-material dimensions of technology, e.g. knowledge, experience, organisational forms, managerial tools, institutional structures, legal provisions and financial incentives.

Village technology: small-scale technology aimed primarily at meeting the basic needs of rural dwellers in the developing countries. This concept was pioneered among others by the United Nations Children's Fund (UNICEF). Examples: small scale on-farm storage systems for food, low-cost dryers.

This growth industry, like any other new field of human activity, is an almost totally uncharted territory as far as statistical information is concerned. While it may be easy to estimate roughly how many organisations are working, or claiming to work, in the field of AT, little if anything is known as to the scale of research and development (R & D) expenditures, the sources of funding, the types of activities carried out by AT organisations, their main areas of work, or their systems of communication and technology transfer. This absence of statistical information has a number of obvious drawbacks. Without any data on R & D for instance, it is impossible to know which fields of activity are under-funded and which are those that may be attracting a disproportionate share of public money. Without any idea of the relative cost of different types of activities (research, extension work, information, etc.) it is very difficult to judge how effectively the available funds are actually spent. But what is perhaps even more important is that this absence of data has contributed to reinforcing a number of conventional ideas about appropriate technology which may have been correct ten years ago but which, as this book will try to show, are now quite clearly out of date, if not patently untrue.

What this book has tried to do is to assemble all the available statistical information about AT activities throughout the world. The purpose was twofold: first, to provide as comprehensive a picture as possible of the scale and nature of these activities; and second, to identify on the basis of these data a number of problems and policy issues of immediate interest to all those who, in one way or another, are involved in the promotion of AT and in the design of development strategies which are better adapted to the new economic and social challenges facing industrialized and developing nations.

ORIGINS AND COVERAGE OF THE BOOK

In 1977, the OECD Development Centre prepared and mailed out to some 680 organisations throughout the world a detailed questionnaire (4) aimed at providing the basic background information for the preparation of a Directory of organisations involved in the development and promotion of appropriate technology. The questionnaire was designed in such a way as to provide both a comprehensive description of each organisation and specific data on sources of financing, types of activities, manpower, fields of activity and channels of technology diffusion. Our original intention was to publish an analysis of these data as an introduction to the Directory. As things developed, this

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(4) The full text of this questionnaire is reproduced in Appendix 3 on pages 204 - 210.

solution proved to be rather impractical: the volume of data provided in the responses to the questionnaire turned out to be considerably larger than expected, and the amount of time needed to process them would have delayed the publication of the Directory by several months. As a result, it was decided to publish the Directory without any statistical analysis, and to use the latter as the basis for a separate work which is presented in the following chapters.

A statistical analysis of this type raises a number of questions, the first of which is that of coverage. The 680 organisations contacted in the course of the preparation of the Directory represented if not the total universe of institutions working on AT, at least the great majority of those which, in one way or another, consciously or not, belonged to the 'AT movement'. This original list of contacts was drawn from a wide range of sources which included directories published by other institutions, press reviews, working files of well-established AT centres, annual reports of research centres and personal relations with knowledgeable individuals.

Each of these organisations received, and was asked to fill in, the above-mentioned questionnaire. Given the length of the questionnaire and the large amount of time needed to fill it in correctly, the response rate to our inquiry turned out to be surprisingly high: 388 organisations (57 per cent of the total) replied, either in the form of a fully completed questionnaire (292 cases) or a partly completed questionnaire (17 cases), or else stating that they were not carrying out any significant work in the field of AT, or that they were only planning to undertake such activities (79 cases). Of the 292 organisations that provided a fully completed questionnaire, some 20 were finally left out of the Directory for a number of specific reasons (5), while a few others which had supplied only partly completed questionnaires were included, since the necessary information about them could be obtained from other sources (e.g. a detailed annual report or a comprehensive presentation by an outside observer). As shown in Table 1, the response rates were fairly similar in all regions of the world, except for the socialist countries where it proved practically impossible to gather any meaningful data.

The total number of organisations finally included in the Directory amounted to 277, and these are the organisations whose data were used as the basis for the analysis carried out in the various chapters of the present book. It should be stressed at the outset that these 277 organisations working in the field of AT do not represent a sample in the statistical sense of the word. Rather, they

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(5) For further details, see the introduction (pages 7 to 19) to the *Appropriate Technology Directory, op.cit.*

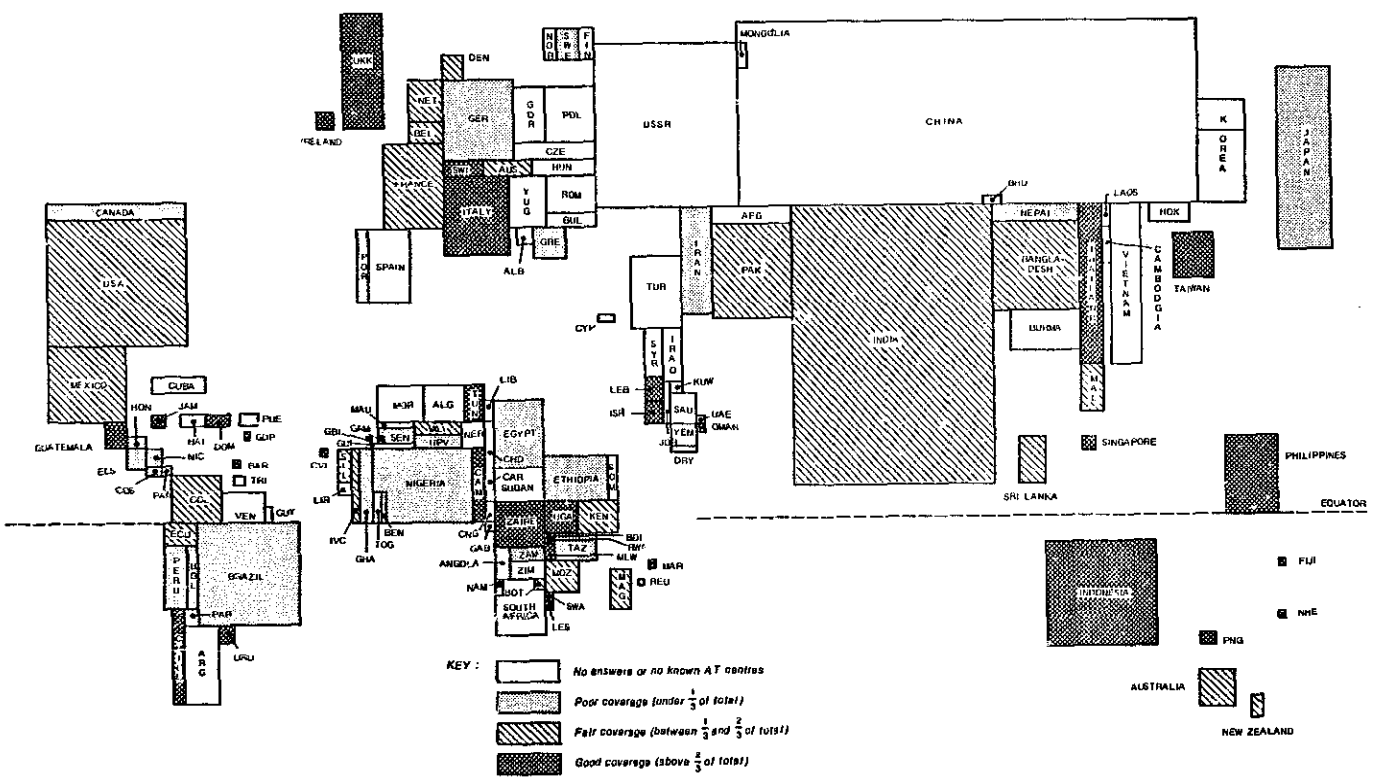
Table 1

RESPONSES TO OECD QUESTIONNAIRE - BREAKDOWN BY GEOGRAPHIC AREA AND TYPE OF ORGANISATION

	North America	Western Europe	Australia & Pacific	Socialist Countries	Latin America & Caribbean	Black & Southern Africa	North Africa Middle East	Indian sub-Continent	Southeast and East Asia	World Total	Response Rate
AT centres	24 (46)	22 (30)	5 (7)	-	7 (10)	7 (18)	-	7 (11)	5 (5)	74 (127)	58.3%
Universities	19 (28)	13 (19)	4 (6)	-	8 (13)	12 (23)	3 (6)	5 (8)	3 (4)	67 (107)	62.6%
Other research centres	11 (22)	15 (21)	2 (3)	0 (6)	14 (34)	13 (30)	11 (11)	9 (20)	11 (17)	86 (164)	52.4%
Industry	8 (15)	8 (20)	2 (3)	-	3 (14)	4 (9)	1 (1)	5 (7)	5 (7)	36 (76)	47.4%
Government agencies	10 (11)	8 (13)	1 (3)	0 (2)	8 (19)	15 (32)	5 (5)	6 (10)	1 (1)	54 (96)	56.3%
International organisations	2 (3)	3 (4)	0 (3)	-	4 (6)	16 (25)	-	1 (3)	3 (4)	29 (48)	60.4%
Financial institutions	4 (10)	1 (3)	-	-	8 (12)	2 (3)	-	0 (1)	2 (3)	17 (32)	53.1%
Other non-governmental organisations	7 (8)	8 (12)	2 (2)	-	4 (4)	2 (2)	-	1 (1)	1 (1)	25 (30)	83.3%
World total	85 (143)	78 (122)	16 (27)	0 (8)	53 (112)	71 (142)	20 (23)	34 (61)	31 (42)	388 (680)	57.1%
Response rate	59.4%	63.9%	59.2%	0%	47.3%	50.0%	86.9%	55.7%	73.8%	57.1%	-

Note : The figures in brackets indicate the number of questionnaires sent out. The figures immediately above indicate the number of responses. See Appendix 1 for details on methodology.

Figure 1 THE WORLDWIDE COVERAGE OF OECD'S SURVEY OF APPROPRIATE TECHNOLOGY ACTIVITIES



Note : The areas of countries are proportional to their 1978 population.
See Appendix 1 for abbreviations and details on methodology.

are what might be called the 'core' of the AT movement, i.e. the largest, oldest, most active or better known of the institutions involved in the development and diffusion of 'appropriate', 'low-cost', 'capital-savings' or 'intermediate' technologies throughout the world.

Given the very rapid growth of the AT movement and the fact that a large number of organisations are now suddenly realizing that they have been working for years on the development and diffusion of appropriate technology without calling it by that name, it is very difficult to determine how large a share of world-wide activities in this field are carried out by these 277 organisations. To give a rough idea, it can be estimated that the Directory, and hence the present analysis, cover between 80 and 90 per cent of the AT activities undertaken by the specialized AT centres, between 30 and 60 per cent of the AT activities of development banks, conventional research institutions and voluntary agencies, and probably not more than 10 per cent of the AT work of private industrial firms. The organisations covered here are certainly representative, but the general picture that can be drawn from their activities should not be considered as comprehensive. When going through this book, the reader is therefore invited to keep this limitation in mind. While certainly incomplete, this analysis does, however, cover as wide a field as was possible, given the data that were available at the time (1977 - 1978) the survey was carried out.

In the same way that this survey's coverage differs significantly from one group of organisations to the other - high for specialized AT centres, low for industrial firms - its coverage by country shows wide variations. The country coverage of the Directory and of this book is given on the world map of Figure 1, where the area of each country is proportional to the size of its population in 1978. The first group of countries, shown in blank on the map, includes those countries which, to the best of our knowledge, were not doing any work in the field of AT in 1977 (e.g. Syria, Paraguay, Burma or Algeria) and a number of other countries which were known (e.g. China) or presumed (e.g. Portugal or South Korea) to be working in this area, but for which no meaningful information could be obtained, despite repeated attempts to this effect.

The most conspicuous of these blank areas is that represented by the socialist countries, from North Korea to East Germany. The problem encountered here was not only the great difficulty of communicating with research institutions in these countries, but also the fact that the concepts and philosophy of the appropriate technology movement were still largely ignored in that part of the world (6).

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(6) This situation now seems to be changing. Vietnam, for instance, is currently envisaging the establishment of a specialized AT centre, and on the occasion of the 1979 United Nations Conference on Science and Technology for Development, China expressed a major interest in the AT work carried out in the industrialized countries of the OECD area.

The countries which were covered in the Directory are divided into three groups, shown in different shadings: those which were well covered (over two-thirds of their AT institutions are included in the Directory), those which are manifestly poorly covered, and those finally which fall in between, with a coverage ranging between one-third and two-thirds of the total. It is well to note here that this country classification is essentially indicative: for each country, the number of centres figuring in the Directory is very easy to add up, but the total number of organisations working on AT in one way or another can at best only be estimated very roughly.

Although this map is intended primarily to show the comprehensiveness of our survey as well as its limitations, it also indirectly brings to light which are the 'big powers' or major innovating countries in the field of appropriate technology. The most conspicuous of these is, of course, India, which is widely recognized today as one of the main originators of the appropriate technology movement (7) and which also happened to be the country in which E.F. Schumacher, one of the founding fathers of the movement, developed some of his main ideas. The second most important country is the United States, which today is spending by far the largest amount of money on research in appropriate technology of any country in the world, closely followed by the group of countries belonging to the European Community.

Three other important features emerge from this map. The first is the relatively large weight of the South-East Asian nations, and notably of Indonesia and the Philippines. The second is the major division in Latin America between the Northern nations (from Mexico to Colombia) and the Southern nations: the former are among the most active in the field of AT, while the latter seem to have come to this idea only fairly recently, as illustrated by the relatively small number of AT organisations operating in these countries. A third feature is the relative weakness of the Arab countries (with the exception of Tunisia), and more generally of almost all the less-industrialized countries bordering the Mediterranean.

GENERAL OUTLINE AND MAIN HIGHLIGHTS

This book is intended not only to provide a comprehensive body of data on appropriate technology activities throughout the world, but also to present a general picture of the AT movement at the end of the 1970's, with its strengths and weaknesses, its new challenges

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(7) For further details on the ideological and philosophical origins of the AT movement, see N. Jéquier (ed.), *Appropriate Technology - Problems and Promises*, OECD, Paris, 1976.

and its unsolved problems. The picture given here does not pretend to be complete, but it is probably sufficiently comprehensive to provide policy-makers, AT practitioners and students of the AT movement with answers to some of the basic questions about the development of appropriate technology throughout the world.

The first of these concerns the growth of the appropriate technology movement. Chapter 2 examines the quantitative growth of appropriate technology organisations and the way in which, in the course of the 1970's, a number of well-established institutions (research centres, government agencies, development banks and international organisations) turned into major innovators in the AT field. This analysis shows among other things that the AT movement, contrary to what is generally believed, is primarily an urban movement based in very large cities. It also suggests that in each country, the structure of the AT movement closely reflects existing political structures: highly centralized countries tend to have a very centralized AT movement, while countries organised on a federal basis have a very decentralized AT structure.

Chapter 3 attempts to answer a number of basic questions about the fields of activity of AT organisations. Are the activities carried out in developing countries fundamentally different from those undertaken in the industrialized nations? Which areas are receiving the largest amount of attention, and which are those suffering from gross neglect? The data presented here confirm some of the conventional wisdom about AT - for instance, that solar energy is one of the main problem areas attracting AT centres - but they also call into question a number of widespread assumptions about the nature and structure of AT activities in different countries. Africa, for instance, was often thought to be the region of the world which was devoting a large share of its AT activities to public health, but the evidence shows that in fact the opposite is true. The data also suggest that the degree of specialisation of the AT movement in each country closely reflects its technological traditions, its social challenges and the level of international competitiveness of its different industrial sectors: AT groups based in Switzerland, for instance, tend to be particularly strong in public health - an indirect reflection of the world leadership of that country's pharmaceutical firms - while Kenya, which has the world's highest rate of population growth, is also the country where AT organisations are doing the largest amount of work in the field of birth control.

The different types of activities of AT organisations is examined in Chapter 4. The figures given here represent the first attempt to measure the size of world-wide activities in the field of AT and to give a breakdown between research expenditures, information processing, extension services and other types of work. A number of unexpected

patterns emerge from this analysis. The first is the very large weight of international organisations based in the industrialized countries: they account for almost two-thirds of the world's total expenditures in AT - a figure which clearly suggests that the small specialized AT organisations are no longer the only driving force in the AT movement. The second is the strength of the developing countries in research: their R & D expenditures are almost as high as those of the industrialized countries, and their R & D effort, measured on the basis of man-months of work, is more than twice as high as in the industrialized countries. This is very different from what can be observed in the field of 'conventional' research, where the developing countries as a group account for little more than 3 per cent of the world's research expenditures and have only 12 per cent of the world's research manpower (8). A third important pattern emerging from our data is that the structure of AT activities differs very significantly from one part of the world to the other, while the similarities that can be observed are not those which would normally have been expected: in North America, for instance, R & D is only the fourth most important activity, while AT organisations in Western Europe and Asia turn out to be spending almost exactly the same amount of time and money on R & D, information and education.

Chapter 5 is devoted to an analysis of the funding mechanisms in AT: Where does the money come from? Where does it go? The data assembled here lay to rest a number of long-held assumptions about the AT movement. It was widely assumed that in the developing countries, AT was promoted primarily by foreign aid agencies - hence the criticism often voiced against the AT movement, namely that it was trying to impose upon the developing countries concepts and technologies which had been developed in the industrialized countries, and that the channel for doing this was foreign aid. The evidence suggests that this can hardly be true, since only 8 per cent of AT activities in the developing nations are funded from foreign aid programmes. In the same way, it was long taken for granted by the AT practitioners themselves that their activities were carried out with little, if any, assistance on the part of national governments. The data, however, point to a very different picture: governments have become the main source of funds for AT activities throughout the world, and their weight tends to be particularly high in the developing nations.

The staffing of AT organisations is analyzed in Chapter 6. As could be expected, the cost of personnel is much higher in the industrialized countries than in the developing countries, but the average

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(8) See Jan Annerstedt, *A Survey of World Research and Development Efforts*, OECD and Roskilde University Centre, Paris and Roskilde, 1979.

number of people employed by AT organisations is almost exactly the same in both parts of the world. The data also show very wide variations in the share of professionals employed by AT organisations, and this indicator points to basic differences in the structure of AT activities from one country to another. In the Netherlands, for instance, AT is very much the preserve of small voluntary groups working on a shoestring, while the groups based in Switzerland are notable for their exceptionally high personnel costs and the large share of professionals in their staff. In some developing countries (e.g. Swaziland, East African nations), local AT groups appear to employ an inordinate number of expensive expatriate staff, while in others (India or Upper Volta), the AT movement appears to be very much an indigenous creation.

In Chapter 7 we have attempted to provide some answers to one of the most critical problems facing AT organisations, namely the difficulty of diffusing innovations to their potential users. What stands out here most clearly as the major obstacle to innovation is the lack of money. Significantly enough, the second most important obstacle cited by AT organisations is bureaucracy. Bureaucratic ways of doing things are certainly not the preserve of governments, but it is nevertheless interesting to observe that while governments have become de facto the major funders of AT activities throughout the world, they are also seen as a major obstacle to innovation. This may be no more than a coincidence - the right hand ignoring what the left hand is doing - but it probably points to a much deeper problem touching upon the role of governments in stimulating the development and diffusion of AT. Another striking feature emerging from this analysis of the main obstacles to the diffusion of innovation is the very small importance of information. Until now, it was always assumed, almost as a matter of faith, that one of the biggest problems facing the AT movement was information, and this is clearly reflected in the very large percentage of the activities of AT organisations currently devoted to the collection and dissemination of information. Yet information clearly emerges as the least important obstacle to innovation, which seems to indicate that AT organisations are devoting too large a share of their work to this topic.

Chapter 8 is devoted to the analysis and mapping of the communications networks in AT. Each of the institutions covered in the Directory was asked to cite the five most important AT organisations with which it was in regular professional contact. This citation analysis brings to light which are the leading AT organisations throughout the world and shows the structure of the main communications networks at the national, regional and world level. These maps of the AT system show for instance that AT organisations in Latin America have at least as much contact with their counterparts in Western Europe as they do

with AT organisations in North America. They also show that there is much more 'South-South' communication (i.e. between developing countries) than was generally assumed until now. Two other important features emerge from this picture: one is the relatively large amount of information and technology flowing from South to North (i.e. from developing to industrialized countries), and the other is the small amount of communication between international organisations on the one hand, and the specialized AT institutions on the other.

In Chapter 9 we have attempted to develop a typology of AT institutions and present the various patterns of growth of such organisations. Four main parameters were used here: the age of an organisation, its budget, the size of its staff and the number of fields of activity. On the basis of these four parameters, which summarize the main operational features of each organisation, one can identify seven different types of AT institutions - no more and no less. Every one of the 277 organisations covered in the Directory fits into one of these seven types. This typology provides a useful multidimensional complement to the quantitative analysis presented in the preceding chapters, but its main interest is that it suggests what are the most promising paths of development for AT institutions and, conversely, which institutional structures represent an evolutionary dead end.

Chapter 10 tries to bring all the threads together and present some of the major policy issues facing AT institutions, governments and international organisations. The main conclusion emerging here is that the AT movement has now entered its second generation, and that the problems currently facing it are as complex as, but rather different from, those it had to face until now. How, for instance, can the concepts and philosophy of the AT movement be integrated into the planning and decision-making processes of government? What part should be played by international organisations? How can financial institutions become a more active partner in the processes of technological innovations? Is private industry poised to take over the AT movement? What role will small, specialized AT institutions have to play in the coming decade? For the moment, there are many more important questions than useful answers, but formulating the right questions is a necessary step in discovering the good answers.

The nine chapters briefly sketched here are followed by three appendices. The first presents a series of methodological notes to the various tables and figures presented in the various chapters; this has been done to avoid overloading the text with footnotes, references and details on the calculations used as the basis for the tables and figures. Appendix 2 gives the list of the 277 organisations covered in the Directory and used as the basis for the analysis presented in the chapters 2 to 10, while Appendix 3 reproduces the full text of the questionnaire which served as the source for the Directory and for the data analysed here.

THE LIMITATIONS OF THE QUANTITATIVE APPROACH

The quantitative approach used in the present analysis has a number of obvious advantages. The statistical information on which it is based is fairly easily verifiable, and was sought from responsible sources who had no interest in providing data other than objectively. They supplied the facts available, rather than select statistics to support prior opinions. Nevertheless, the data have a number of weaknesses, and before presenting our analysis of world-wide activities in AT, a few notes of caution are necessary.

The first concerns the quality of the data themselves: numbers can be added, divided, correlated and otherwise processed in a correct way, but the resulting figures and inferences are not very meaningful if the original data are poor, uncertain or simply wrong. Most of the data supplied in response to the OECD questionnaire were of a fairly straightforward nature - e.g. budgets, number of staff, date of establishment of the organisation or institutional affiliation. Quite a few others, however, were rather less precise: thus, for instance, the figures on the breakdown between different types of activities or main sources of financing, or the relative importance of an organisation's major and minor fields of work. Wherever necessary we have therefore indicated in the methodological appendix how 'hard' or 'soft' the original data proved to be, and in what cases data had to be reconstructed on the basis of qualitative estimates.

A second problem with a quantitative analysis of this type touches upon the relationships and correlations that can be made between very different sets of data. Statistical correlations are one of the important methodological tools in the scientific field, and while a positive correlation does not prove the existence of a causal ralationship, it does point to important relationships between apparently unconnected phenomena. In the present analysis, the reader will observe that very little use was made of such correlations. This is not because of any diffidence against such a tool, but simply because most of the correlations made in the course of the preparation of this book turned out to be trivial, inconclusive or meaningless.

The third problem with data of this kind is that some of the most important phenomena in a social system - and the AT movement is clearly such a system - cannot be reduced to simple statistical data. What we have tried to do here is simply to measure what was measurable, and quantify what was quantifiable, and the picture presented in the chapters that follow should be viewed as one possible representation of reality, and not as the definitive description of the AT movement and its problems at the end of the 1970's.

Chapter 2

THE GROWTH OF APPROPRIATE TECHNOLOGY ACTIVITIES

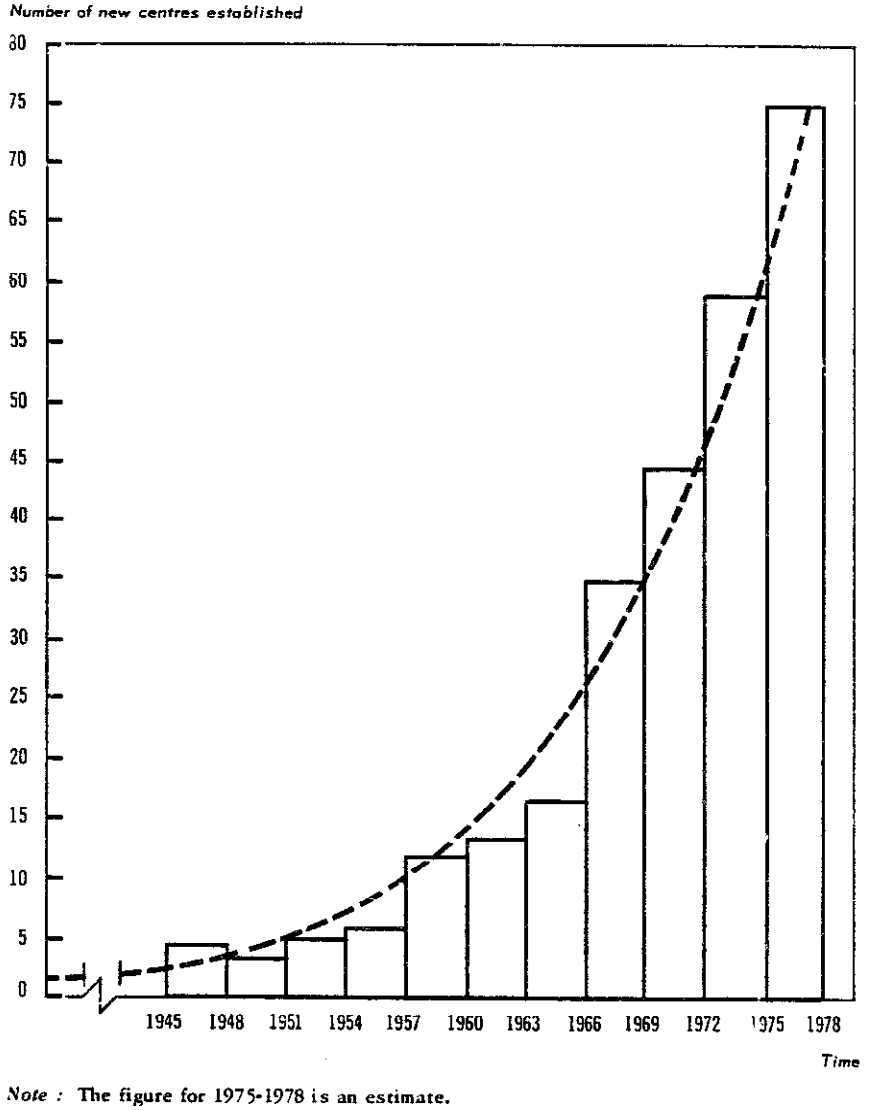
The number of organisations involved in the development and diffusion of appropriate technology has grown very rapidly in the last fifteen years, and there are no signs of a major slowdown in the near future. But if the AT movement can rightly be characterized as a 'growth industry', its rate of expansion is somewhat more difficult to measure than that of new industries such as micro-electronics, robotics or composite materials. The first reason for this is the very heterogeneous nature of its 'products': organisations working in the field of AT produce, and sometimes sell, new pieces of equipment or machinery that can be counted or valued, but most of their output consists of such things as ideas, policy instruments, organisational tools, training packages, planning procedures and communications networks which are by nature very difficult if not impossible to quantify. The second reason is the rather diffuse structure of the AT 'movement': its components are not only the specialised AT organisations - which might be seen as the equivalent of clearly identifiable firms in a particular industry - but a wide range of institutions, ranging from development banks and universities to government departments and research organisations which devote only a part of their work to the promotion of AT.

THE NUMBER OF ORGANISATIONS

Measuring the growth of AT activities may be difficult, but it is not impossible, and one of the best indicators is probably the number of AT organisations set up each year. The available data are summarized in Figure 2, which gives the total number of such organisations established in each three-year period between 1945 and 1978. Based as it is on the 277 institutions figuring in the *Appropriate Technology Directory*, this picture should be considered as a broad indication of the general trend of AT activities throughout the world, and not as a precise representation of reality, since it does not cover all the organisations in the world working on AT. The three-year totals used here are aimed less at smoothing out the variations from

one year to the other than at providing a meaningful indication of the time at which established organisations started to work in the field of AT. In the case of specialized AT organisations, the beginnings of their work in this field generally corresponds with the date at which they were set up. But with organisations such as development banks or research centres which were established long before they became actively engaged in AT work, the date at which they became fully-fledged AT institutions cannot usually be pinpointed in a precise way, and the three-year figures are the least inadequate representation of this evolution in their activities and development strategies.

Figure 2 **RATE OF CREATION OF NEW APPROPRIATE TECHNOLOGY CENTRES, 1945 TO 1978**
(Number of new centres per three-year periods)



Note : The figure for 1975-1978 is an estimate.

The picture presented in Figure 2 clearly confirms the rapid rate of growth of the AT movement throughout the world: the number of centres working on this subject has been growing at an average rate of 12 per cent a year between 1945 and 1978, which corresponds to a doubling of their number in a little less than six years and a half. Preliminary estimates for the 1978-80 period do not show any signs of a slowdown; if anything, the rate of growth seems to be increasing. Assuming here that the organisations covered in the Directory and used as the basis for Figure 1 represent no more than 50 per cent of the world total, this means that by 1980, new AT centres were being set up at the rate of approximately one every four days. And if the Directory's coverage is as high as 75 per cent, this growth corresponds to one new centre every week for the whole world.

If the general trend is fairly clear, a closer look at the three-year figures suggests the existence of three or four distinct phases in the development of the AT movement. The first, which runs until around 1957, might be called the *embryonic stage*: only a few organisations were active in this field, and not one of them considered itself as an 'AT institution' or as a proponent of intermediate technology for the very simple reason that these concepts had yet to be developed. The second stage, from 1957 to 1966, is marked by a big leap forward in the number of new AT organisations in the first three years, followed by six years of relatively moderate growth. This nine-year period might be seen as the *crystallisation stage*. Two of its most salient features are the creation of small organisations such as Volunteers in Technical Assistance (1959) and the Intermediate Technology Development Group (1966) which were soon to become the world leaders among the specialised AT institutions, and the growing realisation that 'low-cost' or 'intermediate' technology could offer some practical solutions to the development problems facing the world's poorer nations.

The third period (1966-1975) is clearly the *take-off stage*: the number of new AT organisations established each year is three times higher than in the previous nine years. But perhaps more important than this quantitative expansion is the emergence of an AT movement focusing more specifically on the problems of the highly industrialized countries, from energy and ecology to new life styles and organic agriculture. Illustrative of this new trend is the creation of such organisations as the Farallones Institute (1969) and the Institute for Local Self-Reliance (1974) in the United States, or the National Centre for Alternative Technology (1974) in the United Kingdom.

While it may be still too early to summarize what happened in the fourth period (after 1975), a number of patterns are beginning to emerge. The first is an increase in the rate of growth of the AT movement. The second is the emergence of international agencies and

government departments as major innovators in AT: the search for alternative patterns of development is no longer the preserve of a few small groups working against 'the system', but a legitimate activity carried out by the establishment. To give but a few examples, the Interamerican Development Bank set up a Committee for the Application of Intermediate Technology in 1976, the World Health Organisation created its Appropriate Technology for Health Programme the following year, and Appropriate Technology International was established by an Act of the U.S. Congress in 1977. In the developing world, the two pioneering countries are undoubtedly India, whose Ministry of Industry set up an Appropriate Technology Unit as far back as 1971, and Pakistan, where an Appropriate Technology Development Organisation was established in 1974 in the government's Planning and Development Division. A third and still largely unrecognized feature in this most recent stage of development of the AT movement is the growing role of private industrial firms: they are coming to realise that AT activities are not merely a useful expression of a corporation's social responsibility, but also a commercially attractive proposition.

THE SCALE OF ACTIVITIES IN APPROPRIATE TECHNOLOGY

This brief analysis of the quantitative growth of AT organisations throughout the world may give a good general idea of the overall trends, but it tends to conceal the most significant differences between the various parts of the world. Table 2 attempts to summarize the available data on the scale of expenditures in AT in the different regions of the world, the number of people working on the development and diffusion of AT, as well as the number of man-months of work in this area. These figures, it should be stressed, are rough estimates which should be used as an indicator of the orders of magnitude of AT activities, and not as a precise representation of reality.

The most significant feature emerging from this table is that the developing countries taken as a group are doing twice as much work in the field of AT as the industrialized nations, even though their total expenditures in this area are significantly lower. As for international organisations, they may be spending almost as much as all the industrialized countries combined, but the effective scale of their AT activities, measured on the basis of man-months of work, is comparatively small. Within the developing world Asia clearly stands out as the big power, which is not totally unexpected, given the size of her population and the pioneering role played by India in AT. Within the industrialized world North America appears to be spending somewhat less than Europe, and the number of people working on AT is significantly lower. However, the number of man-months of

AT work is some 50 per cent higher. What these apparent contradictions in the figures seem to suggest is that, by and large, the level of AT activities is roughly similar on both sides of the North Atlantic.

Table 2

THE APPROPRIATE TECHNOLOGY MOVEMENT IN 1977: NUMBER OF ORGANISATIONS, BUDGET, AND MAN-MONTHS OF WORK ON APPROPRIATE TECHNOLOGY

	Number of organisations	Corrected budget (Million $)	Corrected number of staff	Corrected man-months of AT work
Africa	45	15.6	1,780	15,300
Asia	51	36.0	4,860	35,600
Latin America	33	29.3	1,860	16,800
Europe	65	78.2	4,060	12,900
North America	58	56.6	2,410	18,200
OECD Pacific	8	0.9	100	880
Developing countries	129	80.9	8,500	67,700
Industrialized countries	131	135.7	6,570	32,000
International agencies	17	78.1	5,240	14,400
World total	277	294.7	20,310	114,100

Note: See Appendix 1 for details on methodology.

This general picture of the main regions of the world should be completed by a closer look at some of the main countries involved in AT. Table 3 presents a number of data on the annual growth of AT budgets, the size of these budgets in the gross national product (GNP) and their rate of growth relative to the growth of GNP. The 18 countries selected here are no doubt a small percentage of the total number of countries (77) covered in the Directory, but they account for over two-thirds of the total number of organisations described in the Directory, and every one of them has at least three important organisations working on AT. In this perspective, these figures can be considered as fairly representative, even if they are not very precise.

These 18 countries are what might be called the Big Powers in the field of AT, but the figures show some very significant differences in the relative scale of AT activities: on the average, these activities are five times smaller in the industrialized countries (0.14 per thousand of GNP) than in the developing nations (0.68 per thousand). While this may be seen as another confirmation of the leading role played by some developing countries in the AT field, it is interesting to observe that India and Bangladesh are probably not spending more

on AT than a typical highly industrialized country. Within the developing world, Kenya, Guatemala and Cameroon clearly stand out as exceptionally active AT proponents, and the same can probably be said of Colombia.

Table 3

RELATIVE SIZE OF APPROPRIATE TECHNOLOGY ACTIVITIES IN SELECTED COUNTRIES

	Annual growth rate of GNP 1975-77	Annual growth rate of AT budget 1975-77 (per cent)	Share of AT budget in GNP (per thousand)	Index of growth of AT budget relative to rate of growth of GNP
Australia	2.8%	48.6%	0.06‰	145
Canada	4.1	0.7	0.13	97
France	3.9	11.5	0.22	107
Switzerland	0.9	38.2	0.12	137
United Kingdom	2.2	152.6	0.16	147
United States	5.3	105.0	0.16	195
Bangladesh	6.3	17.5	0.09	111
Cameroon	4.6	6.3	1.77	102
Colombia	4.8	27.3	0.94	122
Ecuador	7.3	17.0	0.19	109
Guatemala	8.5	2.0	1.52	94
India	4.2	104.5	0.07	196
Indonesia	8.3	19.7	0.53	111
Kenya	5.5	14.8	1.94	108
Mexico	2.2	13.5	0.30	111
Nigeria	8.5	24.0	0.30	114
Philippines	6.2	18.5	0.20	112
Taiwan	9.9	9.5	0.30	100

Notes: Annual GNP growth rates are given in real terms.
AT budget growth rates are given in real terms and adjusted to take into account the changes in value of local currencies against the dollar.

See Appendix 1 for details on methodology.

These figures on the size of AT activities relative to GNP give a somewhat static picture, in the sense that they reflect past investments in AT activities. A more dynamic picture, and a better indication of what is currently happening, is provided by the data on the rate of real growth of AT budgets (second column of Table 3) and the index of growth of AT budgets relative to GNP growth (fourth column). These two sets of data bring to light the exceptional dynamism of three countries - the United Kingdom, the United States and India - which are widely recognized today as the leading innovators in the AT field, and which in all probability are likely to remain in this position in the foreseeable future, given the very large size and high growth of their AT effort.

The countries which have experienced a very high growth in the AT budgets are all countries where the scale of AT activities is

fairly small relative to the GNP. Conversely, all the countries in which AT activities are comparatively large (above 0.50 per thousand of GNP) have experienced a relatively slow growth of AT activities. This may be simply a statistical coincidence, but more probably reflects the fact that there is some sort of limit to the scale of AT activities that can be carried out in any one country, in the same way that there are limits to the relative amount of money a country can meaningfully invest in research and development, transportation or telecommunications.

THE DIFFERENT APPROPRIATE TECHNOLOGY FAMILIES

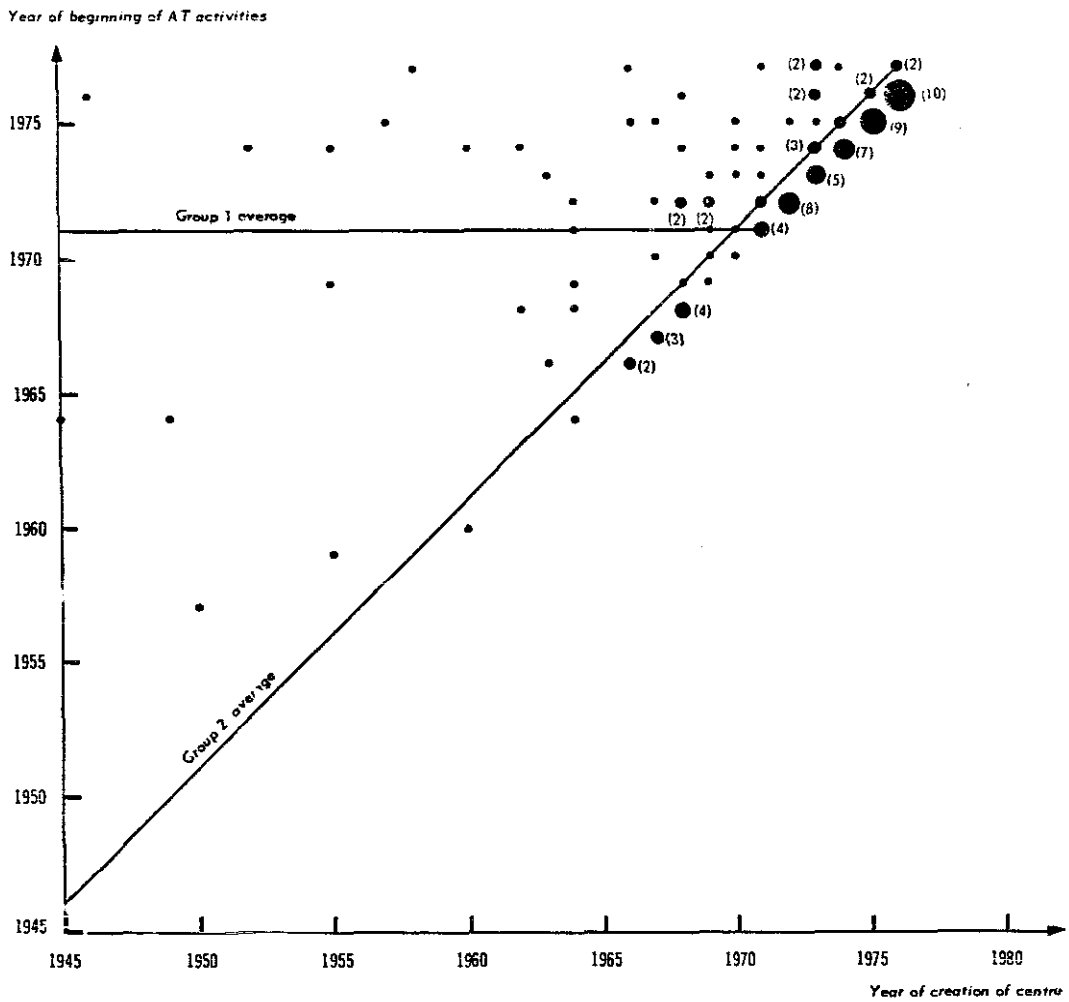
One of the distinctive features of the AT movement as it stands today is the presence of two rather different types of organisations: on the one hand, there are the specialised AT groups, which were set up specifically to promote AT and which devote all their activities to this subject; and on the other hand, there is a large and rapidly growing number of organisations (development banks, conventional research centres, industrial firms, etc.) which, consciously or not, have become major innovators in the AT field, but which for the most part do not consider AT as the main focus of their work. Until now, most of the attention of students of the AT movement has focused on the role of the specialised AT organisations - or Group 1 in our terminology. This is quite natural, considering the seminal role some of these organisations have played in promoting the idea of AT and stimulating a debate on the role of technology in the process of development. These organisations, however, are all rather small, their financial capacity is limited, and few if any of them have the organisational ability to carry out large-scale projects or mass produce large quantities of equipment.

Much less attention has been given to Group 2, i.e. the organisations which are only peripherally involved in AT, or which redirected part of their existing activities to the promotion and diffusion of AT. These are generally not considered as AT organisations in the narrow sense, but experience shows that many of them have become today the leading innovators in the AT field. This is the case, for instance, of the big international development banks, and of the major international agricultural research centres of the CGIAR Group (Consultative Group on International Agricultural Research).

The growth of these two big groups of AT organisations - the 'specialised AT centres' and the so-called 'general organisations' - has been rather similar, and no significant differences can be observed between industrialized and developing countries. Figures 3 and 4 attempt to trace the development of these two groups in the last thirty

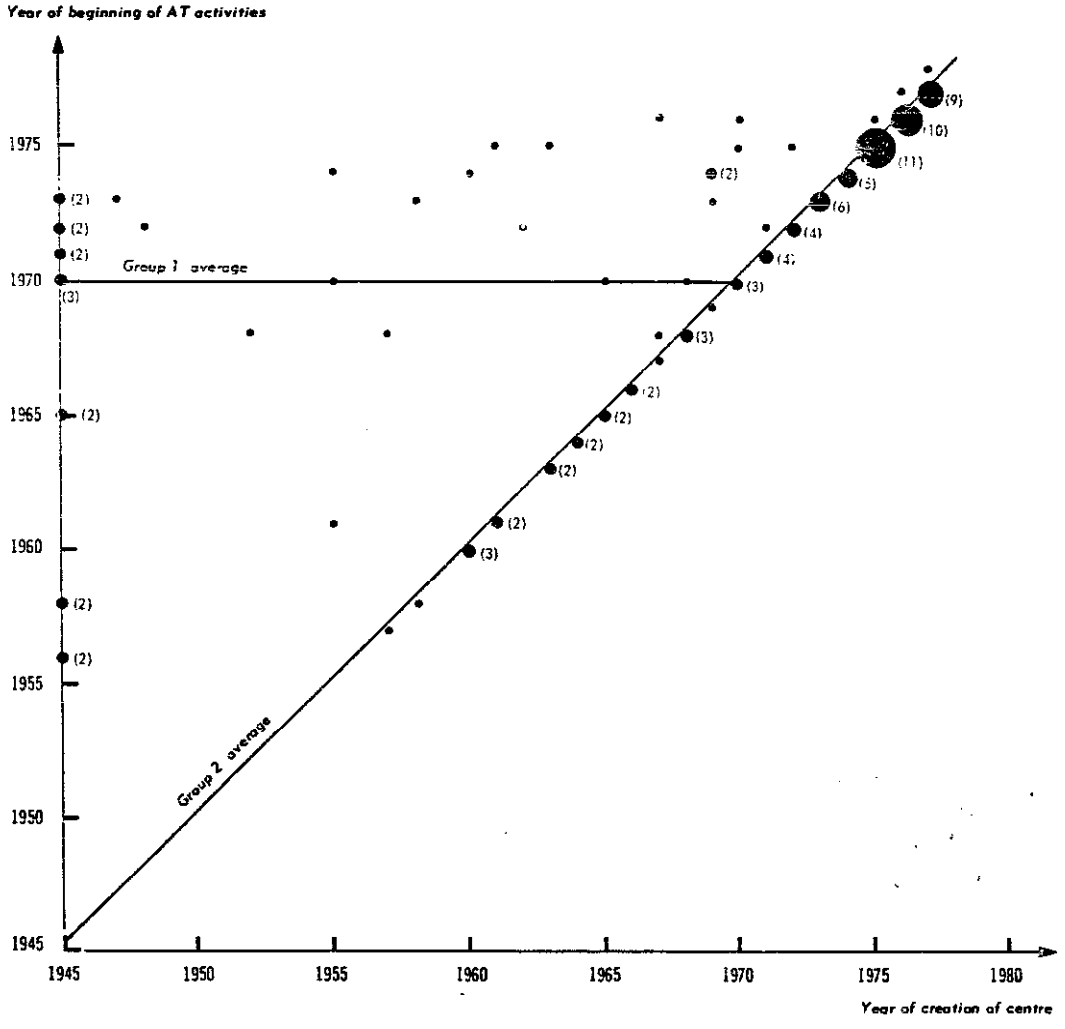
years. Two parameters have been used here: the year of creation of each organisation, and the year in which the organisation began to work in the AT field. Each organisation is represented in the form of a small dot, while the larger dots indicate the total number of organisations which were established in the same year and began to work on AT at the same moment. Organisations located on the diagonal line (the year of creation is the same as the year in which they started to work on AT) or slightly at the right of it are the specialized AT centres, while those located elsewhere are the 'general organisations'.

Figure 3 **THE TRANSITION TO APPROPRIATE TECHNOLOGY IN THE DEVELOPING COUNTRIES**



Note : The size of the dots is proportional to the number of centres. The figures in brackets indicate the number of centres when this number is greater than 1.

Figure 4 **THE TRANSITION TO APPROPRIATE TECHNOLOGY IN THE INDUSTRIALIZED COUNTRIES**



Note : The size of the dots is proportional to the number of centres. The figures in brackets indicate the number of centres when this number is greater than 1.

These two charts which summarize the data available for 117 centres in the developing countries and 114 centres in the industrialized countries, confirm the big take-off of AT activities after 1966, and especially after 1970. A look at the diagonal line in each figure shows that the rate of creation of AT centres is almost exactly the same in both groups of countries. What is more, the average date at which the 'general organisations' started to work on AT is also the same in the two groups of countries. If anything, these two indications confirm that the concepts and philosophy underlying the AT movement

are not, as some critics of the AT movement seem to believe, a creation of the highly industrialized countries which was then imposed upon the developing nations, but a joint or parallel undertaking of both rich and poor nations.

The basic distinction made here between the specialised AT centres (Group 1) and the general organisations (Group 2) should be completed by a distinction between institutions which are working primarily on developing country problems, and those which focus more specifically on the problems of industrialized countries. All the organisations located in the developing nations are working on developing country problems, but in the industrialized countries, quite a few organisations are working on issues of direct concern to the Third World, while others are interested exclusively in problems facing highly industrialized societies. Organisations working on industrialized country problems might be viewed as the 'industrialized country family', while those which are interested mainly in developing country problems could be described as the 'developing country family'.

This distinction between these two major 'AT families' is important. Historically, most of the leading specialized AT groups located in the industrialized countries were set up to respond to developing country problems, and this has been a major factor in shaping their ideas and in giving them a strongly outward-looking orientation. Organisations belonging to the industrialized country family are generally more recent in origin, and they tend to be more directly concerned with such problems as ecology, energy and new life styles. They also have relatively little if any contact with AT organisations in the developing countries.

On the basis of this classification between two major families on the one hand, and two groups on the other (specialized AT centres and general organisations), one can draw the simple matrix, or typology, of AT organisations presented in Table 4.

Table 4

THE BASIC TYPOLOGY OF APPROPRIATE TECHNOLOGY ORGANISATIONS

	Organisations working primarily on developing country problems	Organisations working primarily on industrialized country problems
Specialised AT centres (Group 1)	e.g. Intermediate Technology Development Group (United Kingdom)	e.g. California State Office of Appropriate Technology (United States)
General organisations (Group 2)	e.g. International Rice Research Institute (Philippines)	e.g. Control Data Corporation (United States)

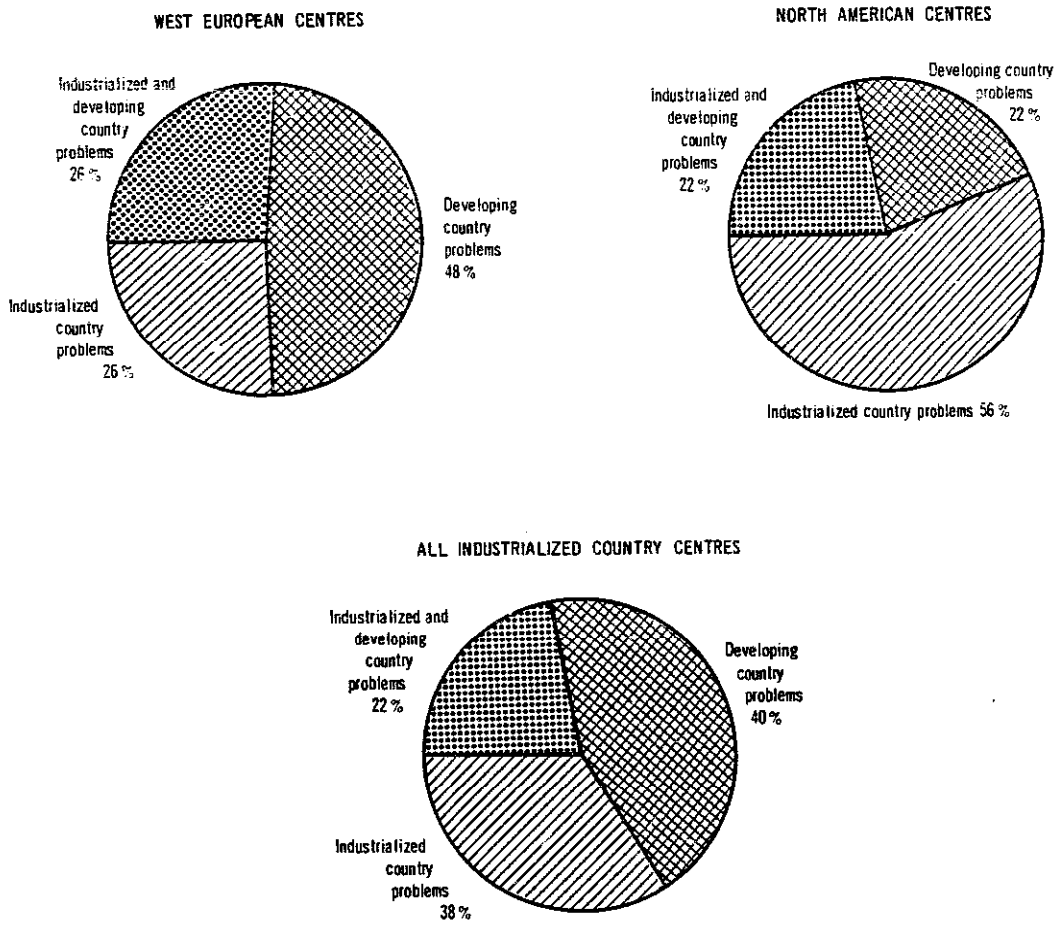
While this typology should not be taken too literally, it does correspond by and large to the four basic types of AT organisations now active throughout the world, and most of the 277 institutions listed in the Directory fall squarely into one of these basic types. It may be interesting to note here that the typological mobility of AT organisations, when it exists, tends to be horizontal, and never vertical: specialized AT groups of the developing country family can, and sometimes do, shift the focus of part of their activities on industrialized country problems (a case in point is the Intermediate Technology Development Group), while some specialized centres of the industrialized country family are beginning to work on developing country problems (as the Farallones Institute in the US is now doing); however, no 'general organisation' has yet become a specialized AT centre, and few if any of the specialized AT centres seem to be in the process of becoming 'general organisations'.

This broad picture of the structure and typology of the AT movement can be completed by a quantitative estimate of the size of the two different AT families in the industrialized countries. Figure 5 shows the breakdown of activities of AT organisations located in the industrialized countries into three categories: those activities devoted specifically to developing country problems, those devoted to industrialized country problems, and finally those which are common to both groups of countries, or simply unclassifiable. The figures, here again, are essentially indicative, but they do show rather clearly that AT organisations in Western Europe are much more heavily oriented towards the developing nations than are the AT organisations of North America.

THE LOCATION OF APPROPRIATE TECHNOLOGY ACTIVITIES

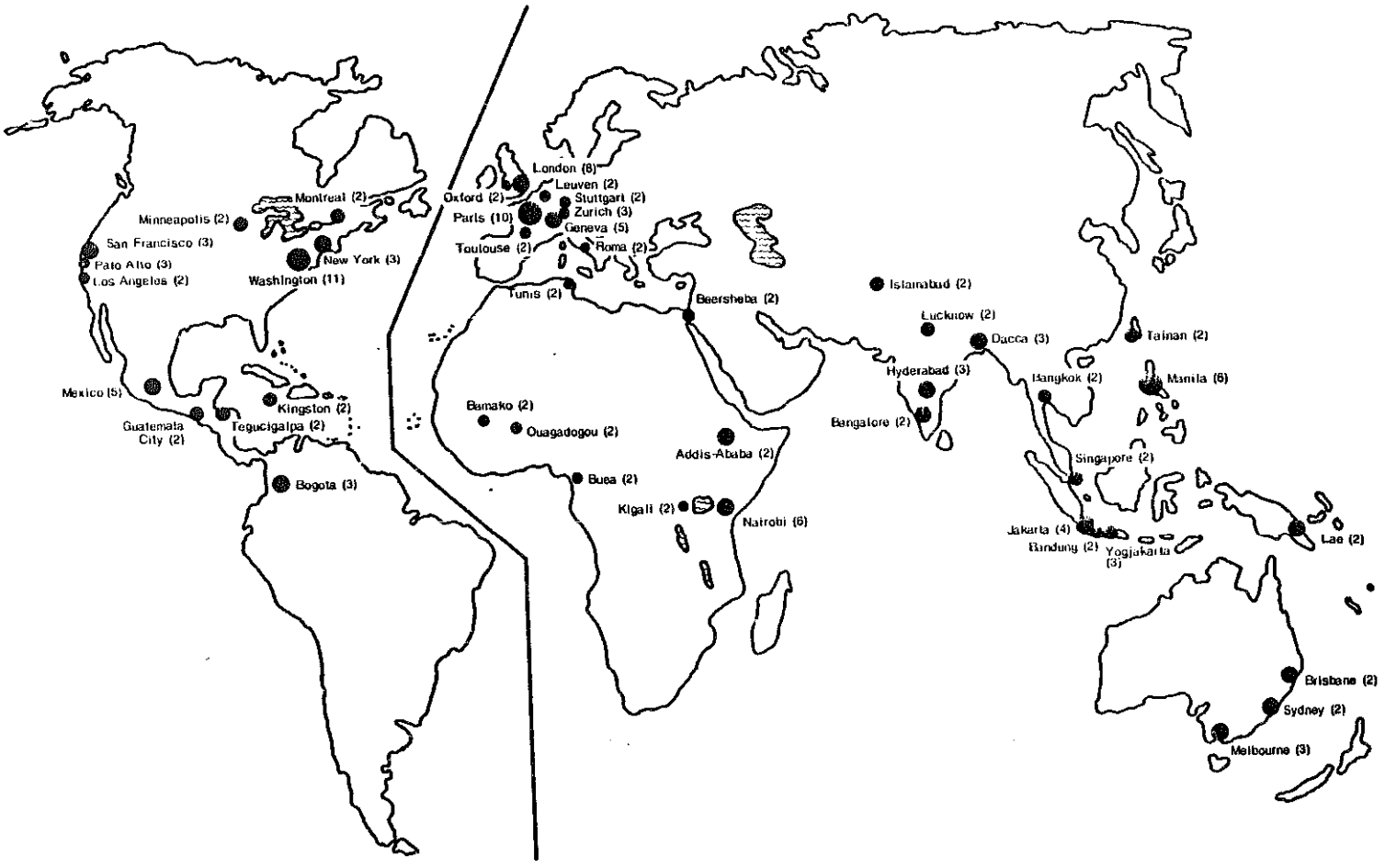
One of the fundamental aims of the AT movement has been to promote development, and more specifically rural development, in the poorer countries of the world. In the industrialized countries, the great majority of AT organisations are seeking to promote new life styles which emphasize local self-reliance, community development, organisational decentralisation and technological autonomy. It might, therefore, be expected that most AT organisations would be located in rural areas and small towns rather than in the largest cities. In fact, the opposite is true, and a look at the physical location of AT organisations suggests that the AT movement is very much a cultural creation of the world's largest cities, and not a grassroots phenomenon stemming from the rural areas and the small towns.

Figure 5 **FOCUS OF ACTIVITIES OF CENTRES IN THE INDUSTRIALIZED COUNTRIES (1977)**



The map of Figure 6 shows the main locations of AT organisations throughout the world in 1977 (only those locations with two AT organisations or more have been shown). It may come as a surprise to see that the largest 'AT city' in the world is Washington and its metropolitan area, closely followed by London, Paris, Manila and Nairobi. In the developing countries, most AT centres tend to be located in the capital, which is most often the largest city. There are, of course, a number of practical reasons for this rather unexpected spatial distribution of AT organisations: large cities are convenient,

Figure 6 **MAIN LOCATIONS OF APPROPRIATE TECHNOLOGY CENTRES IN 1977**



Note : The figures in brackets indicate the number of centres by major metropolitan areas.

communications are easy, the physical infrastructure is generally good, fund raising is easier, and most people simply prefer to live in cities rather than in remote rural areas. Location, however, is also determined by political structures: decentralised, federally-organised countries such as the United States or India tend to have a relatively small proportion of their AT organisations in the capital.

As can be seen from Table 5, a very high proportion of developing countries AT organisations are based in capital cities, and the contrast with the industrialized countries is very striking. Another interesting feature is the major difference between the rather centralised AT system in Western Europe, and the very decentralised system of Canada and the United States. These general patterns, which are confirmed by the complementary data of Table 5 on the decentralisation and concentration of AT activities, beg a number of questions. Should newly-established AT organisations be deliberately located in major metropolitan areas? Is an urban location a necessary condition for the development of such an organisation? Can a centre located in a rural area communicate effectively with other AT organisations? Is access to the political decision-makers vitally important? For the moment, there do not seem to be any simple answers, but the very fact that the AT movement is largely based today in large cities may indicate that this is indeed the optimal location for practical operational purposes.

Table 5

SPATIAL DISTRIBUTION OF APPROPRIATE TECHNOLOGY ORGANISATIONS

	Percentage of organisations in capital city	Decentralisation index	Concentration index
Africa & Middle East	67%	8.2	83.7
Asia	44	7.4	61.1
Latin America	63	5.7	70.6
Europe	42	13.0	63.8
North America	19	24.2	67.8
OECD Pacific	12	*	*
Developing countries	57	7.2	71.0
Industrialized countries	30	17.3	67.6
World average	44%	12.3	69.3

Notes: The decentralisation index is the ratio between the number of organisations located outside the capital cities and main towns, and the total number of organisations. Index 100 = total number of organisations

The concentration index is the ratio between the number of locations and the total number of organisations. Index 100 = total number of organisations.

* Figure not significant owing to the small number of organisations in the region.

See Appendix 1 for details on methodology and definitions.

Chapter 3

THE FIELDS OF ACTIVITY OF APPROPRIATE TECHNOLOGY ORGANISATIONS

While there is today a fairly general agreement as to what constitutes an 'appropriate' technology (1), little empirical evidence was available until now on the relative importance of the different fields of activity of AT organisations. Does the scaling-down of industrial processes receive more attention than the development of inexpensive irrigation systems or simple water supply services? How many organisations are working, for instance, in the field of public health or nutrition? Does the AT movement tend to focus too heavily on certain popular areas such as solar energy, or does it represent a well-balanced research and development effort aimed at meeting the basic needs of the poorest people? Which are the regions of the world doing the largest amount of work on energy or agriculture? Are any important subjects grossly under-studied and under-funded? The data supplied in response to the OECD questionnaire and presented in this chapter provide an answer to most of these questions, and while the picture does not pretend to be complete, it does give some indications as to the major problems facing the AT movement and the public agencies which support it financially and politically.

CONCENTRATION AND DISPERSION

Most AT organisations are fairly small organisations (2) and, as shown in Chapter 2, close to three-quarters of those listed in the OECD Directory were less than ten years old in 1977. Growth industries such as this one generally face a number of familiar problems, one of which is the tendency to try to do too many things at the same time and to disperse their efforts over too wide a range of activities. Is this the case of the AT movement? Conventional wisdom suggests that many AT organisations are indeed trying to cover too much ground, but the statistical evidence points to a rather different and more complex picture.

(1) See the definitions in the box on pages 10 and 11.
(2) See the data in Chapter 5 ("The funding of appropriate technology activities") and Chapter 6 ("The staffing of appropriate technology organisations").

This can clearly be seen from Figure 7, which shows the distribution of the 277 organisations covered in the OECD survey in terms of their number of fields of activity (3). Perhaps the most striking feature emerging from these two charts is the almost identical distribution in industrialized and developing countries: although the average number of fields of activity is slightly higher in the industrialized countries (12 against 10), the median number is the same, and the total of 'highly-focused' AT organisations (i.e. those working in less than 10 different fields) is similar in both parts of the world (88 in the industrialized countries, 86 in the developing countries). The distribution shown here is merely a reflection of the present structure of the AT movement and its normative value is limited, in the sense that it says nothing about the ideal or the optimum number of fields of activity for a typical AT organisation. However, the fact that almost half of the 277 organisations covered here are working in a total number of fields ranging from 3 to 9 suggests indirectly that this fairly narrow range, determined by the processes of evolution of the AT movement, is perhaps the one which corresponds best to the size and capabilities of today's AT organisations.

These two charts also show that the developing countries have a much smaller number of 'highly dispersed' AT organisations (i.e. those working in 30 different fields or more) than the industrialized countries. Here again, it is impossible to draw any qualitative conclusions, but it is interesting to observe that six of the most highly dispersed AT organisations in this group (those working in 40 fields or more) are all clearinghouses and information networkers, and are all located in the industrialized countries (4).

The number of fields of activity quoted by an AT organisation may give an idea of the organisation's effectiveness if it is correlated with the total number of staff and the budget: an organisation employing less than ten people, but which claims to be active in 20 different fields, can quite clearly devote only a very small part of its activities to each one, and probably falls below the critical threshold of effectiveness in most of them. The responses to the OECD questionnaire suggest that quite a few AT organisations fall into this category and this is one of the big problems several organisations will have to solve in the next few years.

These data must, however, be interpreted with caution. Many of the activities carried out by the organisations surveyed here are by

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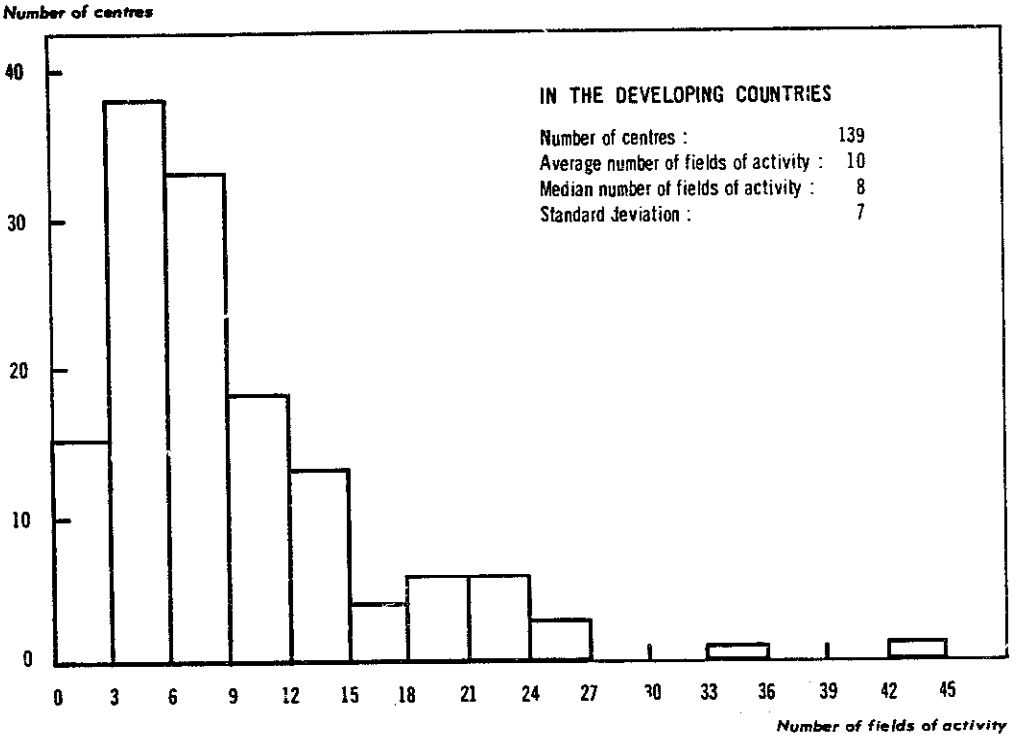
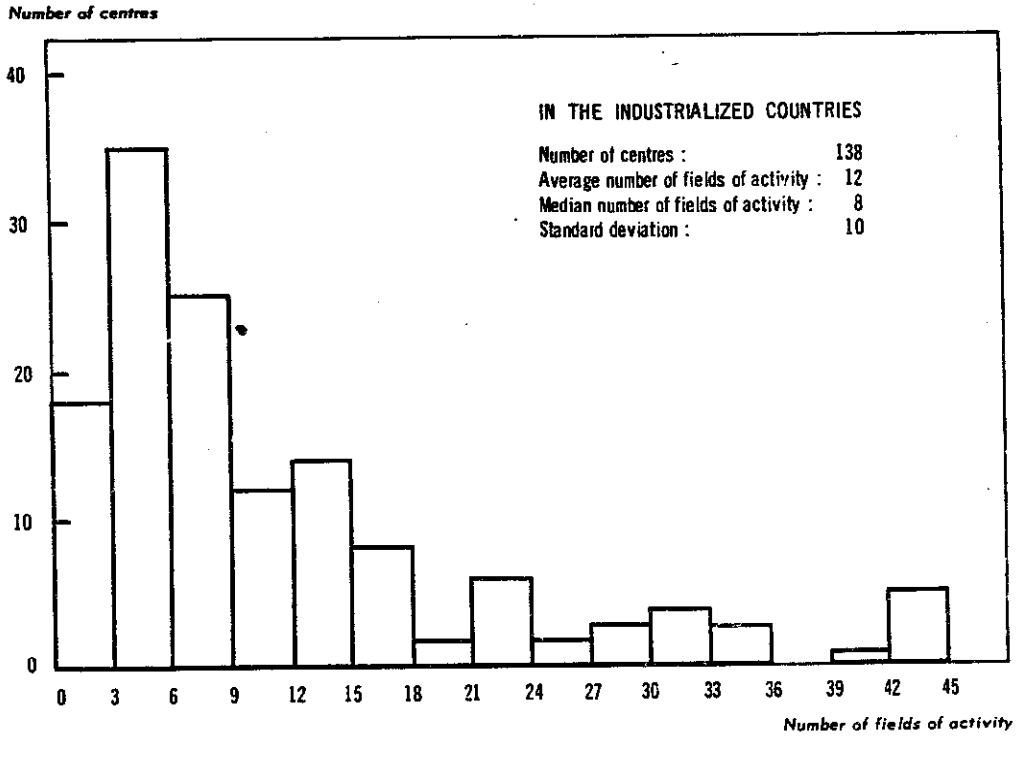
(3) The approximately 50 possible fields of activity of AT organisations are listed in question 16 of the OECD Questionnaire (see Appendix 3).

(4) Two typical examples of such organisations might be TRANET (Transnational Network for Appropriate/Alternative Technologies) in the United States, and GRET (Technological Research and Exchange Group, formerly known as the Research Group on Rural Techniques) in France.

Figure 7 **DISTRIBUTION OF CENTRES BY NUMBER OF FIELDS OF ACTIVITY (1977)**





nature interdisciplinary and thus fall into several different categories, which means that dispersion is more apparent than real. This is the case for instance of organisations working in the field of rural development - a subject which cuts across many areas, from energy supplies to nutrition, and from food storage to basic education. What is more, these figures on the dispersion or concentration of activities do not take into account the time element. Several of the very small AT organisations are working on what appears to be a rather large number of subjects, but a closer look shows that the cumulative number of man-months, or rather man-years of work spent on some of them is considerable, and gives them a professional expertise which is far in excess of that of many other apparently more highly focused AT organisations (5).

THE 21 MAIN FIELDS OF ACTIVITY

Out of the approximately 50 possible fields of activity of AT organisations, the 21 which received the largest number of quotations in the responses to the OECD questionnaire are presented by order of importance in Figure 8 (6). This picture is based on the number of quotations, and not on the effective scale (measured in man-months of work or budgetary expenditures) of activities in each area. For this reason, it is not quite as representative as it might be, but it does give a good idea of the main subjects of interest to AT organisations.

As could be expected, solar energy stands out as the most important field of work of AT organisations throughout the world (116 quotations), but the subject is of far greater interest to organisations based in the industrialized countries than to those in the developing countries. This apparently very large scale of activities in solar energy is interesting for a number of reasons. The first is the obvious disproportion between the large number of organisations working on this subject, and the very marginal importance of solar energy in the primary energy supply of industrialized and developing countries alike. This may be seen as a typically normal phenomenon in the development of technology: new technologies are always quantitatively unimportant in their early days - witness penicillin in 1940, the

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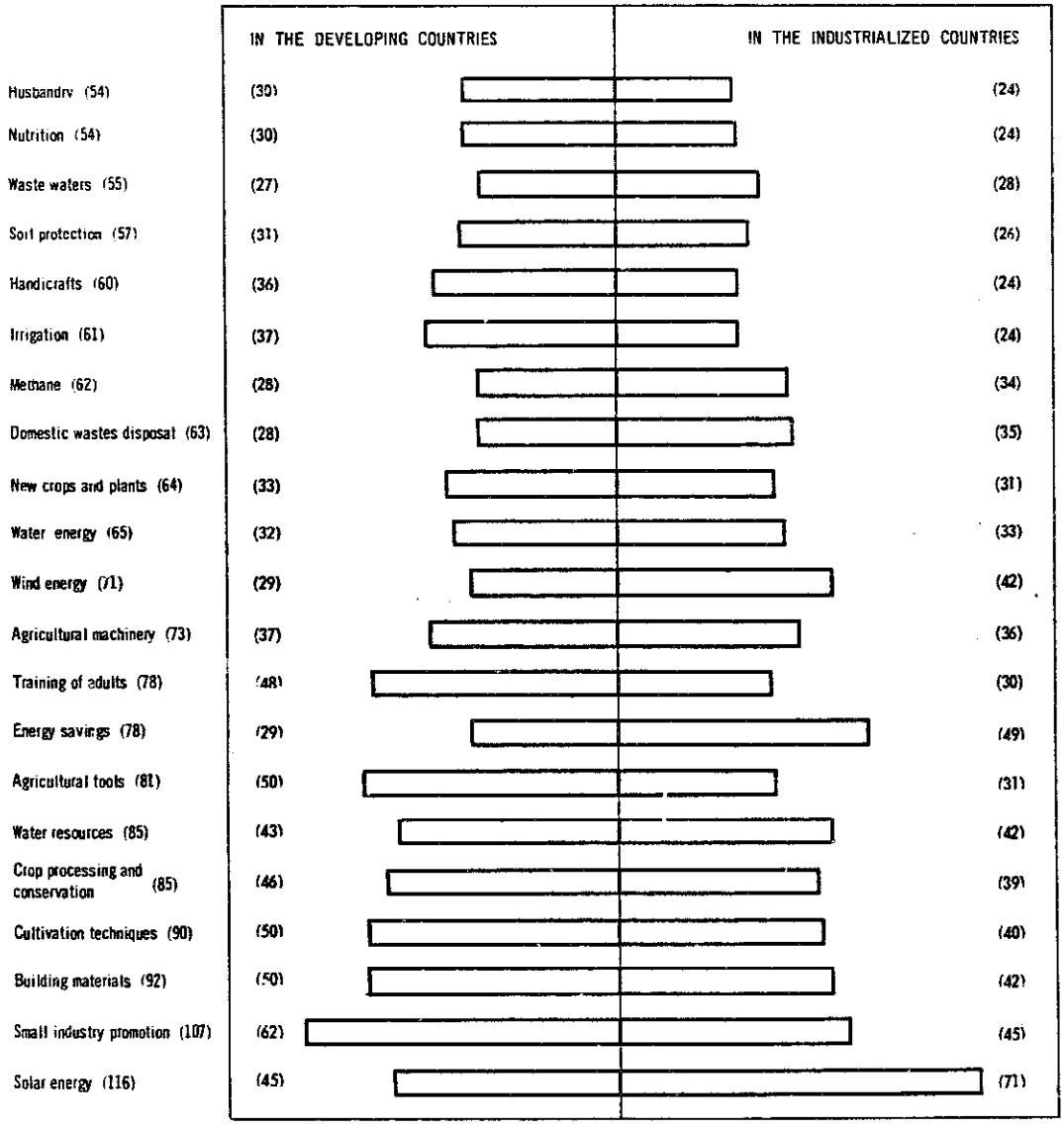
(5) A good example of this is provided by Garg Consultants, a small Indian AT consulting firm, which in 1977 had a budget of some $ 5,000 and employed only 4 full-time people. Founded in 1974, this firm embodies dozens of man-years of experience in the scaling-down of industrial processes and is one of the world leaders in the design of mini sugar mills and small-scale cement plants.

(6) This apparently rather odd number of 21 is simply due to the fact that two fields of activity - nutrition and husbandry - fall in the 20th position.

Figure 8 **THE MAIN FIELDS OF ACTIVITY OF APPROPRIATE TECHNOLOGY CENTRES (1977)**



transistor in 1950 or the integrated circuit in 1960 - but they attract a large number of innovators and entrepreneurs who gradually build them into major industries. Solar energy is such a case in point. But what is interesting about this major emphasis of AT organisations on solar energy is not so much its normality as its symbolic significance. For many AT proponents, solar energy has come to epitomize everything that is good about AT: it does not pollute, it is based on an inexhaustible renewable resource, it can operate on a decentralised basis, it can be very inexpensive, and it is aimed at meeting one of mankind's most basic needs.

In this perspective, the work of AT organisations on solar energy has a major symbolic function to fulfil: it is not so much a contribution to the development of an important new technology as it is the cultural expression of an organisation's commitment to AT. This probably accounts to a large extent for the great number of organisations active in this field, and for the fact that solar energy is very often the first field of work of a newly-created AT organisation. It may also be interesting to note here that AT organisations tend to focus their solar energy activities on the low technology end of the spectrum (solar cookers, solar dryers, solar heaters) and not on the highly sophisticated end of the spectrum (e.g. photovoltaic conversion) which is largely dominated by innovative industrial corporations (7).

The second most important field of activity emerging from Figure 8 is the promotion of small industry. Significantly enough, this is the main subject of interest to AT organisations located in the developing nations. Such a strong showing might be seen as an indirect reflection of the conventional belief that a country's development is based to a large extent on industrialization, but a closer look suggests that this work represents much more than an attempt to promote economic growth through industrialization. Many AT organisations of the developing countries have played a pioneering role in the scaling-down and adaptation of industrial processes, and a lot of their effort in small industry promotion is devoted to the revival of traditional industries (e.g. batik in Indonesia, village-level pottery in India) and the improvement of conventional production technologies in small firms. At the conceptual level, this work in small industry promotion is probably the best example of what is generally known as 'intermediate' technology, i.e. a technology which is more sophisticated and more efficient than 'traditional' technology, but smaller in scale and less expensive than the capital-intensive technology of the modern sector.

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(7) Of all the organisations covered in the OECD survey which gave more specific details about their activities in solar energy, only one mentioned photovoltaic conversion, as against 16 for solar cookers and the same number for solar dryers.

The very large importance given by AT organisations to solar energy and small industry promotion can be seen, with the wisdom of hindsight and statistical evidence, as a rather predictable phenomenon, in the sense that these two fields epitomize rather well some of the basic ideas and principles underlying the AT movement. The third position occupied by building materials is by contrast totally unexpected. This is a subject which is not generally associated with AT, and which was widely believed to be a very minor concern to AT organisations. In fact, the range of activities carried out in this field is surprisingly large, covering as it does a number of substitutes for cement and dozens of types of composite materials (soil-cement, ferrocement, new coating and insulating materials), as well as low-cost machinery for brick-making and earthquake-resistant structures. This field of building materials is obviously important in its own right, and a closer look at the activities of individual AT organisations shows that several of them have become major innovators in their own right. It is also a field which displays a rather high degree of organisational maturity compared to other AT areas: communications networks are well structured, research feeds relatively well into development projects, and the subject has attracted the attention of several leading institutions in the scientific and technological world (8). Furthermore, it may be interesting to note that in one of the sub-areas of building materials, namely ferrocement, there is a highly effective international clearinghouse and information centre - the Asian Institute of Technology's International Ferrocement Information Centre - which can be considered as a rather good model of the ways in which new fields of research and experimentation in AT could be structured in the next few years.

The next two most important fields of activity listed in Figure 8 - cultivation techniques and crop processing and conservation - are related to agriculture, and the preeminence of agriculture in the activities of AT organisations throughout the world is confirmed by the presence of seven other subjects related to agriculture among this list of the 21 main activities. If anything, this confirms the strongly rural orientation of the AT movement, even if, as shown in Chapter 2, most AT organisations are headquartered in large cities. This in fact points to what is perhaps one of the biggest structural and organisational problems facing AT organisations: for a number of practical reasons - ease of communications, quality of the local infrastructures and educational level of their staff - they tend to develop in urban areas, but their operational activities and philosophical inclination are heavily oriented towards the rural areas. In this

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(8) E.g. the U.S. National Academy of Sciences or the Massachusetts Institute of Technology.

connection, it may be interesting to note that there are at present almost no attempts to relate this interest in agriculture with the problems of the cities: of the 277 organisations figuring in the Directory, only two mentioned specifically that they were working on the development of urban agriculture.

If agriculture taken in the wide sense can be considered as the most important unifying theme in the activities of AT organisations, the second place must be attributed to energy. Aside from solar energy, which tops the list of the 21 main fields of activity, one finds energy savings, wind energy, water energy and methane. These energy-related activities generally tend to attract a rather high proportion of AT organisations based in the industrialised countries, and they are rather less important than industry or agriculture for the organisations based in the developing countries. Their strong showing is undoubtedly related to the importance of the energy factor in the growth of the AT movement in the highly industrialized countries.

If the very strong interest of AT organisations in the development of new building materials came as a big surprise, the other big surprise is the poor showing of all the subjects related to public health. Only one - nutrition - figures in the list of the 21 most important fields of activity, and it occupies the last position; all the others (hygiene, training of medical personnel, birth control, promotion of local medical traditions and health care equipment), with one exception, are in the bottom 25 per cent of the approximately fifty fields of activity of AT organisations. This rather puzzling phenomenon is not due, as one might believe, to a structural bias in the coverage of the Directory or the response rates to the OECD questionnaire: the Directory includes a rather high proportion of the main organisations involved in the promotion of AT for health (e.g. the World Health Organisation, the Appropriate Health Resources and Technologies Action Group in the United Kingdom, or the People's Health Centre in Bangladesh). In fact, the reason is probably much simpler; the AT movement as a whole has never really been interested in public health. There are no doubt many exceptions to this pattern, but this explanation is strongly supported by the history of the various AT organisations analyzed here.

The poor showing of public health among the various activities of AT organisations is all the more surprising, considering the major importance of this issue to developing and industrialized countries alike: health invariably stands out as a top political priority in the public opinion polls conducted in the highly industrialized countries, and there is ample statistical evidence to show that in the developing countries, investments in public health are among the most profitable from a social point of view, not to speak of their immense importance to the well-being of the individual.

Interestingly enough, public health is probably the field where AT has the most to contribute, and where large-scale and successful applications of AT are beginning to take place. The social technology now exists to implement low-cost health delivery systems and effective primary health care services, and the experiences of countries such as Sri Lanka, the People's Republic of China or Taiwan show quite clearly that AT for health is an operational reality. Most of these successful national experiments in public health were carried out quite independently of the activities of specialised AT organisations, and generally without any reference to the ideas and philosophy of the AT movement. In this sense, they were an original creation, or rather a reinvention of AT, and it is possible that in the next few years, the AT movement as we know it today, with its strong emphasis on energy and agriculture, will benefit from the intellectual and organisational fertilisation of the public and private agencies involved in promoting AT for health.

THE DIFFERENCES BETWEEN INDUSTRIALIZED AND DEVELOPING COUNTRIES

The general picture of activities of AT organisations as it emerges from an analysis of their main fields of work can be refined by a closer look at the full range of their activities. Figure 9 summarizes all the data provided in the responses to the OECD questionnaire. What is shown here is each of the fifty or so different fields of activity of AT organisations. These activities are ranged in two categories: the 'general' fields of activity (i.e. broad subject areas such as energy, industry or agriculture), and the 'specific' fields of activity (i.e. the different subgroups of each general field). The place of each activity in this figure is determined by two parameters: the percentage of organisations in the industrialized countries working on this activity, and the percentage of organisations working on this same subject in the developing countries. This presentation, which is based for the sake of clarity on a log-log scale covering two pages, presents in a graphical way the relative importance of all the fields of activity compared to one another, and the relative interest in each one of the industrialized countries and the developing countries.

This chart confirms several of the big trends emerging from the presentation of the 21 main fields of activity in Figure 8: thus the importance of agriculture and industry, the particular interest of the industrialized countries in energy and the low priority given by AT organisations to public health. It also confirms a number of more specific points: solar energy and energy savings, for instance, stand out very clearly as subjects of much greater interest to AT organisations based in the industrialized countries than to those of the developing world.

What is, of course, more interesting than the visual confirmation of patterns which are by now well-known is the new information such a chart can provide. Two lines of analysis can be used here. The first focuses upon the major differences, expected or unexpected, between the two major regions of the world. The second focuses upon the ranking of the different fields of activity relative to one another.

If major differences between industrialized and developing countries are to be expected, given the rather different nature of the economic and social problems facing each group, similarities are more surprising, and this chart shows an unexpectedly high convergence between the interests of AT organisations in the industrialized countries and those in the developing countries: of the nine general fields of activity, seven fall exactly on, or very close to, the line of equal interest to both groups of countries, and the only one which is significantly out of line is energy. AT organisations in the developing countries do have a somewhat higher interest in education, while those in the industrialized countries are somewhat stronger in housing and infrastructures, but the general picture emerging from this chart is the rather high degree of unity of the AT movement throughout the world.

Turning to the specific fields of activity (marked as dots in Figure 9), one can observe that the greatest divergences between industrialized and developing countries are usually to be found in the activities which are of rather small importance to the AT movement as a whole: this is the case, for instance, of water desalination, hydroponics, aquaculture, architecture and alternative institutions, which are of much greater interest to AT organisations located in the industrialized countries, but which as a group do not attract the attention of more than 12 per cent of all the AT organisations throughout the world.

Some subjects are quite naturally of greater interest to AT organisations working in the developing countries. This is the case, for instance, of handicrafts, agricultural tools, the training of adults or small-scale metal working. But what is rather more surprising is that several subjects which, on the face of it, appear as particularly important to the developing countries, are subjects where AT organisations from the industrialized countries are particularly active. Typical examples of this unexpected specialization include the scaling-down of industrial processes, fishing, road construction and pest control. This situation, far from being a statistical accident, is a reflection of the fact that many AT institutions in the industrialized countries are working primarily on developing country problems, and thereby belong to what we have called in Chapter 2 the developing country family of AT organisations.

Figure 9 **RELATIVE IMPORTANCE OF FIELDS OF ACTIVITY IN INDUSTRIALIZED AND DEVELOPING COUNTRIES (1977)**

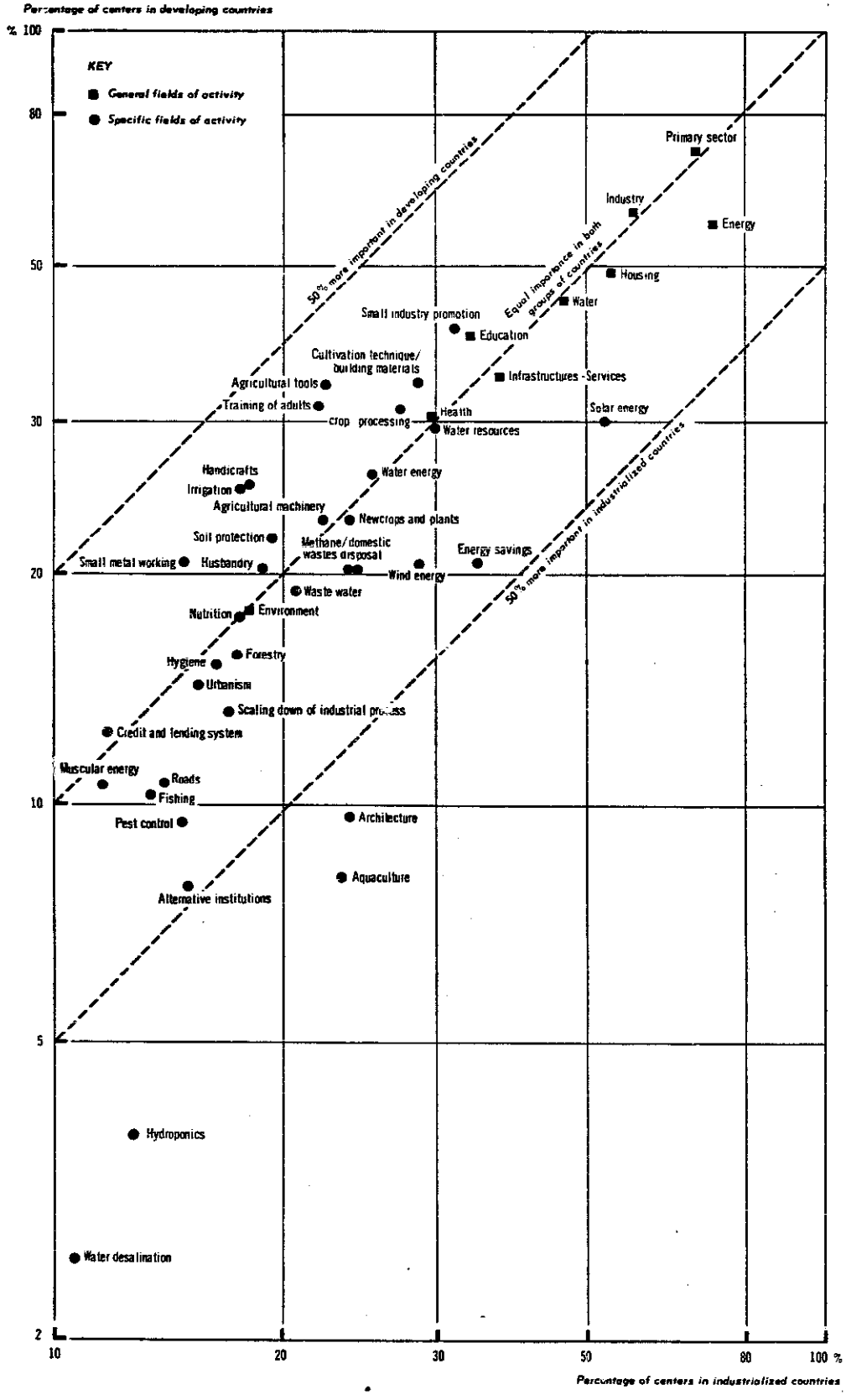
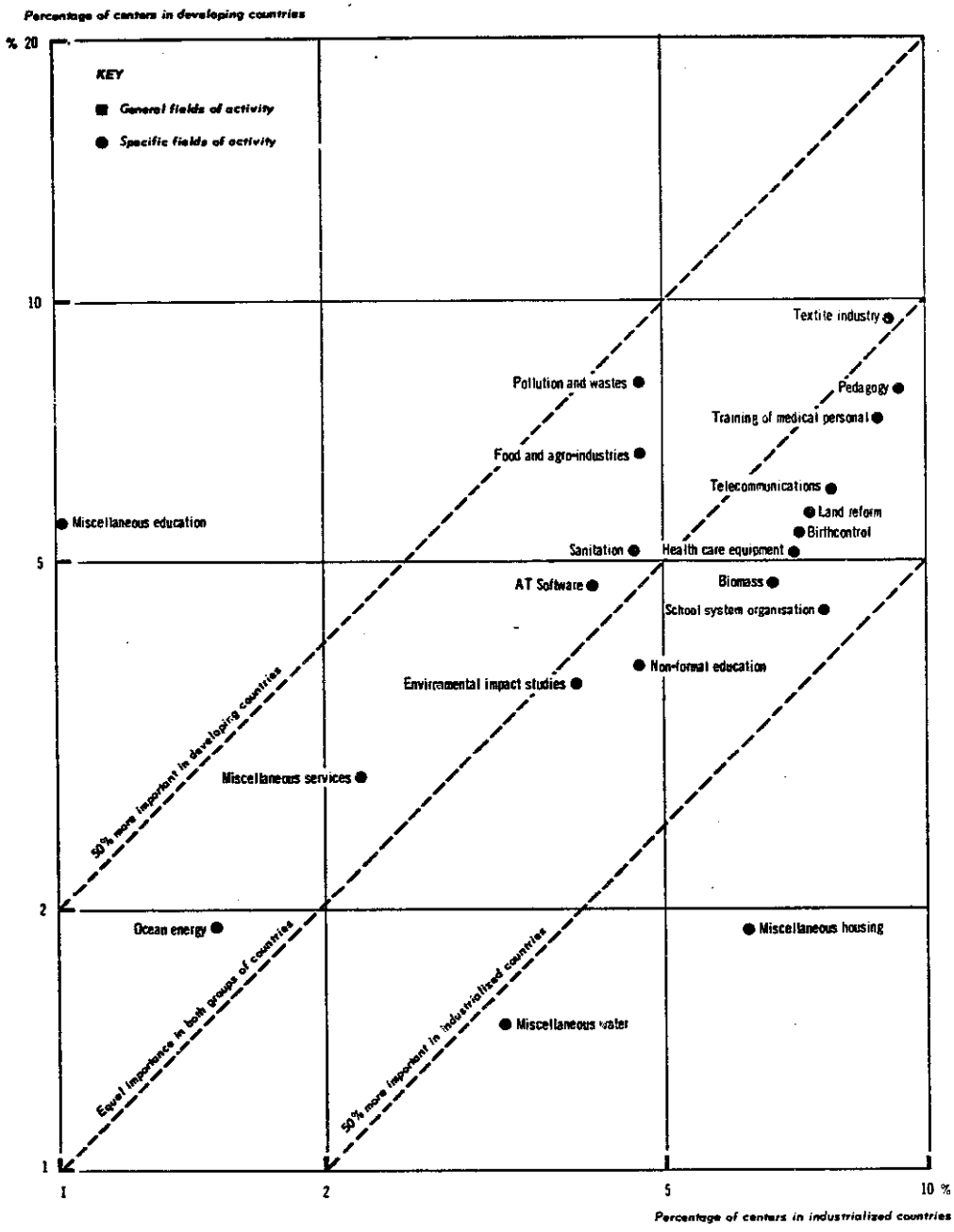


Figure 9 (Cont'd)



The ranking of the general fields of activity confirms the relatively minor importance of health: only 30 per cent of the AT organisations throughout the world are currently working on this subject. The only general field which ranks lower is environment, but this is a rather new subject, and one which might more rightly be put in the category of specific fields of activity. In the latter group, a number of fields occupy an unexpectedly minor position: this is the case, for instance, of credit and lending systems - a critically important problem in the diffusion of AT - and of all the subjects

related to public health (nutrition, hygiene, training of medical personnel, health care equipment). Another interesting case is that of sanitation, on which only 5 per cent of the AT organisations are currently working. This might be seen simply as a result of the low importance attributed to public health, but this poor showing is nevertheless rather surprising, considering the very large number of AT organisations active in all the fields related to water: sanitation is a public health problem, but has very direct relationships with water supply, and more generally with the management and use of water resources. A somewhat similar case is that of nutrition: this is also a public health problem, but its relative neglect by AT organisations (less than 20 per cent of them are active in this field) stands in sharp contrast with the very large amount of attention given to agriculture in general, and all the fields related to agriculture in particular (agricultural tools and machinery, crop processing, new cultivation techniques, new types of crops).

THE REGIONAL DIFFERENCES

The basic distinction made in the previous section between AT organisations based in the industrialized countries and those located in the developing countries is useful in pinpointing some of the main differences and similarities between these two components of the AT movement. It would, however, be a mistake to view these two components as fundamentally different: both of them are the expression of a similar movement of ideas, or general philosophy, which is gradually reaching all parts of the world, rich or poor, over-developed or underdeveloped. This distinction, furthermore, does not tell us anything about the major differences between the big regions of the world: the AT movement in North America is structurally rather different from the AT movement in Western Europe, and the differences between Latin American and Asian organisations are at least as great as those between industrialized country organisations and developing country organisations.

The general picture presented above should, therefore, be corrected, or at least made somewhat more explicit. This has been done here with the help of two figures (Figure 10, covering the industrialized regions of the world, and Figure 11, covering the developing regions) which show the importance of the general fields of activity of AT organisations in each part of the world relative to the world average. These regional 'temperature charts' can be used as a broad indicator of the relative strengths and weaknesses of AT organisations in different parts of the world, but their normative value should not be unduly emphasized: the yardstick, or basic index, used here is the

Figure 10 **RELATIVE IMPORTANCE OF MAIN FIELDS OF ACTIVITY IN THE INDUSTRIALIZED COUNTRIES IN 1977**
(World average = 100)

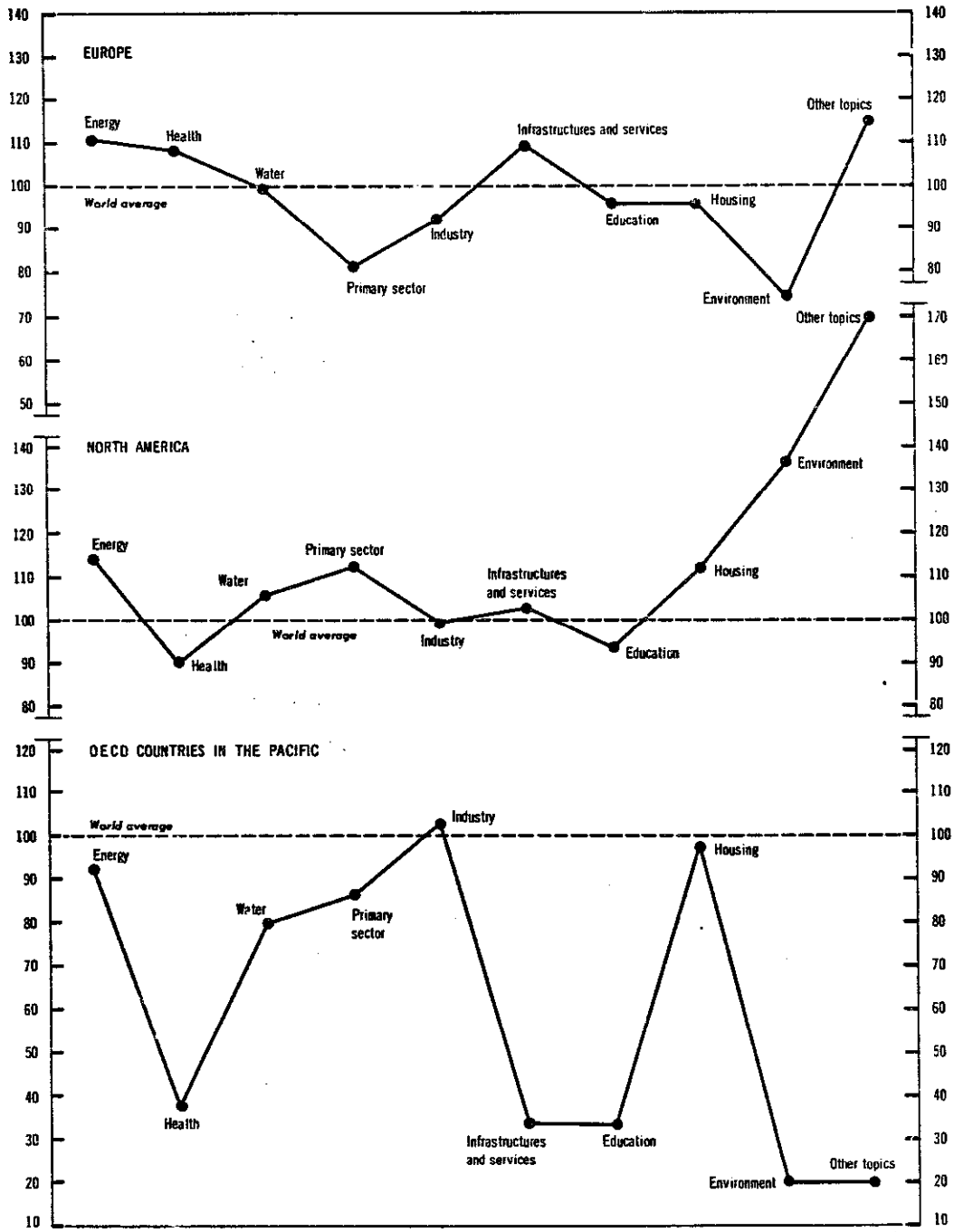
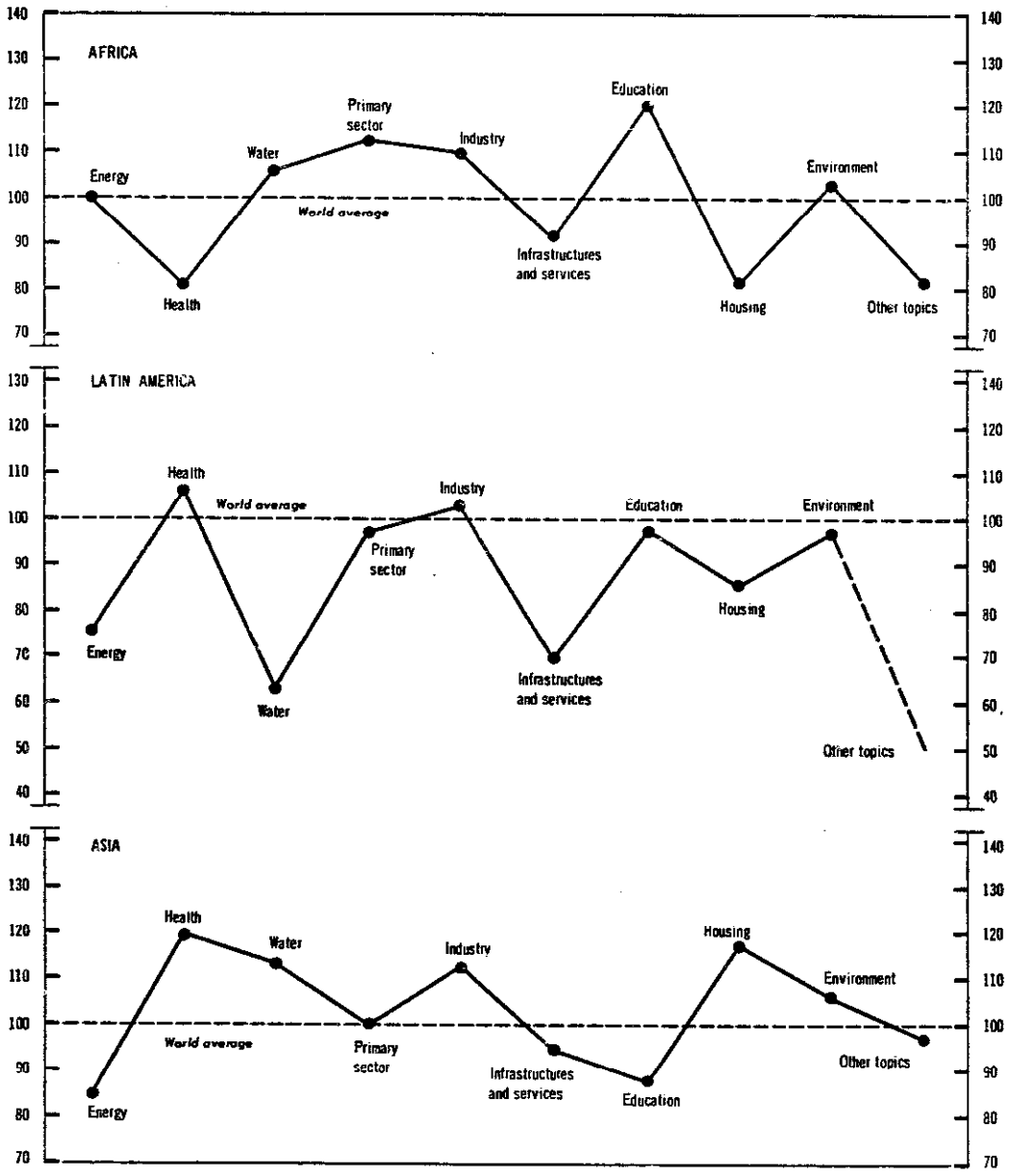


Figure 11 **RELATIVE IMPORTANCE OF MAIN FIELDS OF ACTIVITY IN THE DEVELOPING COUNTRIES IN 1977**
(World average = 100)



world average, and not, as with a thermometer, a 'correct' or 'normal' temperature. What they simply show is how different any one region of the world is compared to the rest of the world, or rather to all the other AT organisations in other regions.

Figure 10 shows the relative importance of the general, or main, fields of activity of AT organisations in Europe, North America and the OECD countries of the Pacific (Australia, Japan and New Zealand). This third group is presented here for the sake of comprehensiveness, but the figures concerning it are not fully representative, owing to the rather small number of organisations (8 in all) covered for that part of the world in the OECD survey. Of all the regions of the world, Europe is the one which comes closest to the world average, or line of normality. By comparison with North America, three of the most striking features are the relatively minor importance of agriculture (or primary sector, to use a slightly broader concept), a fairly strong showing in public health, and the rather limited interest in environmental problems. If the interest of European and North American AT organisations in energy is quite predictable, given the very high importance attributed to this topic by the AT movement as a whole, the strength of North American organisations in agriculture is somewhat more unusual, especially in view of the fact that the AT organisations in that part of the world, as shown in the previous chapter, have only a rather small interest in developing country problems. In fact, this strong showing in agriculture can probably be viewed as a very direct manifestation of the 'new ruralism' (9) of the North American AT movement, with its search for new life styles, its concern for environmental matters and its emphasis on renewable resources. In this connection, it may be interesting to note that in the AT field, as in many other areas, ideas tend to travel from West to East: new life styles and new concepts developed in California gradually spread to the East Coast of the United States, and reach Western Europe a few years later. In this perspective, one can probably anticipate a strong surge of agriculture-related activities among the AT organisations of Western Europe in the next few years.

Of the nine major fields of activity, the one which ranks lowest in North America is health. What is rather interesting about this is that the United States is probably the country where the public debates about health services, the cost of hospitals and the mission of the medical profession are the most intense. It is also the country where some of the most deeply critical assessments of current health delivery

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(9) On this subject, see for instance William N. Ellis, "The New Ruralism: The Post-Industrial Age is Upon Us", *The Futurist*, August 1975, as well as the October 1980 issue of the French review *Autrement* on "Technologies Douces" ("Soft Technologies").

services have been published - and widely read (10). Yet this very wide interest in health has clearly not yet reached the AT movement in North America, and particularly in the United States, and this is certainly one of its great weaknesses at present.

The picture of AT activities in the developing regions of the world, as it emerges from Figure 11, shows a number of interesting patterns. The most conspicuous is undoubtedly the very different shape of the temperature charts in each of the three regions: the differences between these three regions are far greater than those between the industrialized countries on the one hand, and the developing countries on the other.

Energy is a field where both Asia and Latin America are well below the world average. In the field of health, Africa, contrary to what was assumed, is a very poor performer, while Asia is undoubtedly the world leader. This very strong showing of Asia in health is of course purely quantitative: what the figures indicate is simply that a much higher number of AT organisations than average are working in this area. But interestingly enough, this quantitative picture is confirmed by the available qualitative information: AT organisations in Asia are doing a lot of very good work in such fields as the revival of local medical traditions (e.g. ayurvedic medicine in India), the development of low-cost health delivery services (Sri-Lanka), the production of inexpensive pharmaceutical products (Bangladesh) or the development of very low cost training packages for health personnel (Indonesia).

Differences in the field of education are rather striking: Latin America is very close to the world average, Asia well below it, and Africa exceptionally high above it. The rather weak effort of Asian AT organisations in this field may be due in large part to the fact that most countries in the region already have a highly developed public education system (the literacy rate in countries such as Sri Lanka and the Philippines is above 90 per cent), which obviates the need for a complementary effort on the part of AT organisations. What is particularly striking about the African case is that the very large and innovative effort of AT organisations in education is matched by an equally impressive and original effort of Ministries of Education in informal and non-formal education. In many countries, notably in the Sahelian region, these Ministries have become major proponents and innovators in the application of AT to education (11) and would undoubtedly have to be listed in an updated Directory of AT organisations.

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(10) See for instance Ivan Illich, *Medical Nemesis, The Expropriation of Health*, Random House, New York, 1976.

(11) On this subject, see in particular Francis J. Lethem, "Basic Education", in C. Weiss and N. Jéquier (eds.), *Technology, Finance and Development*, The World Bank, Washington (forthcoming).

In the environmental field, Africa is only slightly above the world average, but scores far better than Europe. One may wonder here whether this rather strong interest in environmental problems which may seem surprising considering the major economic and social problems facing the African nations, is not an indirect reflection of the fact that the world's main environmental agency, the United Nations Environment Programme (UNEP) is located in Africa, and also happens to have a very strong interest in AT.

The weakness of both Latin American and African AT organisations in housing is somewhat puzzling. Not only because of the obvious magnitude of the housing problems in these regions of the world, notably in their urban areas (the rate of demographic growth in several very large cities is well above 5 per cent a year), but also because several AT organisations are known to be doing some rather innovative work in this field, notably in Latin America. This is the case, for instance, of El Salvador's Foundation for Development and Minimum Housing, or Nairobi University's Housing Research and Development Unit.

All three developing regions of the world are well below the world average in the field of infrastructures and services (roads, telecommunications, transportation systems, credit and lending systems, etc.). This group of activities is extremely wide, but its uniformly poor showing in all parts of the developing world suggests rather clearly that this is a field which has not attracted the attention it deserves. A number of reasons may account for this. One is the fact that infrastructures and services of this kind are generally the responsibility of the government: AT organisations do not build roads, even if many very appropriate technologies can be used in road construction, and virtually all the significant work on low-cost telecommunications is done by private industrial firms (development of new hardware) and public telecommunications agencies (Ministries of Post and Telecommunications). Another reason is that, with a few exceptions, the development of such infrastructures calls for very substantial investments, which are quite out of line with the financial capabilities of a typical AT organisation. A third reason may well be the very large amount of time that elapses between investments in this field and the beginnings of an economic pay-off, and the lack of visibility of the direct and indirect benefits accruing from such projects.

Whatever the reasons, the whole field of infrastructures and services stands out as a rather neglected subject among the main concerns of AT organisations in the developing world. This situation is very similar to the one which was noted earlier in the field of public health, but the parallel that can be made between these two fields of activity goes further. One can observe, for instance, that civil works construction (essentially the building of roads and canals) is one of the fields, like public health, where some of the most innovative experiments have been made in the application of appropriate

labour-intensive technologies, and where the organisational technology for carrying out such projects is the most highly developed (12). Civil works, like public health, is also one of the fields where these experiments were carried out not at the instigation of AT groups, but under the direct sponsorship of development agencies (international development banks and Ministries of Public Works) which are not generally associated with the AT movement and its ideas. If anything, this suggests that AT organisations are not the only source of ideas and experiments in the field of AT, and that some of the most innovative organisations from an operational point of view are to be found outside the AT movement altogether.

THE PATTERNS OF INTERNATIONAL SPECIALISATION

In the industrial field, all countries are not equal, and the technological leadership of a few nations in some areas is a fact of life - witness the strength of the American computer industry, of Japanese firms in the consumer electronics business or of German industry in machine tools. The same phenomenon is beginning to appear in the field of AT, but like leadership in the industrial field, it results less from conscious decisions on the part of individual organisations or from the natural endowments of a particular country, as from a complex interplay between chance, traditions, the interests of individual entrepreneurs and the collective strivings of a society.

Measuring the level of specialisation of different countries in the field of AT cannot be done with the usual yardsticks such as world market share, export performance or the rate of growth of individual firms. A rather good, although far from perfect, substitute for these yardsticks is the relative size of a particular AT activity in a given country compared to the world average. Size is measured here in terms of the number of organisations working on that subject in the country under consideration. This 'index of specialisation' is purely quantitative, and does not tell us anything about quality, but there are some strong indications that quantity and quality are not totally unrelated.

The specialisation indexes for fifteen different countries are presented in Table 6. Are included in this table all the fields of activity in which each country is doing 50 per cent more work than the world average (i.e. the index is equal or superior to 1.5). Although the coverage of this table is rather narrow - 15 countries out of a total of 77 represented in the Directory - these 15 countries

(12) For a good description of the state-of-the-art in the applications of AT to civil works construction, see for instance *Labor-Based Construction Programs - A Planning and Management Handbook*, The World Bank, Washington, 1980.

represent 60 per cent of the total number of AT organisations figuring in the Directory, and they are the only ones in which AT activities show a significant degree of specialisation.

Table 6

MAIN AREAS OF SPECIALISATION IN APPROPRIATE TECHNOLOGY OF SELECTED COUNTRIES

	Index of specialisation
United Kingdom	
Food and agro-industries	2.9
Hydroponics	2.7
Muscular energy	2.5
Health care equipment	2.4
Training of medical personnel	2.3
Forestry	2.0
Means of transportation	1.9
Pest control	1.7
Nutrition	1.6
United States	
Biomass	2.0
Architecture	1.7
Urbanism	1.7
Alternative institutions	1.6
Aquaculture	1.6
Land reform	1.6
Energy savings	1.5
India	
Muscular energy	2.2
Textile industry	2.0
Methane	1.8
Forestry	1.6
Wind energy	1.6
Australia	
Methane	1.9
Solar energy	1.8
Wind energy	1.7
Building materials	1.5
Indonesia	
Handicrafts	2.2
Nutrition	2.1
Small industry promotion	1.7
Water energy	1.7
Netherlands	
Local medical traditions	6.0
Hygiene and disease prevention	3.2
Small metal working industries	2.3
Wind energy	2.1
Philippines	
Small industry promotion	2.4
Training of adults	2.0
Agricultural machinery	1.8
Methane	1.5
Sri Lanka	
Local medical traditions	5.3
Nutrition	2.6
Building materials	2.5
Wind energy	2.3

Table 6 (Cont'd)

	Index of specialisation
Switzerland	
Methane	2.0
Health care equipment	1.8
Local medical traditions	1.8
Training of adults	1.8
Kenya	
Birth control	6.1
Urbanism	3.2
Hygiene and disease prevention	3.1
France	
Aquaculture	2.1
Architecture	1.6
Germany	
Agricultural machinery	2.3
Wind energy	2.3
Canada	
Water desalination	6.7
Colombia	
Wind energy	2.3
Ecuador	
Animal husbandry	3.4

Note: See Appendix 1 for details on methodology.

The first and perhaps the most striking factor emerging from this table is that three countries with the largest number of fields of specialisation, namely the United Kingdom, the United States and India, are precisely the three 'Big Powers' in the AT field. While it stands to reason that a country's reputation and visibility in the AT field is linked with the overall level of its activities in AT, the correlation which appears here between the degree of specialisation and a country's widely acknowledged standing as a world leader in AT is somewhat more unexpected. A number of explanations can be envisaged. One is that the overall effectiveness of a country's effort in the AT field depends not only on the absolute size of this effort (small countries generally do much less work in AT than very large countries), but on its concentration on very specific targets. This indirectly suggests that there is a minimum threshold of efficiency: countries, or for that matter AT organisations, which are working on too large a number of subjects, are probably less good innovators in AT than those where the national AT effort is more highly focused. In this connection, it may be useful to recall here the discussion in Chapter 2 on the level of concentration and dispersion in the activities of individual AT organisations.

Another reason for this preeminence of the Big Powers among the group of countries with a relatively high degree of specialisation in AT activities could simply be the maturity of the overall AT effort in these countries: as a country expands its activities in the AT

field, these tend to become rather more specialised, as the organisations involved begin to know what sort of work they do best and learn how to move out of those fields in which they have no particular competence. A confirmation of this explanation can be given by a comparison between the United Kingdom and France: both countries have approximately the same number of organisations represented in the Directory (18 for the United Kingdom, 15 for France) as well as a fairly similar population and gross national product. France's AT organisations are for the most part very young, while several of the British ones are among the oldest in the field. And interestingly enough, France has only two clear-cut fields of specialisation, as against nine in the United Kingdom. Mexico and the Philippines are a similar case in point: they are roughly comparable in terms of population and number of AT organisations, but the Philippines, which has been very active in the AT field for a number of years, has four clear-cut fields of specialisation while Mexico does not have a single one.

The data from Table 6 suggest another important pattern, namely the existence of a relationship between a country's specialisation in the AT field ard its overall industrial and technological traditions. The strength of the AT organisations based in Switzerland in the field of health care equipment and the promotion of local medical traditions is probably related in some way to that country's recognized supremacy in the pharmaceutical field, and the major interest of Dutch AT organisations in wind energy is quite probably a carry-over, conscious or unconscious, of several centuries of work in this particular field of technology. These patterns of specialisation, it should be added, also reflect to some extent each country's social problems and industrial priorities. The case of Kenya is a good illustration of this: its AT organisations give a quite exceptional attention to birth control and to hygiene and disease prevention, and this is the country which has the highest rate of population growth in the world.

If the fields of specialisation of each country are influenced to a certain degree by local social problems, historical traditions in technology or current industrial structures, this is certainly not the only factor determining the orientations of that country's AT organisations: the patterns of specialisation are also the result of deliberate development policies carried out by the AT organisations themselves. However, even if one attributes a rather large importance to free will, or rather to the conscious strategies of AT organisations, some of the patterns of specialisation emerging from Table 6 are nevertheless rather surprising. Why, for instance, should the United Kingdom be doing so much work on forestry? Or the United States in architecture? Or the Philippines in the training of adults? If India's interest in muscular energy appears rather logical, that of the United

Kingdom does not. And the major differences between the Philippines and Indonesia - two rather similar countries in many other respects - are equally surprising.

This table on the patterns of specialisation should be read simply as a statement of fact, and not as an indication of the reasons why some countries specialise in certain areas and not in others. As such, it suggests somewhat indirectly which are the fields in which some countries are particularly strong and probably gives a fair idea of where some of the best work in each of these fields of AT is carried out throughout the world.

This picture can be complemented by a more macro-economic look at the efforts made by AT organisations to develop new technologies which are tailored specifically to certain climatic or geographic regions. One of the tenets of the AT movement has always been that technology should be appropriate to the local climatic and geographic environment. Leaving aside a few obvious generalisations - wind energy, for instance, is a totally inappropriate technology in the tropical rain forests - the concept of appropriateness to climatic and geographic conditions is rather difficult to define. In the OECD questionnaire, organisations were asked to mention whether they were trying to develop new technologies which were specifically tailored to these climatic and geographic parameters, and if so, to what particular types of environment these technologies were especially well adapted.

Table 7 shows for each of the five big climatic regions of the world the number of organisations which are working on the development and diffusion of new technologies which are specifically tailored to the particular conditions prevailing in that region. What is perhaps more significant than these absolute numbers is the size of this climatically-oriented AT effort relative to the size of each area: as can be seen from the figures of the second column, the tropical dry regions (essentially the grassland and savanna areas of the world) are those which receive the largest amount of attention on the part of AT organisations. This indicator can be complemented by two other sets of figures, the 'index of specialisation' (column 3) and the 'index of general interest' (column 4). These figures confirm that the tropical dry regions are indeed the ones receiving the largest amount of relative attention on the part of AT organisations or, to put things differently, that AT organisations located in these regions are those which are the most conscious of the need to tailor technology to the local climatic and geographic conditions.

Table 7

CLIMATIC AND GEOGRAPHIC FOCUS OF APPROPRIATE TECHNOLOGY ACTIVITIES

	Total number of organisations	Number of organisations per million sq.km.	Index of specialisation	Index of general interest
Arctic & cold regions	12	0.6	0.3	1.0
Temperate regions	51	1.9	0.9	0.9
Tropical humid regions	57	2.9	1.4	1.3
Tropical dry regions	70	4.7	2.3	1.9
Arid & semi-arid regions	74	1.8	0.9	0.7

Note: See Appendix 1 for definitions and details on methodology.

Whether this attention to local climatic conditions can be translated in practice into new technologies that are somehow different from those used in other regions of the world is of course another matter. These figures do however suggest that the AT movement is making a much greater effort than was generally believed to take these climatic and geographic parameters into account when developing and diffusing new technologies.

This general picture of the climatic and geographic orientation of AT activities can be completed by a more detailed analysis of one of the main climatic areas of interest to AT organisations, namely the arid and semi-arid zones. Table 8 shows for each of the big regions of the world the number of AT organisations focusing on arid and semi-arid zone problems, the relative number of such organisations in each part of the world, and the degree of interest of these organisations in developing technologies which are particularly appropriate to these zones.

Table 8

APPROPRIATE TECHNOLOGY ORGANISATIONS WITH A FOCUS ON ARID AND SEMI-ARID ZONES

	Total number of organisations	Number of organisations per million sq.km.	Index of specialisation	Index of general interest
Africa	22	1.7	1.0	0.5
Asia	11	0.8	0.4	0.5
Latin America	6	2.0	1.1	1.3
Europe	23	23	13	11
North America	6	1.6	0.9	2.4
Australia & Pacific	2	0.3	0.2	0.6
Developing countries	39	1.3	0.7	0.6
Industrialized countries	31	2.8	1.5	3.6
World	76	1.8	1.0	1.0

Note: See Appendix 1 for definitions and details on methodology.

This table shows, somewhat unexpectedly, that AT organisations in the industrialized countries have a comparatively much higher interest in arid zone technology than the organisations located in the developing nations. Conventional wisdom would suggest the opposite pattern: most of the world's arid and semi-arid zones are after all in the developing regions of the world. What is also particularly interesting is the exceptionally high level of interest of European AT organisations in arid and semi-arid zone problems. If anything, this confirms one of the important patterns noted in Chapter 2, namely the much higher interest of European AT organisations in developing country problems compared to North American AT organisations. What is also interesting about this preeminent role of European AT organisations in arid zone problems is that it shows both the world-wide nature of the AT movement, and the importance of the technological cross-fertilization between industrialized country organisations and developing country organisations.

Chapter 4

THE TYPES OF ACTIVITIES OF APPROPRIATE TECHNOLOGY ORGANISATIONS

The general picture of the main fields of activity of AT organisations given in the preceding chapter has shown some of the main thrusts of the work of these organisations throughout the world, but does not tell us anything about the ways in which they carry out this work. Some AT organisations are essentially information networkers, others are more interested in the development of new hardware, and there are fundamental structural differences between a big international development bank which indirectly promotes AT in the course of its project-lending activities, and a specialised AT group which views itself primarily as a political lobbyist. Some AT organisations are highly specialised as far as types of activities are concerned, but most of them are involved in a rather large range of activities, from research and development (R & D) to the testing of new equipment, and from information networking to technology extension. The present chapter will try to measure the relative importance of these different types of activities and provide an answer to several basic questions facing the AT movement today. Do the industrialized countries, for instance, tend to be much stronger in the R & D field than the developing nations? Do AT organisations give too much attention to information? Do some countries or some regions of the world specialise in certain types of activities, or is there on the contrary a fairly high degree of unity in the means chosen to promote AT throughout the world? Are some types of activities inherently more costly or more difficult to carry out than others?

GLOBAL EXPENDITURES ON APPROPRIATE TECHNOLOGY

The AT movement, as noted earlier, is a 'growth industry'. It is also a new and young 'industry', or social activity, and for this very reason, is far less highly structured than a conventional academic discipline or a mature industry. Its patterns of growth and development are still very volatile, and for the moment it is impossible to determine what is the 'ideal' or 'normal' pattern of evolution for an

organisation interested in one way or another in the promotion of AT. Some AT organisations believe that the most critical problem is the lack of good hardware, and consequently devote a very large part of their work to the development of new equipment. Others are convinced that the real issue is to influence the decision-makers in Planning Ministries, banks, development agencies and industry, since these are the people who in practice have the greatest responsibility in shaping a country's social and technological future. As for industrial firms, some got involved in AT as a result of a genuine concern for the corporation's social responsibility, while others simply sensed that AT was a potentially very profitable line of new business, and consequently devote most of their work in the AT field to research, marketing and the testing of new equipment.

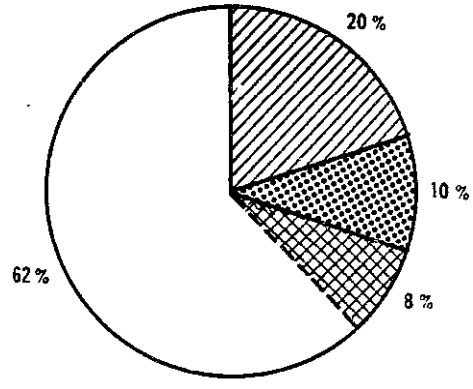
This diversity in motivations accounts in large part for the great diversity in the types of activities carried out by AT organisations, and this chapter will try to shed some light on what AT organisations are effectively doing throughout the world. As an introduction to this analysis, it may be useful to put these activities of AT organisations in a broader context, and measure their approximate size. Size, of course, is not everything: all industries and all new fields of human activity start on a very small basis, and the impact of new ideas - and AT also belongs to this category - does not lend itself to any meaningful quantification. Figures are nevertheless one of the many important approaches to social phenomena of this type, and their usefulness should not be underestimated.

The analysis of the growth of AT activities made in Chapter 2 showed that the total corrected budget of the 277 AT organisations figuring in the OECD Directory was approximately $ 300 million in 1977 (1). Although no precise figures are available for later years, one can estimate that by 1980, these 277 organisations were spending in the region of $ 600 million in nominal terms, or some 70 per cent more in real terms than in 1977. These figures do not represent the totality of AT activities throughout the world, but only those of organisations listed in the Directory. In order to get a more complete picture, account should be taken of the work of all the other institutions which either did not reply to the OECD questionnaire or else which were left out of the survey altogether.

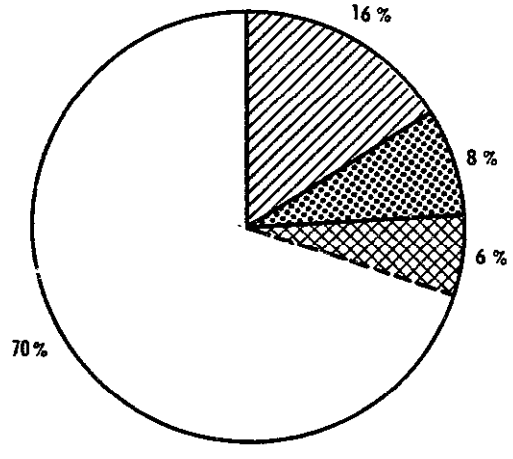
Putting such figures together is a perilous exercise, and the reconstructed data on total world-wide expenditures in AT presented in Figure 12 should be considered as no more than very rough guesstimates. They do nevertheless suggest a number of important observations. The first is that the overall level of activities in AT throughout the world is much higher than was generally believed to

(1) See Table 2 in Chapter 2, page 27.

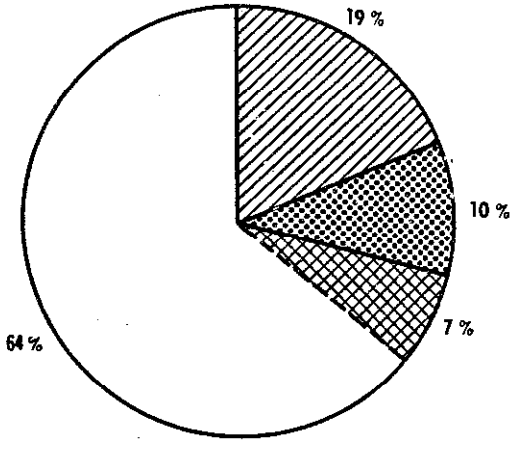
Figure 12 **WORLD-WIDE EXPENDITURES ON APPROPRIATE TECHNOLOGY, 1975 TO 1977**



1975 : US $ 620 million



1976 : US $ 950 million



1977 : US $ 1075 million

KEY :

Expenditures by industrialized countries

Expenditures by developing countries

Expenditures by international organisations located in industrialized countries

Expenditures by international organisations located in developing countries

be the case until now: even if one admits that the data given in this figure are 50 per cent too high - which is probably not the case - and that the $ 300 million figure given above as the total corrected budget of the 277 organisations figuring in the Directory is somewhat inflated, AT stands out as a fairly large undertaking. It clearly falls in the hundred-million-dollar league, and not in the ten-million-dollar league suggested by the scale of activities of the best known specialised AT organisations.

The second observation is that AT activities, large as they are, nevertheless represent a very small share of the world's economic and social activities. The approximately $ 1,000 million quoted here as the total estimated expenditures in AT in 1977 amount to less than 0.015 per cent of the world's gross national product, and a hundred times less than total world-wide expenditures on research and development.

The third observation is that AT activities seem to be very largely dominated by international organisations. This is to a large extent a reflection of the fact that several international organisations have become major innovators in AT - like the World Health Organisation in the field of health or the World Bank in such areas as civil works or water supply - but it is also due to the fact that the AT expenditures of international organisations include a rather high proportion of development projects calling for substantial investments. Specialised AT organisations, by contrast, do not finance big projects and tend to focus on other types of activities such as research, information collection and dissemination or political lobbying.

MAJOR AND MINOR FIELDS OF ACTIVITY

If the rough estimates given in Figure 12 are a useful indicator of the approximate size of AT activities throughout the world, they are not very helpful in analysing the detailed structure of activities of AT organisations. In order to draw a picture of these activities, it is necessary to revert to the detailed data supplied in the responses to the OECD questionnaire and try to find out on what types of work the 277 organisations listed in the Directory are spending their total AT budget of some $ 300 million.

The breakdown of total expenditures by major types of activities given in Figure 13 should be read in conjunction with the data of Figure 14, which give the breakdown by man-months of work: what is important is not only the total amount of money spent by these 277 organisations on different types of work, but the real level of effort in each of these activities measured in man-months. Some types of activity are by nature rather expensive: this is the case, for instance,

Figure 13 **BREAKDOWN OF WORLD-WIDE EXPENDITURES IN APPROPRIATE TECHNOLOGY BY MAIN TYPES OF ACTIVITY (1977)**

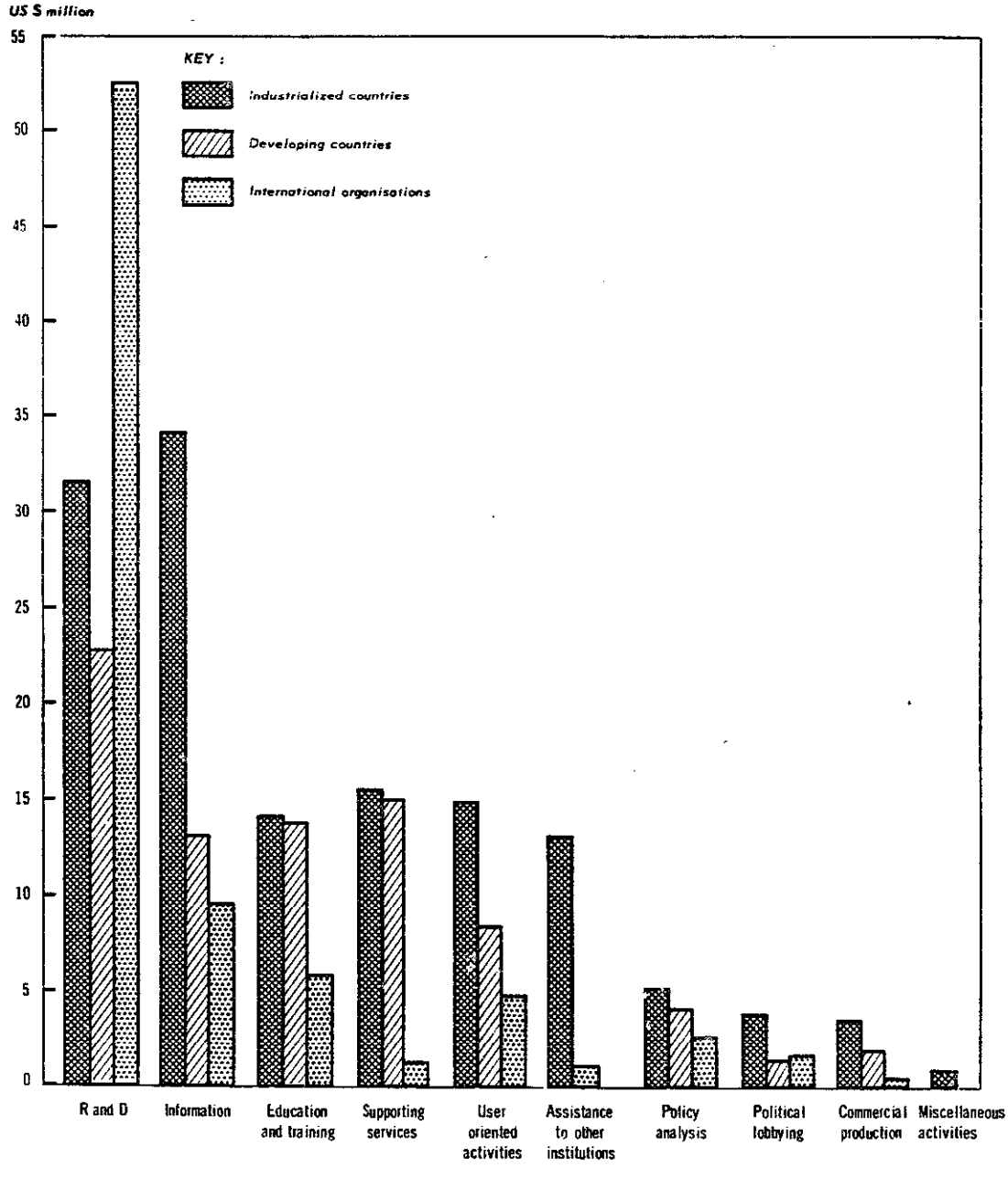
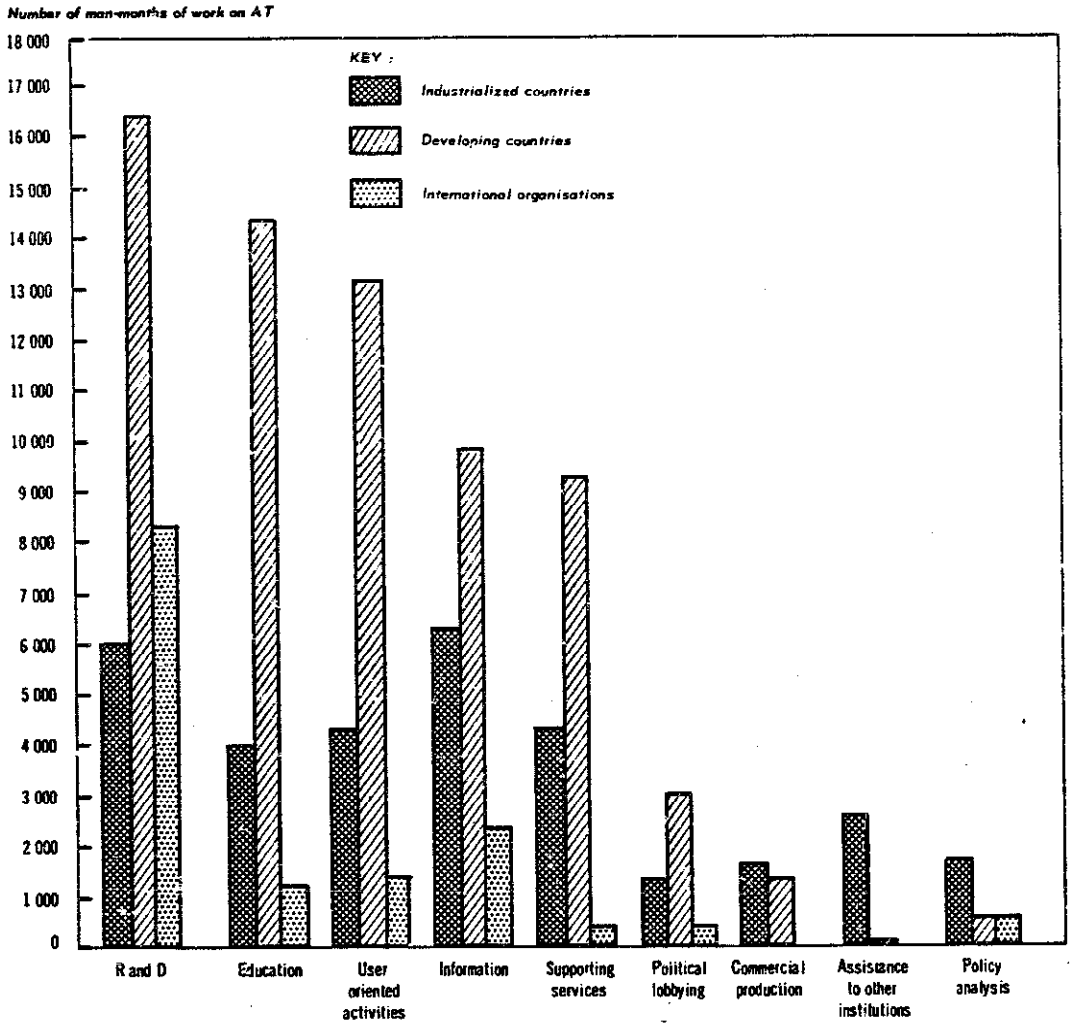


Figure 14 **BREAKDOWN OF WORLD-WIDE MAN-MONTHS OF WORK IN APPROPRIATE TECHNOLOGY BY MAIN TYPES OF ACTIVITY (1977)**



of R & D, or technical and financial assistance to other AT organisations. Other activities are, by contrast, comparatively inexpensive (e.g. political lobbying or policy analysis), and a comparison based solely on expenditures tends to overstate the relative importance of the more expensive activities; it also tends to understate the amount of work carried out in the developing countries which, taken as a group, have much lower salary levels than the industrialized countries.

For the sake of clarity, and in order to avoid having too great a number of operational categories, the various types of activities of AT organisations indicated in the responses to the OECD questionnaire have been regrouped into the ten broad areas shown in Table 9.

Table 9

THE DIFFERENT TYPES OF ACTIVITIES OF APPROPRIATE TECHNOLOGY ORGANISATIONS

1. RESEARCH AND DEVELOPMENT
2. INFORMATION
   - Information and documentation
   - Regular publications
   - Occasional publications
3. EDUCATION AND TRAINING
4. SUPPORTING SERVICES
   - Testing and evaluation of new equipment
   - Pilot production
   - Technical feasibility studies
5. USER-ORIENTED ACTIVITIES
   - Technology extension services
   - Promotion of local technological traditions
   - Technology diffusion
   - Demonstration and exhibits
6. ASSISTANCE TO OTHER INSTITUTIONS
   - Financing AT activities of other institutions
   - Technical assistance to other AT institutions
7. POLICY ANALYSIS
   - Policy analysis
   - Economic studies
8. POLITICAL LOBBYING
9. COMMERCIAL PRODUCTION
10. MISCELLANEOUS ACTIVITIES

Figures 13 and 14 clearly bring to light the very great importance of R & D in the activities of AT organisations: this subject accounts for some 27 per cent of the total AT effort throughout the world (2). Four other subjects fall into this category of 'main' fields of activity: information (19 per cent of the total), user-

(2) This figure and those that follow it are based on a weighted average between expenditures (weighting: 1) and man-months of work (weighting: 2). For more details, see Figure 15 below.

oriented activities (15 per cent), education (14 per cent) and supporting services (12 per cent). Among the 'minor' fields of activity, the two largest are policy analysis and political lobbying (4 per cent each), followed by assistance to other organisations (3 per cent) and commercial production (2 per cent).

The distinction made here between AT organisations based in the industrialized countries, those based in the developing countries, and finally the international agencies, brings to light a number of important features. The first is the great strength of the developing countries in the field of R & D: their total expenditures are slightly lower than those of the industrialized nations, but their manpower effort, which is a much more significant indicator, is more than twice as large. Even if one admits that the effectiveness of their research is somewhat lower than in the industrialized countries, they are nevertheless the leaders, and this clearly invalidates the widely held view that technological innovation in the AT field is largely dominated by the industrialized nations. As for international organisations, they are by far the largest spenders on R & D. This can be accounted for in part by the high level of their salaries, but even if one makes an allowance for this distortion, the fact remains that they are doing slightly more R & D than all the AT organisations in the industrialized countries.

A second important feature is the very strong emphasis put by developing country organisations on the software aspects of AT (user-oriented activities such as technology extension services and technology diffusion) and on supporting services such as testing, pilot production and technical feasibility studies. These are the areas where international organisations appear as a whole to be rather weak, which is somewhat unexpected, given the major importance attributed by several large international agricultural research centres to technology extension services and the testing of new equipment.

A third interesting feature emerging from these figures is the very small importance of commercial production. While it is understandable for international organisations not to be active in this field, since it is generally contrary to their legal status, the very low priority accorded to this type of activity by AT organisations in both industrialized and developing countries is somewhat more surprising: commercial production is after all one of the main, if not the main channel of technology diffusion, and one of the central concerns of AT organisations is to foster the widespread adoption of more appropriate types of technology. This very low rating of commercial

production can be attributed in part to the coverage of the OECD survey and the consequently small representation of industrial firms in the Directory, but the problem probably goes much deeper: by their very origins and ideological orientations, AT organisations tend to be rather unfamiliar with, and distrustful of, commercially-oriented activities, and the profit motive is quite alien to their ways of thinking. While this may be understandable, it is nevertheless rather paradoxical, considering the very large effort they devote to such subjects as technical feasibility studies, pilot production, testing of new equipment, technology extension and, of course, research and development.

THE REGIONAL DIFFERENCES

This brief overview of the main types of activities carried out by AT organisations throughout the world should be complemented by a closer analysis of the work done in the different regions. Figure 15 shows which are the most important fields of activity in each part of the world, and summarizes the global data for developing countries, industrialized countries and international organisations. The weighted averages between expenditures and man-months of work in each of these fields in the six regions of the world indicate a number of rather significant differences.

The first is undoubtedly the very different priority given to R & D: overall, it ranks as the first field of activity of AT organisations (27 per cent of the total world-wide AT effort), but in North America it ranks only fourth, and in Africa fifth. If the weakness of African AT organisations in the R & D field is understandable, given the overall weakness of R & D in general in that part of the world, the case of North America is rather more surprising. The United States is the largest R & D spender in the world, it has the most highly developed scientific and technological infrastructure and has an exceptionally large number of research scientists and engineers (3). One could, therefore, normally expect its AT organisations to be particularly strong in research and in the development of new technology. The figures clearly suggest that this is not the case. Another rather surprising finding is the very high priority given to R & D by AT organisations in Latin America. Here again, one would have expected a different pattern: Latin America as a whole is not particularly

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(3) It may be recalled here that the United States accounts for some 90 per cent of the AT effort in North America (Mexico is included in the group of Latin American countries), and that the figures given here for North America are de facto the figures for the United States.

Figure 15 **MAIN TYPES OF ACTIVITY OF APPROPRIATE TECHNOLOGY CENTRES (1977)**

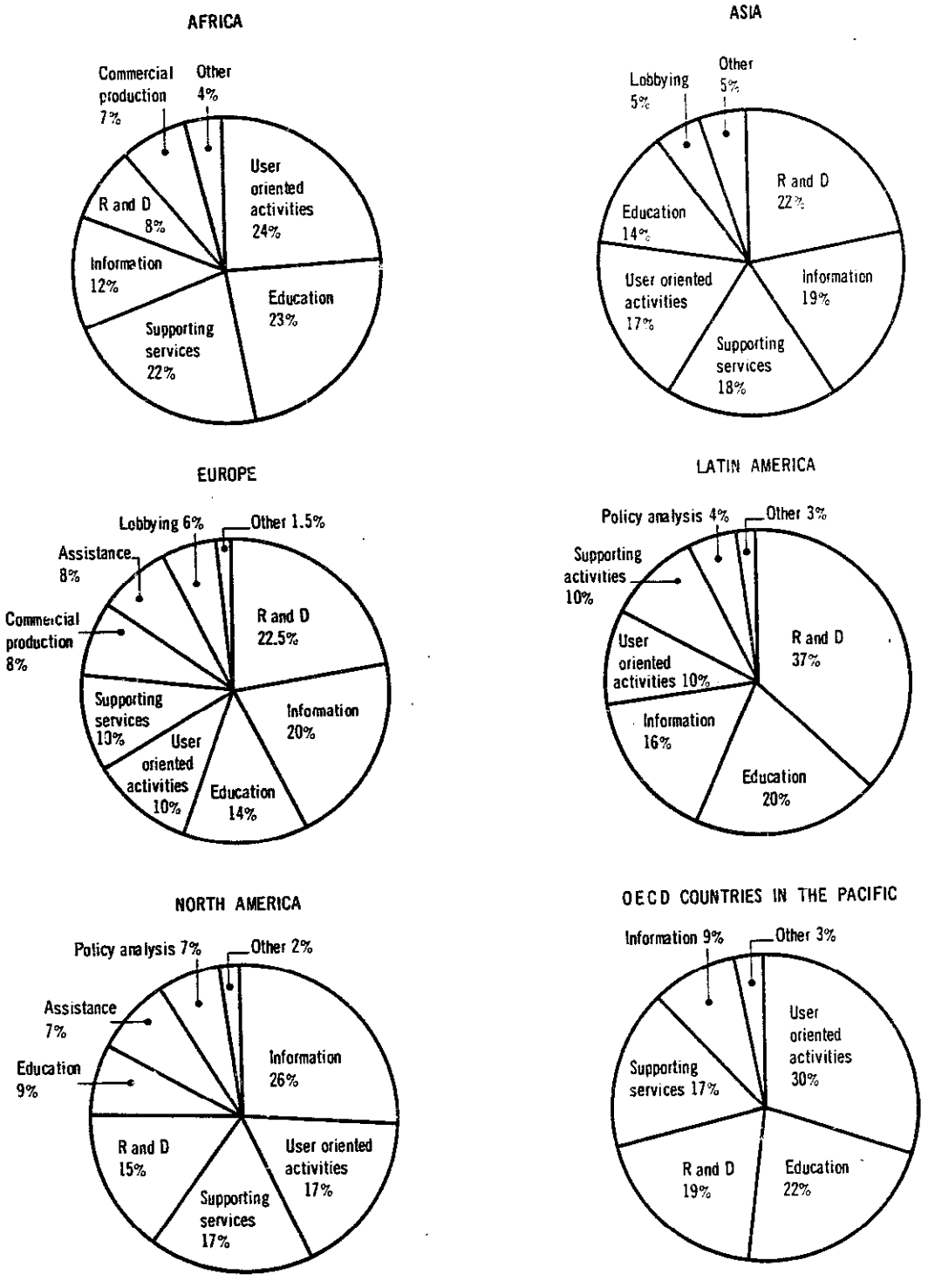
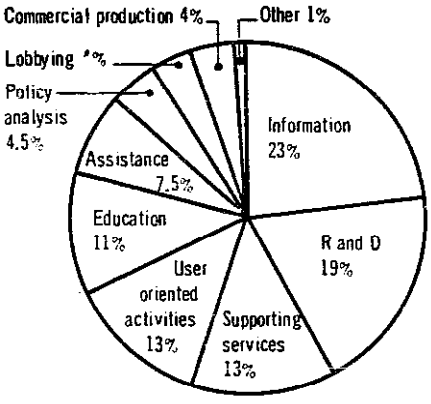
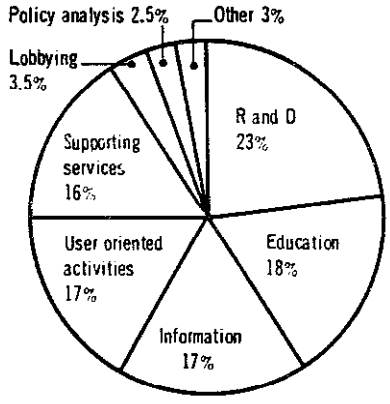


Figure 15 **(Cont'd)**

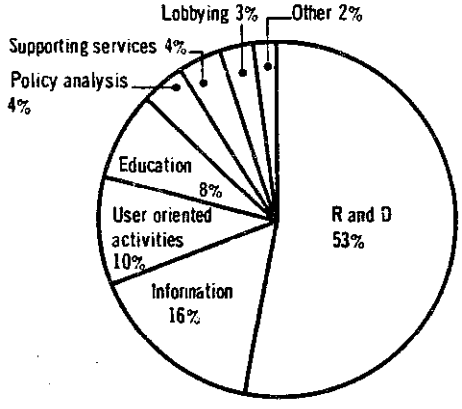
INDUSTRIALIZED COUNTRIES



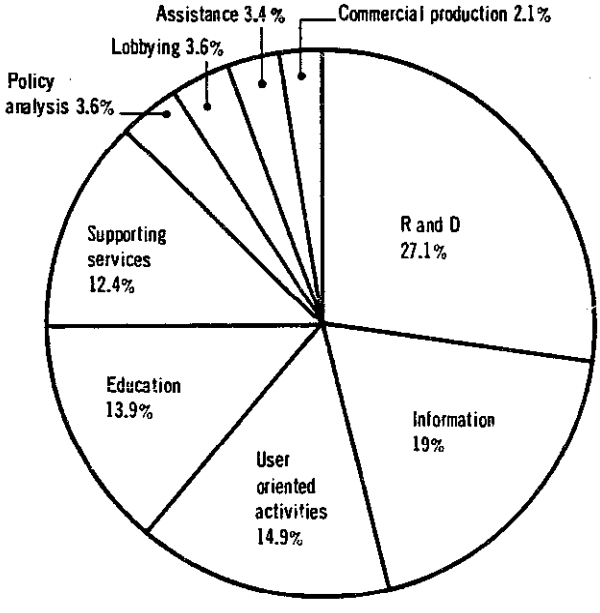
DEVELOPING COUNTRIES



INTERNATIONAL ORGANISATIONS



WORLD



strong in R & D, and a much lower ranking of this subject among the priorities of local AT organisations would have seemed more normal. What is interesting about these findings is their counter-intuitive nature: reality is very different from what could be expected from an intuitive perception of AT activities throughout the world, or of the comparative advantages enjoyed by each region of the world.

The second important difference emerging from the data of Figure 15 is the wide discrepancy in the level of information-oriented activities. Europe and Asia, as in the case of R & D, are rather close to the world average, but in North America this subject accounts for some 26 per cent of total AT activities, as against only 12 per cent in Africa. Information has always been considered as one of the centrally important subjects by AT organisations (4), and it usually ranks as the first priority in a newly-established AT organisation. While information is undoubtedly important, there is a growing amount of evidence to suggest that many AT organisations are in fact spending too much time and money on this field of activity. Furthermore, as shown in Chapter 7 below, it clearly appears that the lack of information is not a significant obstacle to the diffusion of innovation. The high priority given by North American AT organisations to information-related activities may reflect a comparative advantage - North America is an information-intensive region with highly developed channels of communication - but it is not necessarily the best 'model' to follow by AT organisations elsewhere. If anything, this priority could be viewed as a relic of the past, and notably of the time when information was considered to be the main problem facing the AT movement.

The strong emphasis given by Latin American AT organisations to R & D is matched by a comparative neglect of what might be called the operational aspects of innovation: supporting services (i.e. testing and evaluation, pilot production and technical feasibility studies) and user-oriented activities (technology diffusion, extension services, promotion of local technological traditions and demonstration work) taken together account for only 20 per cent of all their activities. The contrast with Africa is quite striking: in that continent, these two big groups of activity account for close to half the work of AT organisations. In this connection, Latin America and Africa probably represent the two most distinct strategies, or 'development models', in the field of AT: the first is clearly based on research, and

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(4) On this point, see for instance George McRobie, "The Mobilisation of Knowledge on Low-Cost Technology: Outline of a Strategy", in N. Jéquier (ed.), *Appropriate Technology - Problems and Promises*, OECD, Paris, 1976.

implicity assumes that if more appropriate products and technologies can be developed, diffusion will automatically follow, more or less as a matter of course. The second, by contrast, puts a very heavy emphasis on the whole environment of innovation (hence also the great amount of attention given to education) and assumes that "research will follow" if the environment is right.

Among the minor fields of activity of AT organisations, a number of rather unexpected patterns are beginning to emerge. The first is the comparatively high share of commercial production in Africa, and its near-total absence in North America. Here again, the opposite would have seemed more normal: the United States has a very highly developed commercial and industrial infrastructure, making money is a socially acceptable activity, and one would have expected this to shape the culture and activities of local AT organisations. Clearly, this is not the case.

A second unexpected pattern is the high importance of political lobbying in Europe and Asia, and its negligible role in North America: Washington is the capital city with the largest number of AT organisations, and many of them are very active on Capitol Hill and in the administration. One would, therefore, have expected political lobbying to rank rather high. While it certainly does for the Washington-based AT organisations, it does not for all the other AT organisations in North America. Political lobbying is one of the essential channels of communication between AT organisations and government. It is also a major instrument in influencing the decisions of governments in such fields as technology, rural development and industrialisation. What is interesting here is that this type of activity is so much more important in Asia than in the other regions of the developing world. This might be seen as an indication of a relatively high degree of political maturity on the part of Asian organisations, and if not, at least as a recognition of the fact that technological choices are not so much a technical problem as a political one.

This brief analysis of the major and minor types of activity of AT organisations throughout the world suggests that there are a number of rather fundamental differences in development strategies and methods of operation. For the moment it is impossible to determine which is the most effective strategy or the most adequate way of operating: all one can do is to take note of these differences, and identify a number of possible strengths and weaknesses at the regional level. What is interesting to observe is that these differences in the types of activity carried out by AT organisations do not follow the usual dichotomy between industrialized and developing countries: there is no clear-cut industrialized country model or developing country model of activities, but rather a set of regional models which are very largely independent of one another. European AT organisations, for instance,

seem to have the same priorities as their counterparts in Asia, but are very different from AT organisations in North America. As for African AT organisations, their activities are just about as different as could be from those of Latin American organisations. These major differences in types of activities stands in sharp contrast with the rather high degree of unity noted in Chapter 2 in the fields of activities of AT organisations: when it comes to subjects of work, there seems to be a rather wide consensus throughout the world as to what is important, and the areas of neglect (e.g. public health or environmental problems) are the same in industrialized and developing countries.

THE COST OF DIFFERENT TYPES OF ACTIVITIES

The very different priorities given by AT organisations in various parts of the world to each type of activity are difficult to explain, and with a few exceptions, do not seem to follow a 'logical' pattern. There is no obvious reason why African AT organisations, for instance, should be so active in commercially-oriented activities, or why Latin American organisations should have put such a heavy emphasis on R & D, unlike the organisations in the United States and Canada. The explanations one may adduce are essentially speculative, and the only thing one can meaningfully do at this stage is take note of these basic differences. If anything, these differences probably reflect the fact that AT is still a very new field of activity with a high degree of institutional and organisational fluidity: contrary to what happens in such fields as education, industrial research, social policy or public administration, there are no clear-cut 'models' to follow, no general consensus as to what are the best development strategies, and not enough experience to serve as a guideline for the future.

The empirical data gathered in the course of the OECD survey of AT activities throughout the world do, however, give some indication as to possible areas of specialisation in the future and potential comparative advantages of developing and industrialized countries. In Table 10, we have attempted to summarize some of the most significant data on the relative cost of different types of activities. This indicator is, no doubt, rather crude, but it suggests two important conclusions. First, that some types of activity are considerably more expensive to carry out in developing countries (or, conversely, in industrialized countries). Second, that these cost differences are not necessarily those which would seem logical, given the well-known factor endowments of both groups of countries and the prevailing conventional wisdom about AT activities throughout the world.

Table 10

COST-RATIOS OF DIFFERENT TYPES OF ACTIVITIES IN APPROPRIATE TECHNOLOGY

	Index
A. Activities with low cost-ratio in the industrialized countries	
Policy analysis	0.11
Testing and evaluation	0.20
Occasional publications	0.33
Commercial production	0.44
B. Activities with low cost-ratio in the developing countries	
Technical feasibility studies	1.46
Technology diffusion	1.57
Technology extension	1.83
Political lobbying	2.06
Information and documentation	2.67
C. Activities of similar cost in industrialized and developing countries	
Promotion of local technologies	0.85
Education and training	1.01
Research and development	1.06
Regular publications	1.06
Pilot production	1.30

Note: See Appendix 1 for details on methodology.

The various fields of activity of AT organisations have been divided here into three groups: those which are significantly cheaper to carry out in the industrialized countries (group A), those where the developing countries enjoy a strong cost advantage (group B), and finally those which have rather similar costs in both groups of countries (group C). This table lists most of the fields of activity summarized in Table 9 above: the few that have been left out are those which do not clearly fit into any one of these three categories.

The most significant area in which the industrialized countries seem to have a very strong comparative advantage is the testing and evaluation of new equipment. This is an extremely important subject, even if it accounts for a fairly small share of AT activities throughout the world: one of the big problems facing AT organisations is the low reliability of the new types of equipment and machinery they have developed and tried to diffuse to users. And low reliability, as will be seen in Chapter 7, ranks as one of the major obstacles to innovation. Testing and evaluation is an intrinsically very expensive work, which calls for a good technical infrastructure and high skills in engineering (or rather reverse engineering). Quite a few AT organisations in the developing world are active in this field, but the total amount of work done world-wide is dramatically insufficient. If anything, this clearly suggests that testing and evaluation of new equipment is probably the field in which the industrialized countries in

general, and their testing laboratories in particular, could make one of the most significant contributions to the promotion of AT in the developing countries.

Three of the five types of activity in which the developing countries seem to enjoy a strong comparative advantage belong to what we called the infrastructure of innovation, namely technical feasibility studies, technology diffusion and technology extension services. That these three activities should be among the least expensive to carry out in developing countries does not necessarily mean that they should be a top priority for AT organisations in that part of the world. But developing country AT organisations which are particularly strong in these areas (and this is clearly the case for the African AT organisations) are probably doing the right thing, given the resources at their disposal.

One of the rather surprising features emerging from Table 10 is the relatively very low cost of information and documentation in the developing nations. While it is probably true, as noted earlier, that AT organisations are devoting too great a share of their work to this subject, its low cost suggests that AT organisations in the developing countries still have a lot to gain from this type of work, notably as a channel of access to the technologies, ideas and experiences of the industrialized countries.

If cost differences are rather revealing, especially when they are unexpected, cost similarities are equally instructive. The most significant similarity emerging from Table 10 is that concerning research and development. The industrialized countries may have an edge over the developing countries as far as the efficiency of R & D is concerned, but in terms of overall costs, this activity is not more expensive to carry out in the developing world. If these figures are correct, they can be seen as a good justification for the rather heavy emphasis given by developing country AT organisations to R & D (23 per cent of total activities, as against 19 per cent on the average in the industrialized countries). They also indicate that it would make little sense to concentrate a greater share of the world's AT research devoted to developing country problems in the industrialized countries, since these do not enjoy any clear-cut cost advantage.

Chapter 5

THE FUNDING OF APPROPRIATE TECHNOLOGY ACTIVITIES

In its early days, the AT movement was financed primarily by donations, charities and non-profit institutions such as missionary organisations, foundations and universities. Today the picture is very different, and the patterns of funding of AT activities throughout the world clearly indicate that AT has now become a subject of direct interest to governments, international organisations and private industry. This change in the patterns of funding which took place between the mid-1960's and the late 1970's has been matched by very significant increases in the absolute level of funding of AT activities. Yet despite this quantitative growth, funding is widely acknowledged by AT organisations as one of the biggest constraints on their long-term development. This problem of funding is important for a number of reasons. The first is that, with a few exceptions, AT organisations generally do not have any stable long-term supply of funds to carry out their activities, and have to spend a considerable amount of effort in fund raising. The second is that the widespread diffusion of more appropriate types of technology in the next few years is going to call for very substantial investments in the building-up of new industries, the development of new types of low-cost public services and the promotion of less energy-intensive types of agriculture. The pioneering work carried out by AT groups throughout the world has shown that in many cases, AT was not simply a good idea, but an operational reality and a viable alternative, or complement, to the large-scale capital-intensive technologies that prevail today. The challenge now facing the AT movement is to make the transition from the 'first generation' of pilot experiments, feasibility studies and piecemeal innovation, to the 'second generation' characterised by the massive diffusion of AT (1).

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(1) On this point see N. Jéquier, "Appropriate Technology: The Second Generation" in *Appropriate Technology - Hearings Before the Subcommittee on Domestic and International Scientific Planning, Analysis and Cooperation of the Committee on Science and Technology*, U.S. House of Representatives, 95th Congress, 2nd Session, July 25, 26 and 27, 1978, U.S. Government Printing Office, Washington, 1978.

In this perspective, the funding mechanisms of the AT movement appear to be a particularly important issue, and this chapter will seek to answer some of basic questions concerning the financing of AT activities throughout the world. Where do AT organisations get their money from? How stable and how diverse are their sources of funding? Are the funding mechanisms in the developing countries very different from those that can be observed in the industrialized countries?

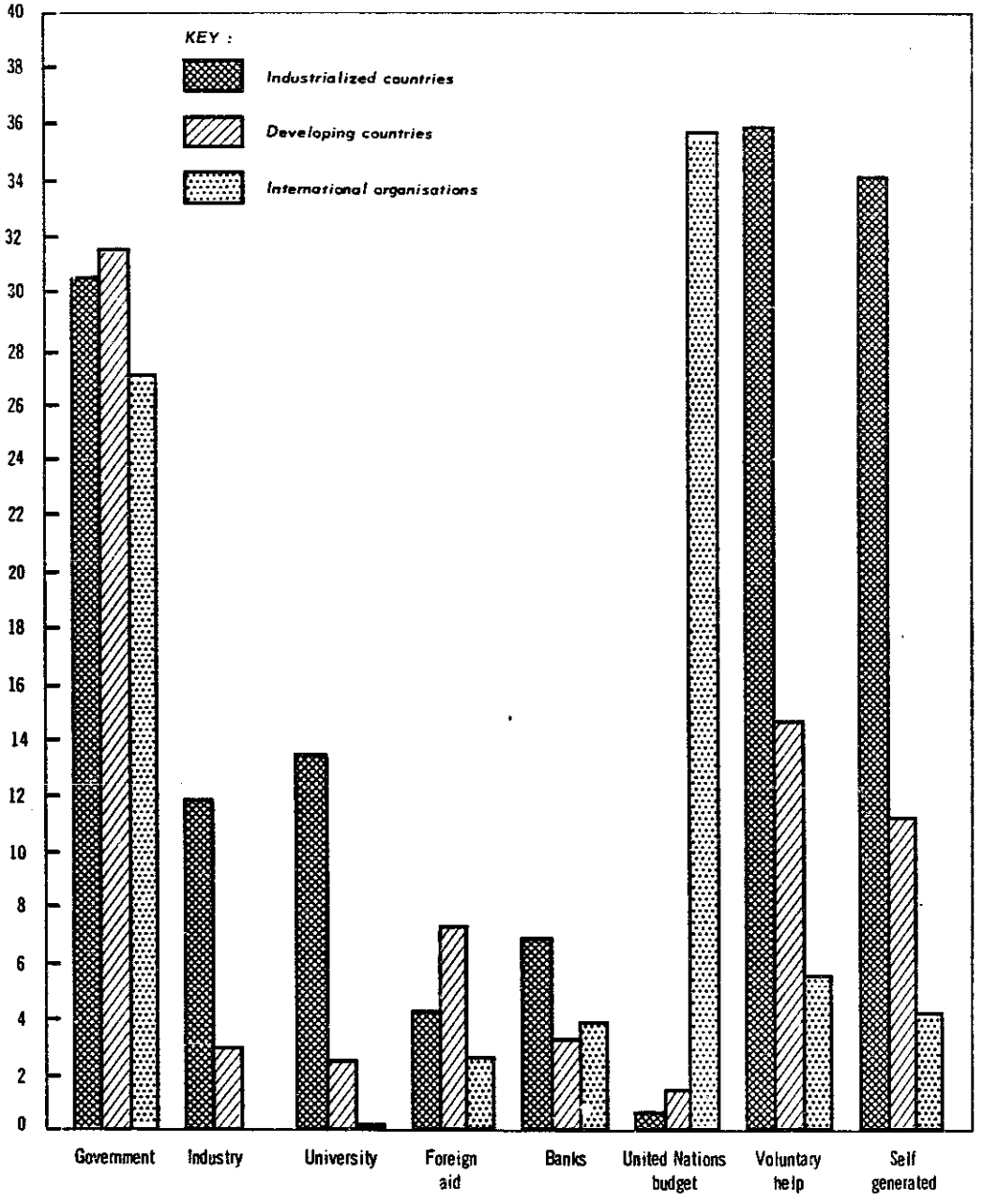
THE GLOBAL PATTERNS OF FUNDING

The available data show that national governments are today by far the largest single source of funds for AT activities throughout the world: in 1977, 33 per cent of the total budget of the 277 organisations covered in the OECD survey came directly from governments. If account is taken of indirect government funding through foreign aid, international organisations and universities, the share of the public sector is as high as 50 per cent. By contrast, the funding from the private non-profit sector (voluntary help organisations, foundations, charities, donations, etc.), which fifteen years ago was the prime mover of AT activities in both industrialized and developing countries, accounts today for less than 19 per cent of the total budgets of AT organisations.

At the time the OECD survey was carried out, it was known that governments were beginning to show a strong interest in AT, but the magnitude of their financial contribution was quite unexpected. In fact, there are reasons to believe that most AT organisations are themselves still largely unaware of the fact that national governments have become the major sponsors of AT, and continue to view their role as that of independent pressure groups and research centres working if not against the 'establishment', at least in parallel to it, or independently of it. The figures show very clearly that this image of the AT movement no longer corresponds to reality: AT is now developing 'within the system', and not outside of it.

The more detailed picture of sources of funding given in Figure 16 shows that in addition to governments, there are three other big groups of contributors to the budgets of AT organisations throughout the world. First is the money coming from the traditional source of 'voluntary help', i.e. foundations, churches and missionary organisations, private donations and contributions by independent non-profit associations. Second is the 'self-generated' income of the AT organisations themselves. This includes consulting fees, profits from commercial or industrial activities, membership fees and subscriptions, sales of publications, royalties and income from educational and training activities. The third big source of funds is the United Nations budget.

Figure 16 **SOURCES OF FUNDING OF APPROPRIATE TECHNOLOGY ACTIVITIES IN INDUSTRIALIZED AND DEVELOPING COUNTRIES AND IN INTERNATIONAL ORGANISATIONS IN 1977**
(US $ millions)



The four other clearly identifiable sources of funds are much smaller: banks, foreign aid agencies, universities and private industry each account for around 5 per cent of the total budgets of AT organisations. What is particularly interesting to note here is the small role played by foreign aid. One of the most widely aired criticisms levelled against AT by some developing countries is that AT is promoted primarily by foreign aid agencies of the industrialized countries, and not by local innovators, and therefore represents an unwelcome intrusion into their economic and social system. The figures show that this can hardly be the case, given the small overall importance of foreign aid in the financing of AT activities (4.6 per cent world-wide, and 8.9 per cent in the developing countries).

It should be emphasized here that the data summarized in Figure 16 represent only the *direct* sources of financing of AT organisations. In practice, the patterns of funding are often rather more complex. Some AT organisations in the industrialized countries, for instance, work as consultants and advisers for a national foreign aid agency: this income is, therefore, included in the category of self-generated funds, but it comes in fact from the aid agency, which in turn is financed by the government. In the same way, part of the money received from universities by European or developing country AT organisations is, in a final analysis, governmental money, since universities are funded by national Ministries of Education. In order to be truly representative, the global picture of the funding mechanisms presented here should take into account these *indirect* sources of funds. This, unfortunately, is very difficult, if not impossible: there are as yet no standard accounting practices in the community of AT organisations, many institutions do not publish any detailed financial reports, and the budgets of several AT groups without a distinct legal personality are included in the overall budget of the institution with which they are affiliated (university, industrial firm or government ministry).

The picture presented here is, therefore, rather rough, and one should keep in mind the fact that reality is somewhat more complex. The general patterns, however, are fairly clear. Aside from the major part played by national governments in the funding of AT activities in both industrialized and developing countries, a few other important features deserve to be noted. First is the comparatively high share of self-generated income and of funding from voluntary help sources in the industrialized countries; AT organisations in the developing countries are by contrast much more dependent on government money. Second is the very small share of industry and universities in the funding of AT activities in the developing countries. And third is the rather unexpected way in which foreign aid money is spent: contrary to what is generally believed, the foreign aid money channelled by the industrialized countries into AT activities does not all go directly "

to local AT organisations in the developing countries. Around 30 per cent of it goes directly to AT organisations in the industrialized countries which are working on developing country problems, and close to 20 per cent goes to international organisations. Ultimately, most of this foreign aid money ends up in the developing countries in the form of grants, technical services or new technology, but only after this 'transit' through an international organisation or an industrialized country AT organisation.

Banks, like foreign aid agencies, clearly belong to the category of minor sources of funding of AT activities. But what is surprising is not so much their small share in overall funding as the fact that they are sufficiently important to be represented in Figure 16 (2). The emergence of banks, and notably of the big international development banks, on the AT scene is an extremely important phenomenon, in the sense that it represents the critical linkage between the innovative activities of AT organisations and the project-oriented activities of the financial system. This linkage is one of the main instruments required to make the transition from the first generation of pilot experiments in AT to the second generation of large-scale applications.

THE REGIONAL DIFFERENCES

The global picture of funding patterns presented in the preceding section can be complemented by a more detailed analysis of the six big regions of the world. This regional analysis can be carried out in two steps. The first is a comparison between the relative size of each source of funds in the six regions. These data, summarized in Figure 17, show which are the major and the minor sources of funding, and give a general idea of the overall balance between these different sources. The second step, summarized in Figure 18, is a comparison between the size of each source of funds in each region and the overall importance of each source world-wide. This indicator, presented in the form of a series of 'temperature charts', shows how each region differs from the world average and brings to light the critical importance of two or three sources of funds in each region.

The breakdown between different sources of funds given in Figure 17 suggests two rather different patterns of funding. The first, exemplified by North American AT organisations, might be described as highly diversified: the five major sources of funds account for an average of 10 to 20 per cent of total funding, and there are no

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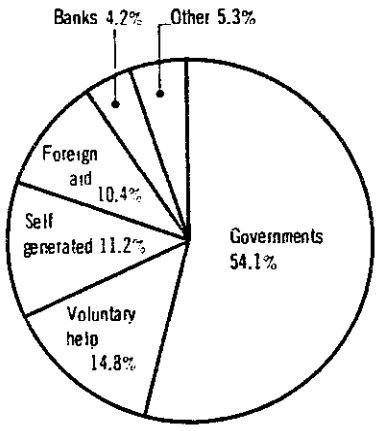
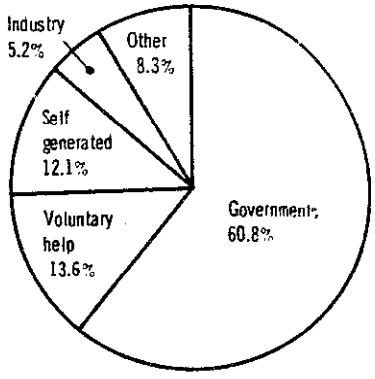
(2) The AT activities of the World Bank are included in this Figure in the budget of the United Nations, and not in that of banks, since this organisation is part of the U.N. system.

Figure 17 **SOURCES OF FUNDING OF APPROPRIATE TECHNOLOGY ACTIVITIES IN EACH MAJOR REGION IN 1977**
(Percentage breakdown)

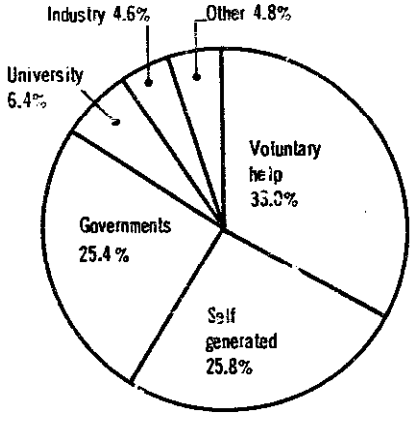
AFRICA



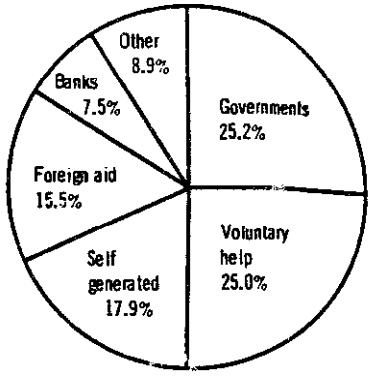
ASIA



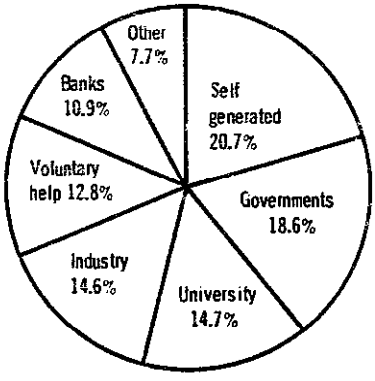
EUROPE



LATIN AMERICA



NORTH AMERICA



OECD COUNTRIES IN THE PACIFIC

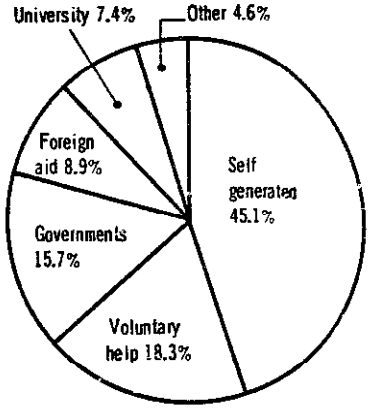
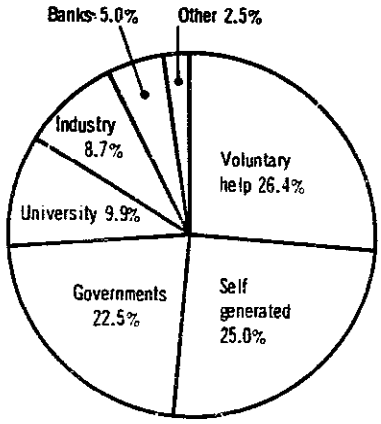
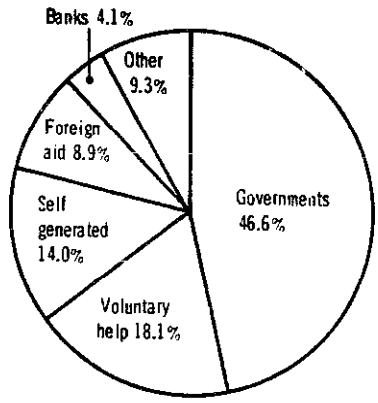


Figure 17 **(Cont'd)**

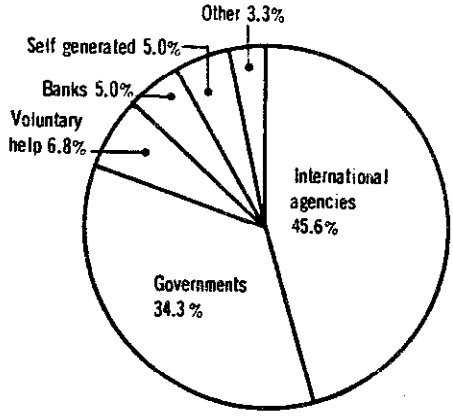
INDUSTRIALIZED COUNTRIES



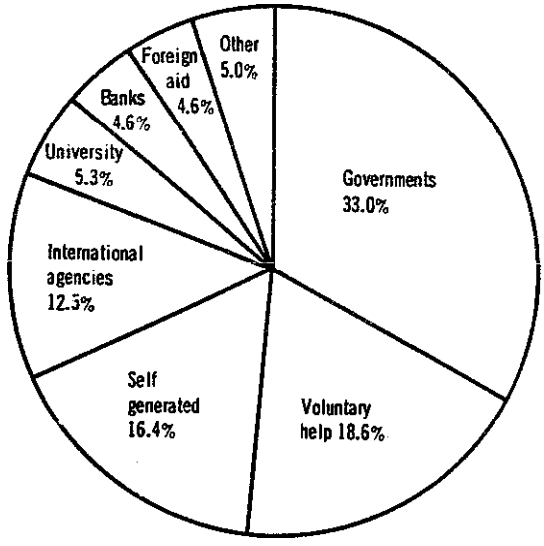
DEVELOPING COUNTRIES



INTERNATIONAL ORGANISATIONS



WORLD



clearly dominant sources of funds. The second pattern, typical of Asia and Africa, is characterised by the overwhelming importance of one particular source of funds - in this case national governments (3). Latin America and Europe fall somewhere between these two extremes of diversity and dominance, but are undoubtedly closer to the North American pattern than to the African or Asian pattern. A comparison between industrialized and developing countries (see the second part of Figure 17) confirms the existence of these two characteristic patterns of funding: in the developing countries, close to half of all AT activities are funded by the government, but in the industrialized countries, AT organisations are funded by three main sources of almost equal importance.

These figures clearly suggest that in the developing countries, the main driving force behind the AT movement is the government. This statement, however, deserves some qualifications: macro-economic data of this kind simply show the global patterns, and do not, of course, imply that all AT organisations in the developing world are financed to the tune of some 50 per cent by their government. Nor do they suggest that all AT organisations in the industrialized countries are financed by a wide range of sources of equivalent importance.

A first correction to the general impression given by the data in Figure 17 can be made by looking at the importance of each source of funding relative to the world average. This indicator, used in Figure 18, confirms the strong importance of government funding in Asia and Latin America, and the weight of self-generated funds in Europe and North America, but what is more interesting is the deviation from the world average for the other sources of funds, major or minor.

In this connection, one of the most striking features is undoubtedly the high relative share of foreign aid in Africa and Latin America. Overall, this is a small source of funds, and in these two regions it is only the fourth most important source. But compared to the world average, Latin America and Africa are the two regions where the impact of foreign aid is the greatest in relative terms. What is also interesting to note is that Latin American AT organisations receive a comparatively large amount of money from banks and from voluntary help groups, and that the contribution of universities in the developing world as a whole is uniformly below the world average. By contrast, universities are above average in all three industrialized regions.

In the industrialized world, the contrast between North America and Europe deserves to be underlined. Contrary to what is widely believed, the contribution of voluntary help groups in North America

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(3) The figures given here for the OECD countries of the Pacific (Japan, Australia and New Zealand) are not entirely representative, owing to the small number of organisations covered in the OECD survey.

Figure 18 **RELATIVE CONTRIBUTION OF THE VARIOUS SOURCES OF FUNDING TO THE BUDGET OF APPROPRIATE TECHNOLOGY CENTRES IN 1977**
(World average = 100)

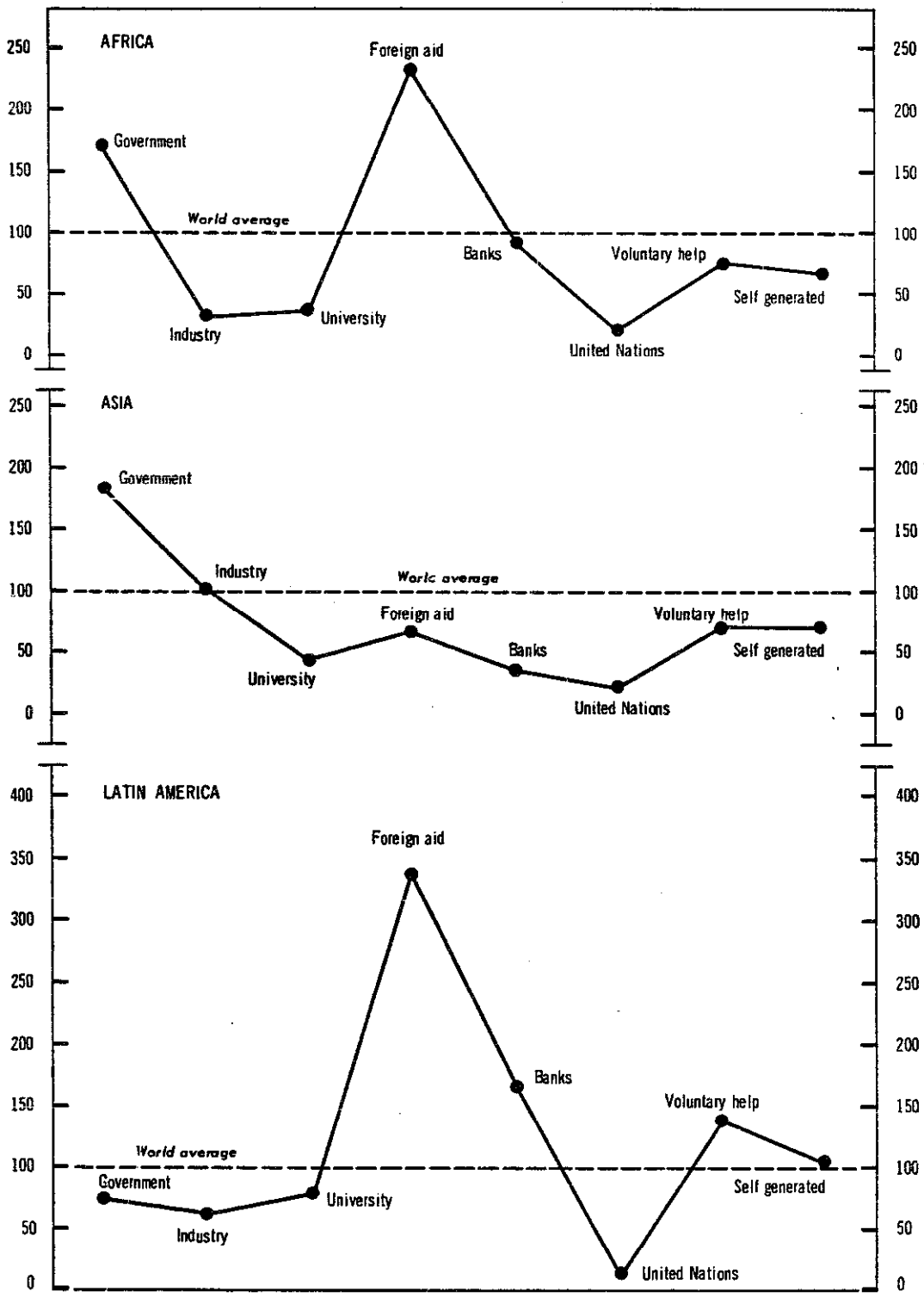
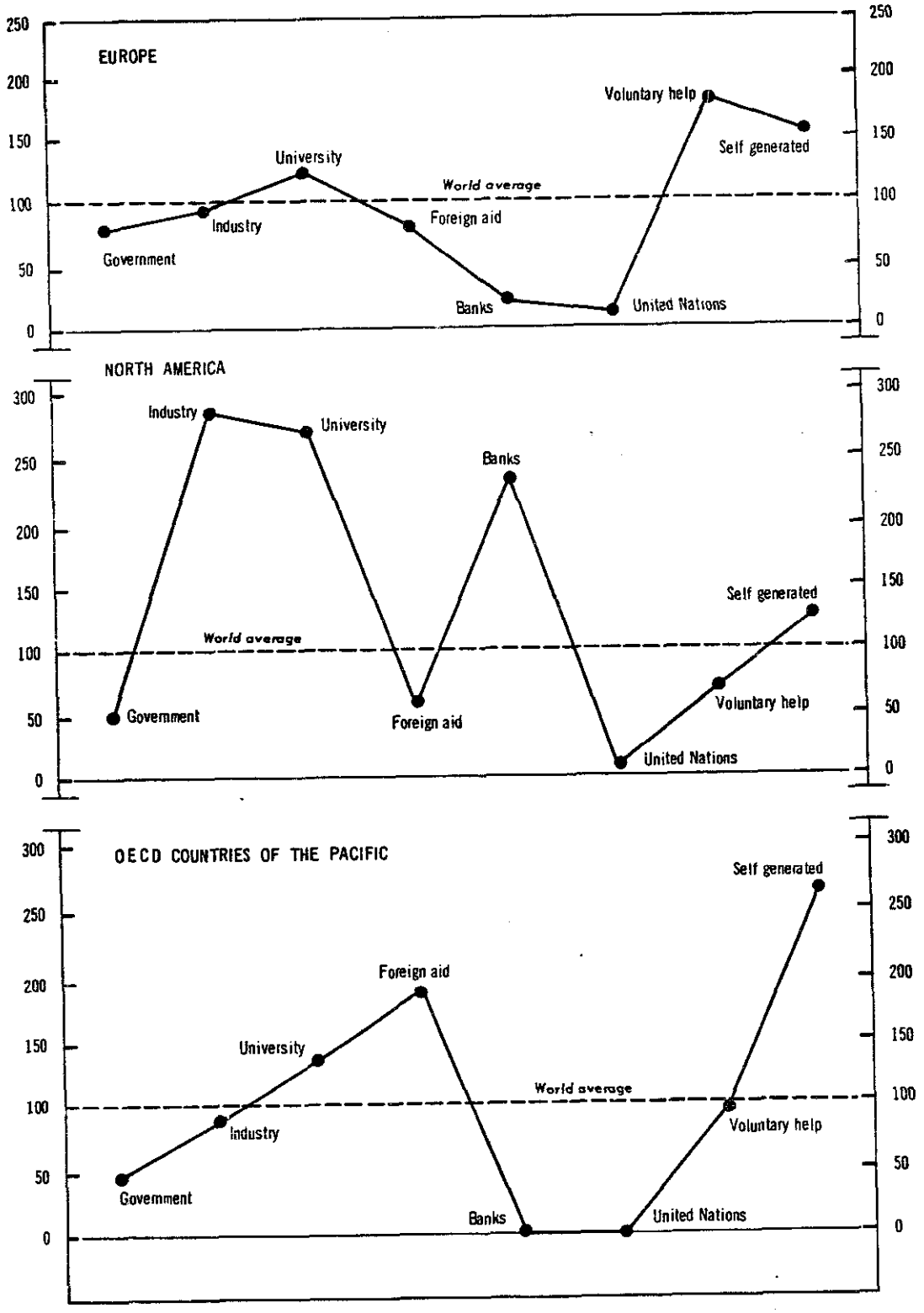


Figure 18 **(Cont'd)**



is significantly below the world average, and lower than in other regions of the world, developing or industrialized. North America is above the world average as far as self-generated funds are concerned, but this source is comparatively much less important than in Europe - contrary to what could have been expected. As for the contributions of industry and universities, they are very close to the world average in Europe, but outstandingly important in North America.

This picture of the relative importance of the various sources of funding does not, of course, imply any value judgement. The fact that government funding, for instance, is so important in Asia is not in itself a positive or negative factor, but simply a reflection of the historical evolution of AT organisations in that part of the world. These indicators do, however, indirectly suggest which are the sources that could perhaps be tapped more effectively in the future: industry could undoubtedly play a more important role in the development of AT in Latin America for instance, and the same can probably be said of banks in Europe, and voluntary help groups in North America.

THE ROLE OF GOVERNMENTS AND FOREIGN AID

Two of the funding sources of the AT movement - governments and foreign aid - deserve to be scrutinised more closely, the first because of its effective importance, and the second because of its assumed importance. As noted earlier, governments are by far the largest single source of funds for AT activities throughout the world, and make a very important indirect contribution through their support to universities, their foreign aid programmes and their funding of United Nations agencies. The figures, however, tend to overstate the role of governments, and it is well to note that there is no simple linear relationship between the size of the governmental contribution to the budgets of AT organisations and the effective influence of governments on these organisations. Governments tend to fund the fairly large AT organisations, and the great majority of the individual AT organisations receive only a small share of their total budget from the public sector.

This can perhaps best be understood by looking at the proportion of the budgets of AT organisations financed by the government in the different parts of the world, as shown in Figure 19. Of the 277 organisations figuring in the Directory, 155 (56 per cent) receive up to 10 per cent of their budget from national governments, and only 44 are financed to the tune of more than 80 per cent by this one source. In other terms, while very many organisations receive some money from the public sector, only a very small number are totally dependent on government funds.

Figure 19

THE SHARE OF GOVERNMENTS IN THE BUDGETS OF APPROPRIATE TECHNOLOGY ORGANISATIONS

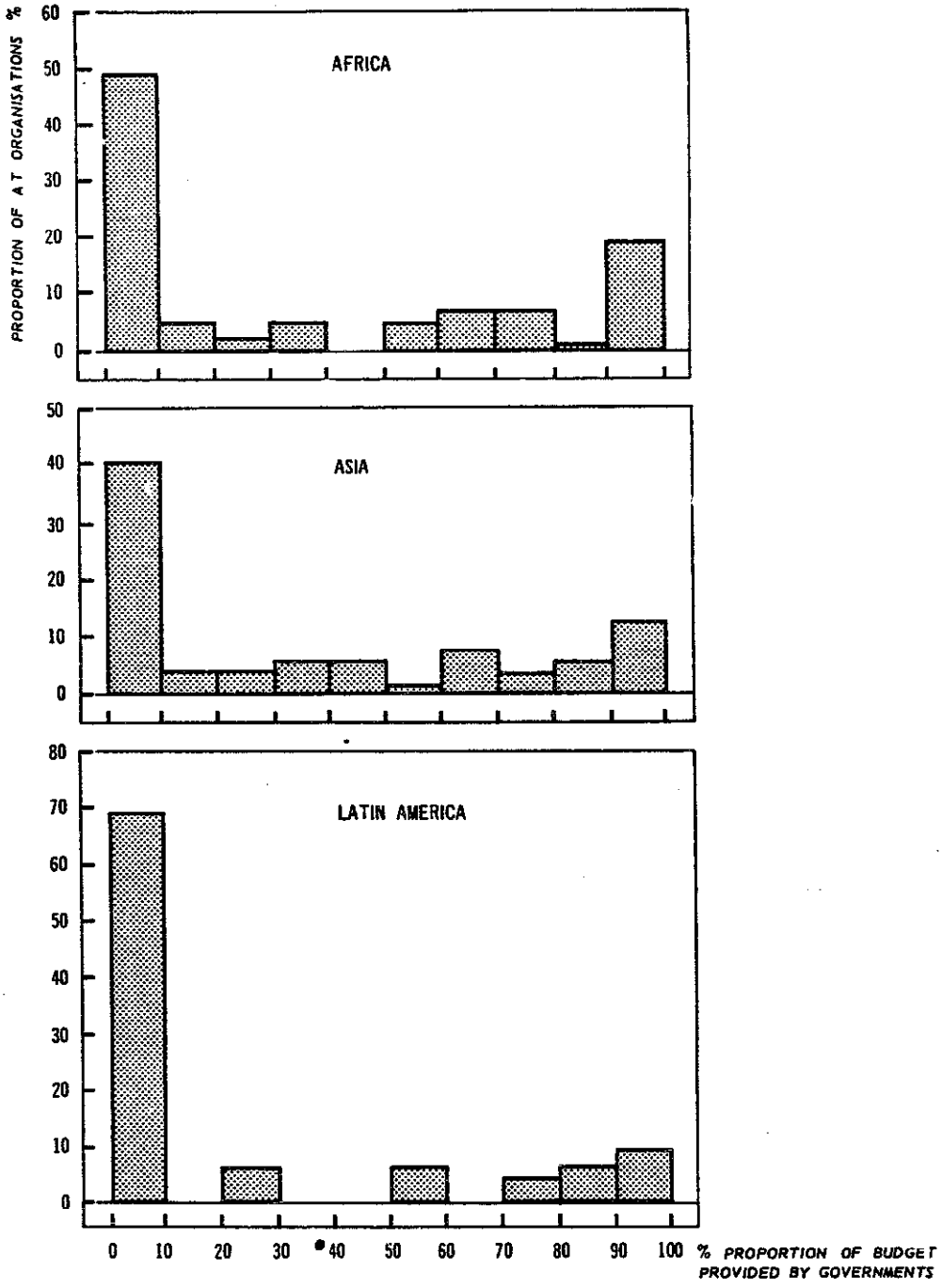
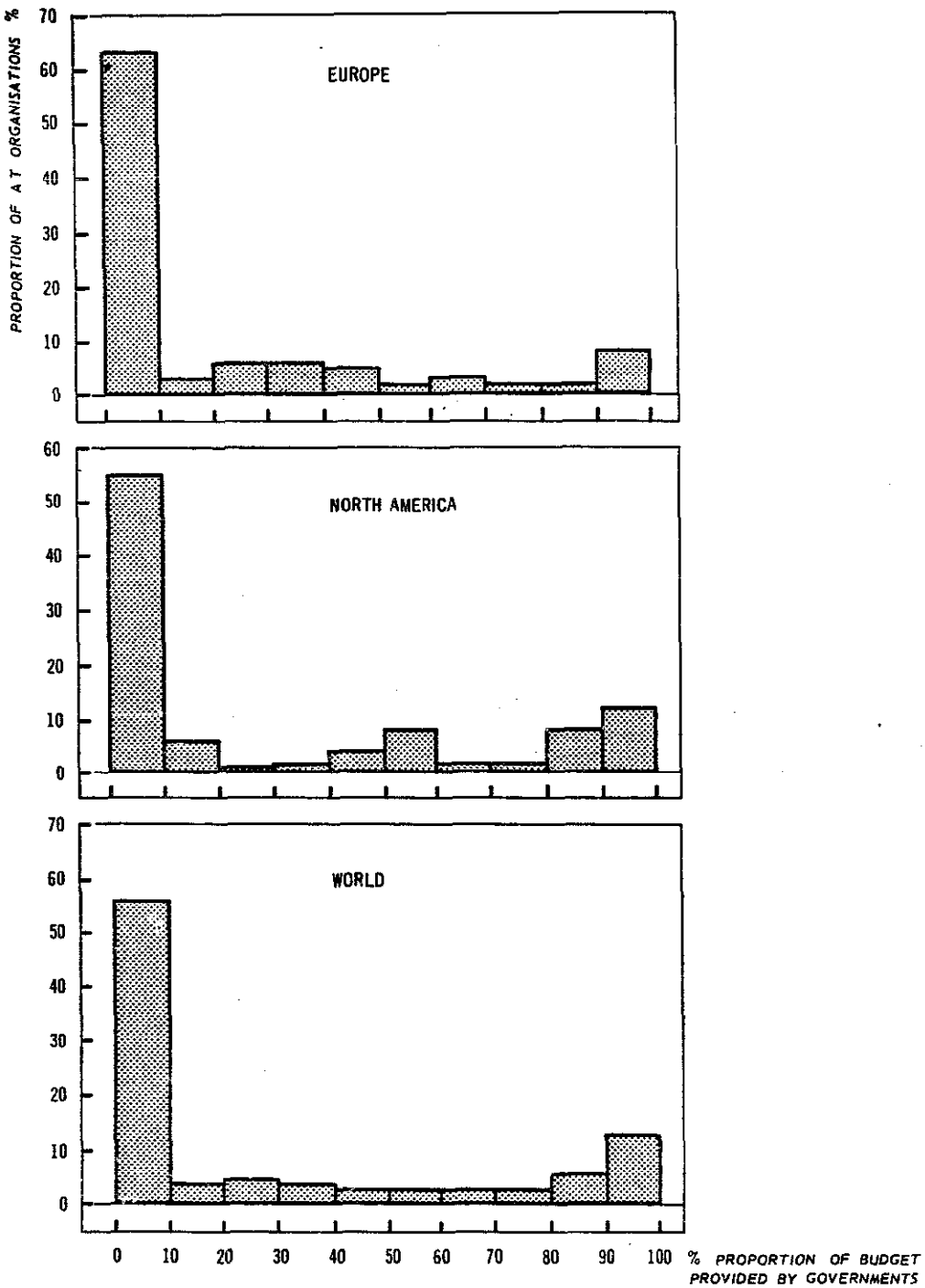


Figure 19 (Cont'd)



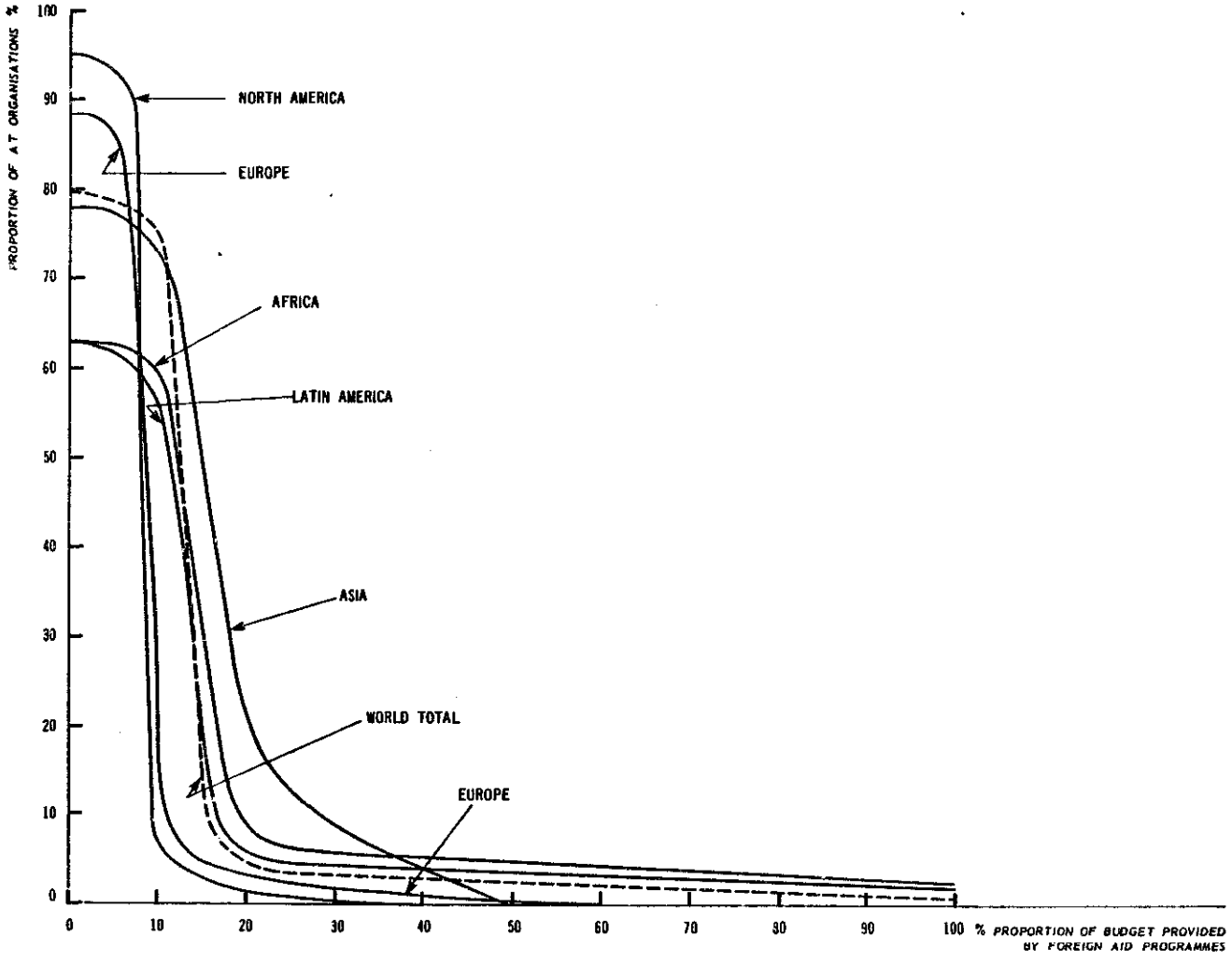
The distribution is strikingly similar in all parts of the world: the largest group, by far, is composed of AT organisations which receive up to 10 per cent of their budget from governmental sources, and in each region of the world, the second largest group is the one located at the other extreme of the distribution, and which is comprised of organisations which receive more than 90 per cent of their funds from that source. This second group is much smaller than the first, but its overall weight is considerable since it includes a high proportion of fairly large AT organisations.

The influence of governments on the operations of AT organisations is a rather subtle phenomenon which does not lend itself to quantification. One can nevertheless try to approach the problem in an indirect way, and look at the number of organisations which receive more than 30 per cent of their funds from the government. This figure of 30 per cent is no doubt somewhat arbitrary, but probably represents a fairly good quantitative approximation of the level at which government funding becomes a decisive element in the policy of an organisation. World-wide, 35 per cent of the AT organisations receive more than 30 per cent of their funding from this source. North America is the region which comes closest to this average (38 per cent of the AT organisations receive more than 30 per cent of their funding from the government), Africa and Asia are well above it (44 and 43 per cent), and Europe and Latin America are significantly below it (28 and 25 per cent). These figures thus indirectly confirm the rather heavy weight of governments in Asia and Africa, and their much more limited influence in Latin America and Europe.

The second source of funding which deserves a close analysis is foreign aid. Conventional wisdom has always assumed that foreign aid programmes were one of the main driving forces in the promotion of AT in the developing countries, but the figures presented in the preceding sections suggest that this is very unlikely, given the small part played by foreign aid in the funding of AT organisations. A more precise picture of the importance of foreign aid is provided in Figure 20, which shows the share of the budgets of AT organisations financed by foreign aid in different parts of the world. On a world-wide basis, 80 per cent of the 277 organisations listed in the Directory receive less than 10 per cent of their budget from this source, and only 5 per cent of them receive 80 per cent or more of their funds from foreign aid. The regional differences are not very significant, and fit into the expected patterns: the role of foreign aid is smallest in North America and Europe, and larger in Asia and Africa than in Latin America. There are, of course, a few exceptions to this general pattern: AT organisations in countries such as Rwanda and Botswana are significantly more dependent on the funding from foreign aid programmes than organisations in the rest of Africa, and a very

Figure 20

THE SHARE OF FOREIGN AID IN THE BUDGETS OF APPROPRIATE TECHNOLOGY ORGANISATIONS



small number of organisations in the industrialized countries (e.g. the Minimum Cost Housing Group in Canada or the Association for the Development of African Architecture and Urbanism in Switzerland) are financed primarily by a national aid agency. As a whole, however, the role of foreign aid is quantitatively marginal. This is not to say that it is qualitatively unimportant: witness, for instance, the seminal role played by some of the international agriculture research centres, and notably the International Rice Research Institute, in the large-scale diffusion of highly appropriate types of agricultural machinery.

If foreign aid makes such a small contribution to the budgets of AT organisations, how has it come to assume such an importance in the mind of critics and proponents of AT? One of the reasons, which is difficult to document, is that foreign aid may indeed have been much more important ten or fifteen years ago than it is today, and that conventional wisdom has yet to adapt to changing realities. This, however, may be no more than an idle speculation, and a more likely explanation should be sought in the philosophical basis and intellectual origins of the AT movement. In the industrialized countries, the concept of appropriate, or rather intermediate technology was invented, or at least popularised, by E.F. Schumacher in his best selling book *Small is Beautiful*. Most of Schumacher's demonstration of the need for more appropriate types of technology is based on the experiences of developing countries and his far-reaching criticisms of the inappropriateness of the technologies transferred to these countries in the framework of foreign aid programmes. By extension, the promotion of AT came to be seen as a foreign aid problem, and the fact that a growing number of aid agencies were beginning to get involved in the promotion of AT in the early 1970's gave some credibility to the view that these agencies were indeed the main supporters of AT organisations in the developing countries.

DIVERSITY AND INDEPENDENCE IN THE SOURCES OF FUNDING

The global and regional breakdown between the various sources of funding of AT organisations shows which are the main funding patterns throughout the world, but tells us little about the ways in which individual organisations are financed. The picture presented in the preceding sections should, therefore, be completed, and this is done in Table 11 with the help of two sets of indicators. The first of these tries to measure the degree of concentration and diversity in the sources of funding: what is the number of AT organisations which rely exclusively on a single source of funds? How numerous are those with a highly diversified system of financial support? The second

Table 11

DIVERSITY AND INDEPENDENCE IN THE FUNDING OF APPROPRIATE TECHNOLOGY ORGANISATIONS

	Europe	North America	Asia	Africa	Latin America
Only one source of funding	29%	25%	29%	37%	21%
Several sources with one dominant source	9%	12%	11%	14%	10%
Highly diversified sources of funding	62%	63%	60%	49%	69%
Total	100%	100%	100%	100%	100%
No 'establishment' type of funding	33%	25%	7%	20%	23%
Only voluntary help	7%	2%	4%	2%	8%
Only self-generated income	16%	7%	0%	4%	2%
Number of organisations covered	58	60	45	49	39

Note: See Appendix 1 for details on methodology and definitions.

set of indicators is a rather tentative evaluation of the degree of political and financial independence of AT organisations. Independence can be measured in three ways: by the number of AT organisations which, deliberately or not, receive no money from what might be called the 'establishment' sources (i.e. governments, banks, international organisations, universities, foreign aid programmes and industry); by the number of organisations which are financed exclusively from voluntary help sources; and finally by the number of organisations which rely entirely on self-generated funds.

The great majority (61 per cent) of the 251 AT organisations covered here are characterised by a highly diversified funding system (4), and the relative size of this group is strikingly similar in all parts of the world, with the exception of Africa. This pattern of funding, which is generally the result of necessity rather than deliberate choice, is a reflection of one of the most difficult and time-consuming problems facing AT organisations, namely the need to secure an adequate and stable source of income. Fund raising has become one of the most important, if largely unrecognized, activities of AT organisations, and there are strong indications that this problem of financing does not get lighter when an AT organisation becomes larger and better known.

The number of AT organisations which receive the totality of their income from a single source is very much the same throughout the world, with the same exception of Africa. The rather large share

(4) This table leaves out the 8 AT organisations of the OECD Pacific region as well as 18 organisations in other regions which did not provide any information on the breakdown between their various sources of funding.

of African AT organisations falling in this group is due primarily to the high number of organisations financed by governments, and this is yet another sign of the major role played by governments in the promotion of AT in that part of the world. A closer look at the funding patterns of organisations belonging to the intermediate group - those with several sources of income, among which one is clearly predominant - shows that a lot of this subsidiary funding is of a symbolic nature: money is given to an AT organisation as an expression of interest in its work, and contributions of this type are seldom of a long-term nature.

Measuring the degree of financial and political independence of AT organisations is at best a risky exercise, but the figures presented in the bottom half of Table 11 are nevertheless rather revealing. One interesting feature emerging here is the surprisingly high number of European AT organisations which do not rely on any 'establishment' source of funding, and the very low number of such organisations in Asia. The figure for Europe seems to suggest that in that part of the world, a very substantial share of AT activities are carried out by organisations which view themselves as 'anti-establishment' forces working against the system'.

The AT movement in Europe is also notable for the rather high proportion of organisations which are entirely self-financed, but the figures for the rest of the world clearly indicate that AT activities are still very far from becoming a self-sustaining business. The role of voluntary help is a rather interesting case: a very large number of AT organisations receive some funding from this source - witness the role of the Gandhian movement in India or the Sarvodaya movement in Sri Lanka - but this is generally a complementary source of income, and it is only in Europe and Latin America that one can find more than a couple of organisations relying exclusively on this type of funding.

If one leaves aside the fairly high number of AT organisations which are financed by non-establishment sources (23 per cent worldwide), the figures given in the second half of Table 11 seem to indicate that for the time being at least, voluntary help and self-generated income will remain no more than a rather marginal source of support for AT activities. However, it is well to note that these two sources can be critically important at certain stages in the development of an individual organisation: voluntary help is known to have been at the origin of a number of new AT centres, while commercial and industrial activities (which account for the bulk of self-generated income) can be critically important once an organisation has gained a certain amount of practical experience and begun to find its niche in the world of AT (5).

(5) See Chapter 9, "The typology of appropriate technology organisations" and its presentation of the typical changes in the focus of activities of such organisations as they become more mature.

THE BUDGET DISTRIBUTION OF APPROPRIATE TECHNOLOGY ORGANISATIONS

Most AT organisations are rather small: the median budget of such organisations throughout the world is of the order of $ 250,000, and only 20 of the 277 institutions listed in the OECD Directory have a total budget above $ 5 million. The distribution of AT organisations by size of budget given in Figure 21 shows a number of significant differences between industrialized and developing countries. The first is undoubtedly the heavy concentration of the very large AT organisations in the industrialized world: these are for the most part international agencies of the United Nations system. Although they are physically located in the industrialized countries, most of their activities in AT are carried out in the developing countries, or related to developing country problems. This is the case, for instance, of the World Bank's work on labour-intensive construction methods or low-cost sanitation systems, of the World Health Organisation's programmes on AT for health or of the United Nations Development Programme's projects aimed at the promotion of small-scale industries.

A second feature, which is not totally unexpected, is the much larger number of small-budget AT organisations in the developing world. This is to a large extent a reflection of the much lower salary levels prevailing in that part of the world, and not of a smaller average number of employees per organisation (6).

The budget distribution shown in Figure 21 follows a typical bell-shaped curve, with a small number of organisations at each extreme, and the bulk of them close to the centre. Here again, this is a predictable phenomenon which, if anything, confirms that the activities of AT organisations are not fundamentally different, sociologically speaking, from any other type of human activity.

The figures given in Table 12 on the average budget per organisation and the average expenditure per staff member confirm these basic differences between industrialized and developing countries. What is, however, somewhat unexpected is the very low expenditure per staff member in the OECD countries of the Pacific, and its rather high level in Latin America. But probably the most instructive set of figures is the ratio between the average budgets of AT organisations in a given region and the average per capita income in that region. This ratio is an indirect and rather approximative way of measuring the real economic cost of the work carried out by local AT organisations.

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(6) See Figure 22 in Chapter 6.

Figure 21 **BUDGET DISTRIBUTION OF APPROPRIATE TECHNOLOGY CENTRES IN 1977**

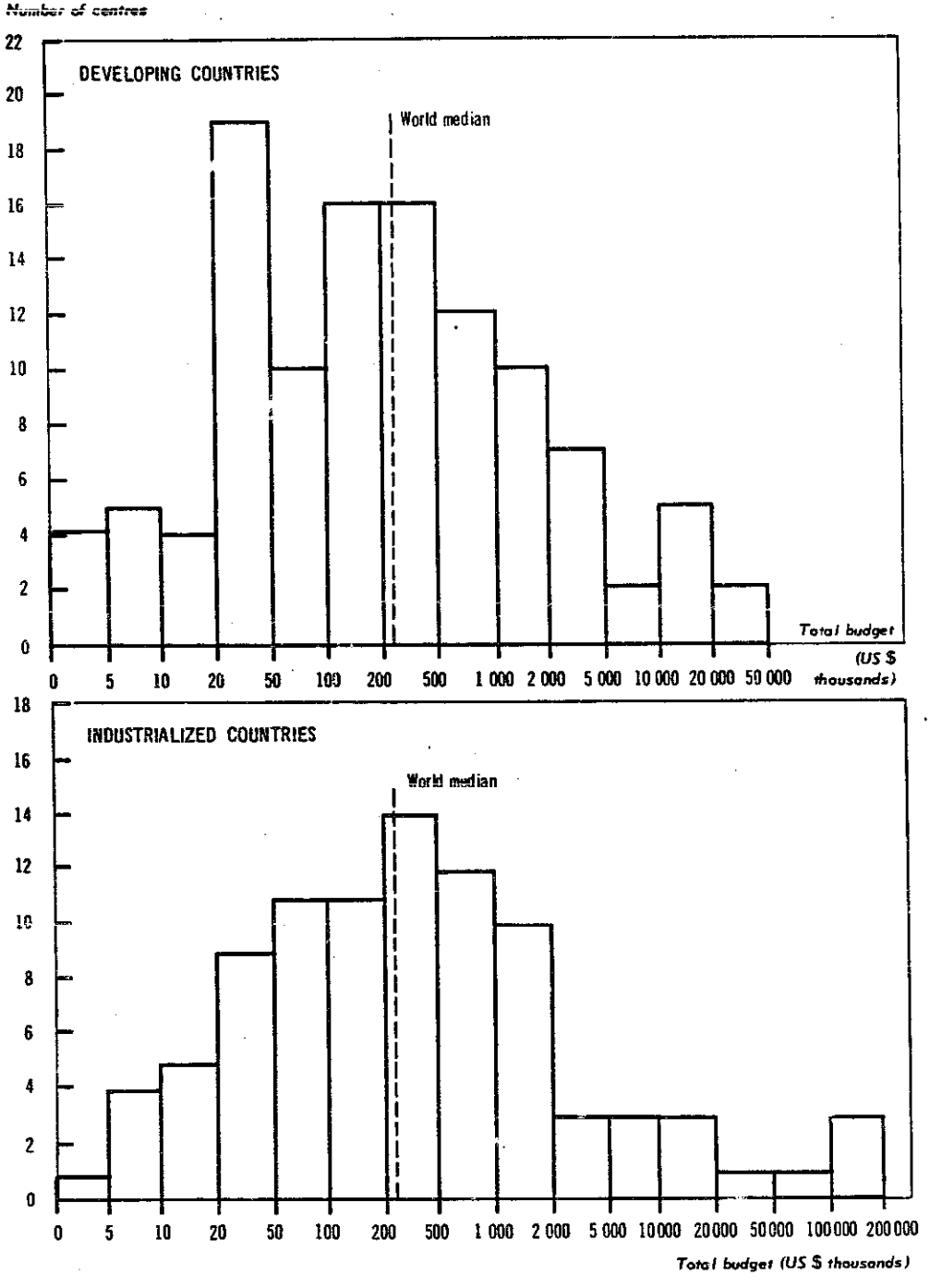


Table 12

SIZE OF BUDGETS, EXPENDITURES PER STAFF MEMBER AND COST OF STAFF RELATIVE TO PER CAPITA GROSS NATIONAL PRODUCT

	Total budgets ($ million)	Average budget per organisation ($ million)	Average budget per staff member ($)	ratio between budget per staff & per capita GNP
Africa	15.6	0.35	8,710	18
Asia	36.0	0.70	7,420	37
Latin America	29.3	0.89	15,780	15
Europe	78.2	1.20	19,290	3
North America	56.6	0.98	23,490	3
OECD Pacific	0.9	0.11	9,000	2
Developing countries	80.9	0.63	9,520	24
Industrialised countries	135.7	1.04	20,670	3
International agencies	78.1	4.59	-	-
World	294.7	1.06	17,660	8

Note: See Appendix 1 for details on methodology.

Most of the income received by these organisations is provided by local public or private sources (e.g. by governments which raise this money through taxes, or by voluntary groups which raise it from their individual members). In developing countries, AT activities are very much a part of the modern sector, as can be seen from the predominantly urban location of AT groups, the high educational level of their staff members or the size of their salaries. These activities are financed, directly or indirectly, by the economic surplus generated by the population as a whole, i.e. in the final analysis by farmers, workers and other people with a low level of income. This is far from being an unusual phenomenon, and the same observation could be made for a number of other activities, and notably for education or research and development. But this does suggest that AT activities carried out in the developing countries have a much higher social cost (or opportunity cost) than implied by the figures on the budget expenditure per staff member. In any event, it is well to remember that the relatively high social cost of such an activity tells us nothing about its social value, and there are good reasons to believe that the promotion of AT, even if it is costly, probably also has a very high social value.

Chapter 6

THE STAFFING OF APPROPRIATE TECHNOLOGY ORGANISATIONS

Most AT organisations are fairly small, work in difficult economic circumstances, and are widely viewed in the public as the representatives of a rather marginal counter-culture which shuns professionalism, high salaries and the trappings of the consumer society. This image, which some AT groups have themselves deliberately sought to promote, is not entirely without foundation, but a closer look at the AT movement as a whole suggests that reality is somewhat different. Aside from a few characteristically 'marginal' groups, most AT organisations are notable for the high proportion of qualified professionals on their staff, their comparatively large expenditures per staff member, and their close links with the 'establishment'. Furthermore, even the marginal groups are not as marginal as they appear to be. One of the most striking examples of this is probably that of The Farm, a hippie community of 1,200 people in Tennessee, which has developed a number of very low-cost technologies in the fields of health, nutrition and housing. Hippies are not normally associated with the establishment, yet several of The Farm's members have worked as consultants on World Bank projects in South Asia and Central America!

The analysis of the staffing of AT organisations presented in this chapter will try to shed some light on the role of professionals in the AT movement and answer a few basic questions about the cost of manpower in AT activities. Do professionals cost much more than non-professionals? Do AT organisations tend to have an inordinately large proportion of supporting staff? Is the staff structure of AT organisations in industrialized countries very different from that of organisations in developing countries? Do AT organisations in the developing countries tend to be directed by foreign experts, or are they on the contrary the expression of a country's indigenous innovative efforts?

THE NUMBER OF STAFF MEMBERS

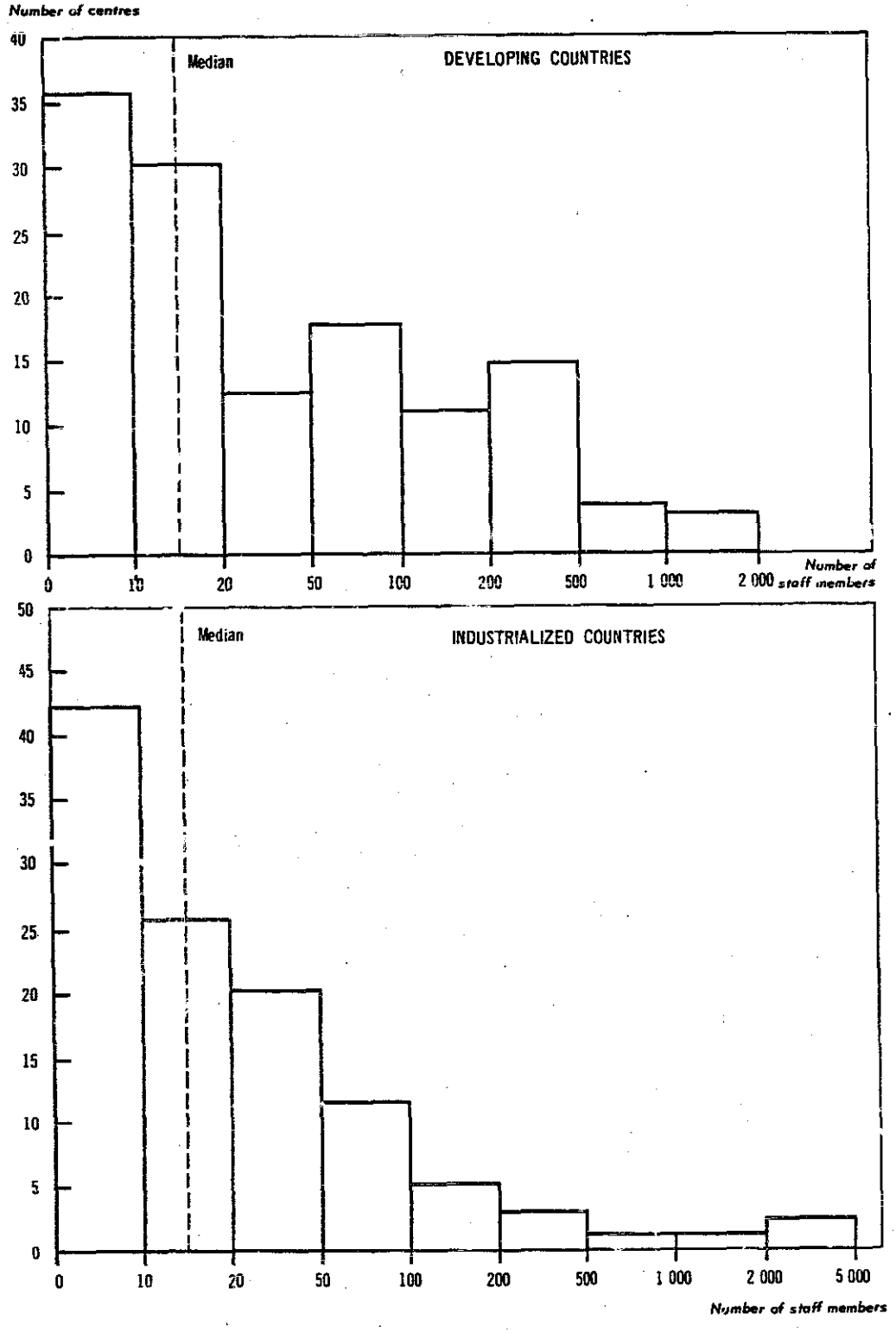
One of the many approximations of the average size of AT organisations is the number of staff members. This is a somewhat more reliable indicator than the average budget per organisation, since it evens out the major differences between industrialized and developing countries caused by the much higher salary levels prevailing in the first group of countries.

The distribution of AT organisations by number of staff members shown in Figure 22 shows that there are no significant differences between industrialized and developing countries: in both groups, the median number of staff members in AT organisations is 15, and approximately half the organisations in each group employ less than 20 people. Contrary to what conventional wisdom would suggest, the industrialized countries have a somewhat higher relative number of very small organisations (i.e. those employing ten people or less), while the developing nations have a surprisingly high number of comparatively large organisations (total number of staff between 50 and 500).

This median number of 15 staff members, while statistically informative, is not an indication of the ideal size of a typical AT organisation. It can nevertheless be related with the number of fields of activity of AT organisations. Figure 7 in Chapter 3 showed that the median number of fields of activity of the 277 organisations covered in the Directory amounted to 8. This means - and here again this is a very rough indicator - that the 'average' AT organisation has approximately two people working on each subject. This is not enormous, but two man-years of highly qualified professional staff spent on any particular technical problem is far from marginal, and can in many cases make a very significant contribution. If anything, the comparison between these two figures - median number of staff members and median number of fields of activity - suggests that AT organisations tend to operate rather like small innovative industrial firms, and are not as highly dispersed as the average number of fields of activity would suggest, if considered alone.

Measuring the salary levels in AT organisations is much more difficult than counting the total number of staff members, and in many cases is rather meaningless, not only because of the relatively high proportion of non-salaried voluntary workers in many of the smaller organisations, but also because of the major differences from one country to another in taxation rates and social security charges. What also makes for additional difficulties is the fact that in many of the organisations which are not small specialised AT centres, staff members often devote only part of their time to AT activities.

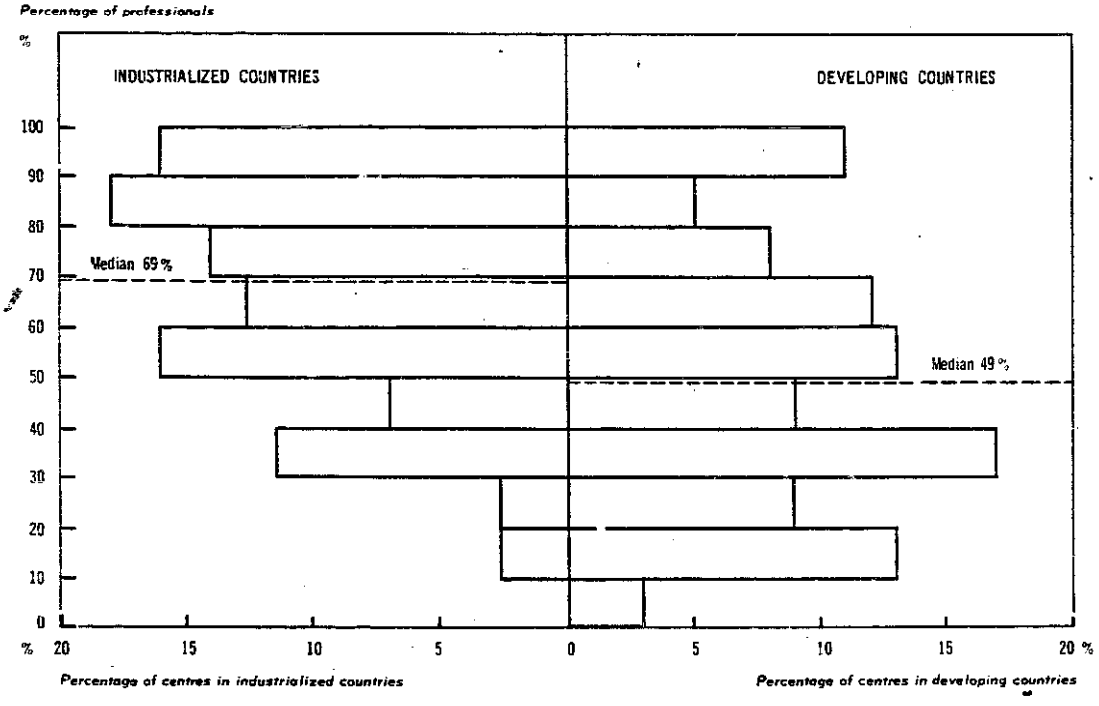
Figure 22 **NUMBER OF STAFF MEMBERS IN APPROPRIATE TECHNOLOGY CENTRES IN 1977**



The other indicator one can use to measure the cost or personnel is the average budget per staff member. This figure, obtained by dividing the total budget by the number of staff, is, of course, higher than the average salary per worker, since it includes overhead costs, rental of buildings, purchases of equipment, travel and communications. What is interesting here is not the absolute level of such figures, but their relative size for different organisations in different countries.

The data on average budget per staff member in AT organisations summarized in Figure 23 show, as expected, a much higher expenditure in the industrialized countries: the median budget per staff member is more than three times higher than in the developing countries. The two distributions are, however, somewhat different at first sight, but this is due in part to the use of a logarithmic scale on the vertical axis of the figure. What may appear somewhat surprising is the relatively high percentage (21 per cent) of AT organisations in the developing countries with a very low budget per staff member (under $ 2,000). From a closer look at the organisations falling into this group, it appears clearly that this low budget is due to the fact that part of the salaries of the staff is carried on another organisation's budget (e.g. a government department or a university) or else to the voluntary nature of the work undertaken by staff members. One should, therefore, not be led to believe that some organisations are paying famine-level salaries to their staff!

Figure 23 **SHARE OF PROFESSIONALS IN TOTAL STAFF OF APPROPRIATE TECHNOLOGY CENTRES IN 1977**



THE DEGREE OF PROFESSIONALISATION

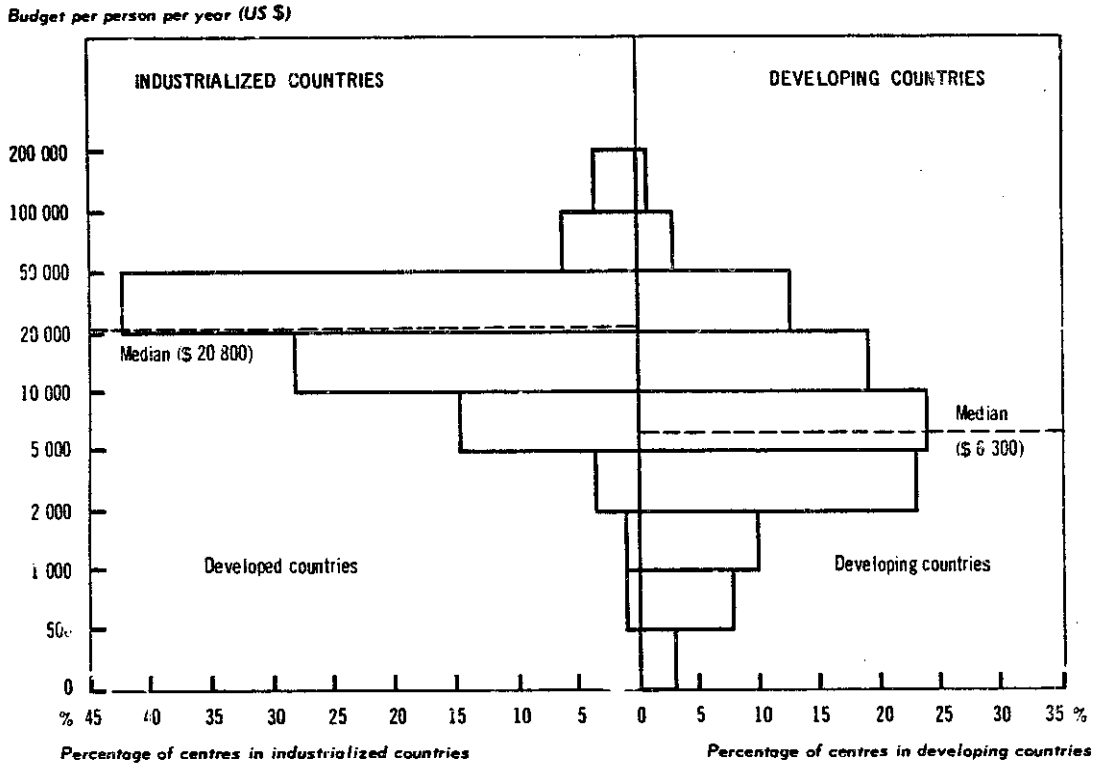
An important indicator of the effectiveness of an AT organisation is the total number of professionals on its staff, and more specifically the balance between professionals and non-professionals. The definition of what constitutes a professional is somewhat arbitrary, and the line between the two categories is not always very clear. The professional category obviously includes all people with university degrees, but a number of other people also fall into it: this is the case, for instance, of an AT organisation's managerial staff (which do not necessarily have academic qualifications) and some of its senior-level technicians.

If the statistical definitions of these categories vary from country to country, it is well to note that each organisation's perception of who is a professional and who is not is also very different. In developing countries such as India, which have a very high number of university graduates, one finds many people with degrees working in positions which are obviously non-professional, while in countries with very few academic graduates (e.g. in parts of Black Africa), AT organisations consider as professionals some people who elsewhere would not normally be classified under such a heading. Because of the difficulty in drawing the line between these two categories, the OECD questionnaire deliberately left the definition open, and each organisation was simply asked to provide a breakdown between professional and non-professional staff without any further explanations or definitions.

This problem of definition may account in part for the apparent inconclusiveness of the global data summarized in Figure 24. If the median number of professionals clearly appears to be higher in the industrialized country AT organisations, the overall distribution in each group of countries is not particularly instructive, except for the fact that the industrialized countries have a much higher proportion of AT organisations with a very large number of professionals.

However, if we look at individual countries and the relationship between number of professionals and average expenditure per staff member, the patterns become much clearer and bring to light a number of fundamental structural differences within the AT movement. Figure 25 shows for some 23 countries the average number of professionals in local AT organisations and the average budget per staff member in these organisations. These 23 countries taken together account for some 68 per cent of 277 organisations figuring in the Directory, and the picture presented here can, therefore, be considered as fairly representative of the AT movement as a whole.

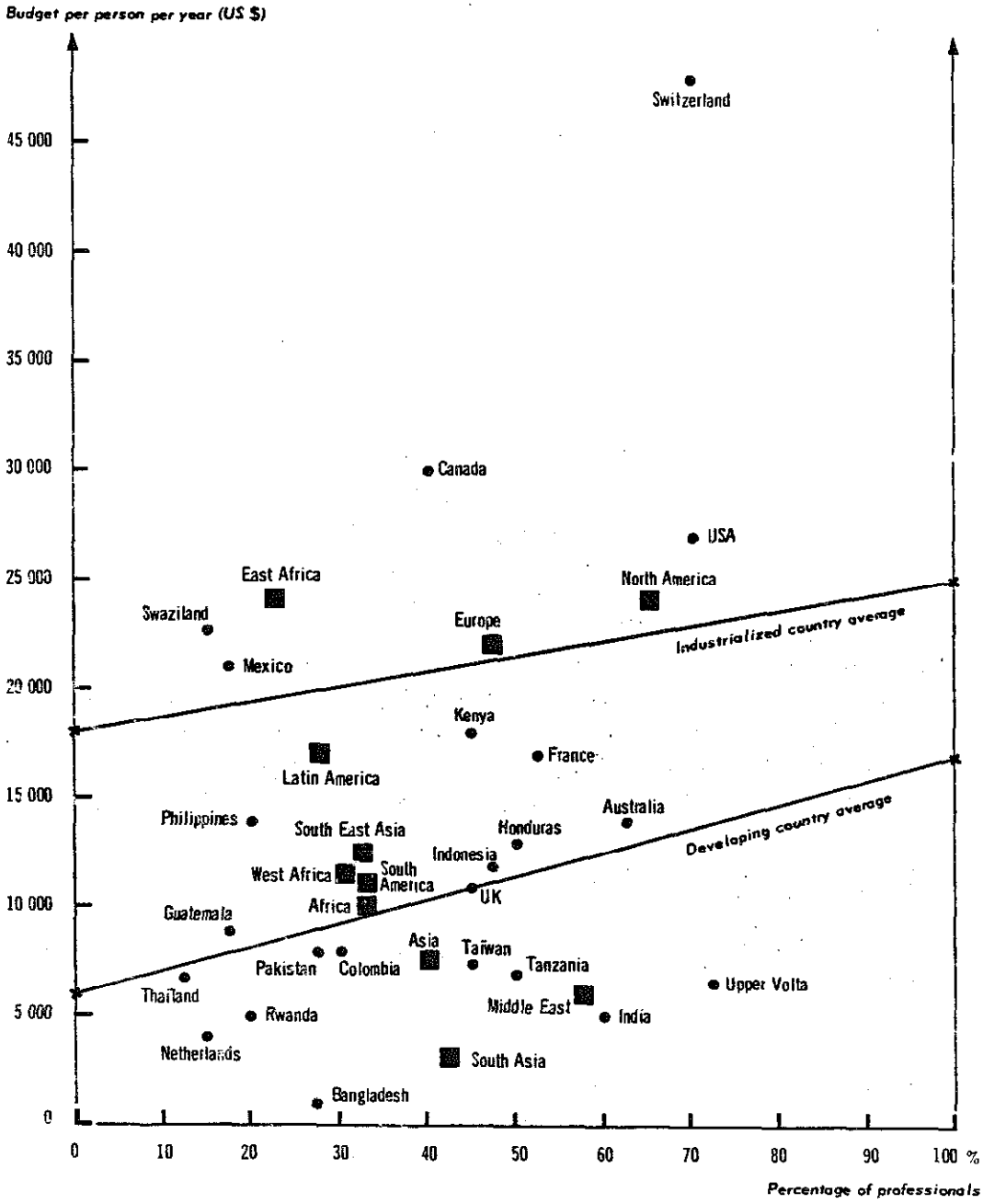
Figure 24 **AVERAGE BUDGET PER PERSON IN 1977**



Normally, one could have expected most countries to fall fairly close to a diagonal line of correlation between the percentage of professionals and the average expenditure per staff member. In other terms, a higher proportion of professionals should correspond to a higher expenditure per staff member, since professionals are generally more costly than non-professionals. This figure shows that the pattern is much more complex, and at first sight rather puzzling. Why, for instance, should the AT movement in the Netherlands be apparently so similar to the movement in Rwanda or Thailand? Why should two countries with a rather similar economic structure like Swaziland and Upper Volta be located so far apart from one another in this figure? Is it a mere coincidence that the United Kingdom should fall exactly on the average line of the developing countries?

A comparison between the percentage of professionals and the budget per staff member shows that the line of correlation has almost the same slope in industrialized and developing countries. The correlation, however, is not a simple one-to-one relationship: when the percentage of professionals doubles, the average budget per staff member increases by only 20 per cent. This indirectly suggests that professionals are not particularly costly or, to put things differently, that a very high share of professionals is not an inordinately

Figure 25 **AVERAGE BUDGET PER PERSON PER YEAR AND SHARE OF PROFESSIONALS IN TOTAL STAFF IN SELECTED COUNTRIES AND GEOGRAPHIC AREAS IN 1977**



heavy burden on the budget of a typical AT organisation. As could be expected, the average line of correlation between number of professionals and budgets per staff member in the developing countries is located significantly lower than in the industrialized countries.

In the developing world, the most striking contrast is undoubtedly that between East Africa and South Asia (i.e. the Indian subcontinent): East African AT organisations are characterized by the small share of their professionals and a very high budget per staff member, while the South Asian AT organisations are notable for the opposite features. These differences are due in large part to the fact that in East Africa, a high proportion of AT organisations employ a comparatively large number of expensive expatriate staff; in South Asia, by contrast, virtually all AT organisations are staffed by local people, and the salaries paid to professionals and non-professionals alike are low (1).

The same sort of contrast can be found in the case of two African countries mentioned earlier, namely Upper Volta and Swaziland: the two AT organisations in Upper Volta are staffed exclusively by local people or by citizens of neighbouring nations, while the two organisations in Swaziland have a fairly high proportion of expatriate staff, as well as a large proportion of non-professionals working in production-oriented activities.

In the industrialized world, there are a number of equally striking contrasts: the AT organisations based in Switzerland - many of which are international agencies - have an exceptionally high budget per staff member as well as a very high share of professionals, while those in the Netherlands have exactly the opposite features. The high budget per staff member in Switzerland can be explained in large part by the high level of salaries in that country, as well as by the strength of the Swiss franc relative to other currencies, and notably to the dollar. However, the Dutch guilder is also a strong currency, and salaries in the Netherlands are high by international standards, yet the AT organisations in that country have an exceptionally low budget per staff member. This indirectly suggests that the average salary levels in a country, or the international value of a currency, are not the only determinants in the location of a country's AT organisations in Figure 25.

What probably plays a much greater part is the structure and philosophy of the AT movement in each country. In Switzerland, a large share of AT activities is carried out by international organisations which are very much a part of the establishment. In the

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(1) In this figure, all international organisations are included among the AT organisations of the country in which they have their headquarters.

Netherlands, by contrast, they are heavily dominated by small voluntary groups linked with universities. A large proportion of the members of these groups work only part time on AT, and do not receive any salaries for what is in effect a form of charitable work. In this perspective, the Dutch AT movement is probably the most 'marginal' of those in the industrialized countries. Marginality has, of course, nothing to do with efficiency or originality: it is essentially a form of financial, institutional and political independence vis-à-vis the government, large industrial firms and foreign aid agencies.

THE COST OF PROFESSIONALS AND NON-PROFESSIONALS

Measuring the cost of professional and non-professional staff, or more specifically the average budgetary expenditure for each of these two categories, raises a few conceptual and statistical difficulties. First is the major difference in the size and nature of AT organisations: the large international organisations, for instance, have a large number of professional and non-professional staff, and generally offer relatively high salaries; by contrast, the small voluntary AT groups have a much smaller staff, as well as many voluntary and part-time workers who do not receive any direct compensation. This tends to distort in a rather significant way the average figures on staff expenditures which can be obtained for each of the big regions of the world. A second difficulty is that non-labour costs tend to vary rather significantly from one organisation to the other, and appear to be particularly high in the newly-established AT organisations which have to face installation charges, purchase new equipment and build up their documentation facilities. A third difficulty is the way in which the OECD questionnaire itself was formulated: the respondents were asked to provide data about their budgets and the breakdown of their staff between professionals and non-professionals, but not about the average cost of staff in each of these two categories.

Despite these difficulties, it is possible to arrive at a reasonably accurate estimate of the cost of professional and non-professional staff by using a simple linear regression. These data, summarized in Table 13, cover only the industrialized countries and the developing countries, and not individual countries or big geographic regions, since the number of responding organisations in each country and each region was too small.

Table 13

THE COST OF PROFESSIONAL AND NON-PROFESSIONAL STAFF

	Developing countries	Industrialized countries
Average share of professionals in total staff	1/3	2/3
Average cost of a professional	$ 17,000	$ 27,500
Average cost of a non-professional	$ 6,000	$ 20,500

The cost differential for a professional between industrialized and developing countries clearly appears to be significantly smaller than suggested by the differences in income levels between these two groups of countries. In fact the rather high cost of professionals in the developing countries can be seen as yet another indication of the AT movement's linkages with the modern sector: even though most AT organisations in the developing countries are dealing with the problems of rural areas and the most underprivileged people in the urban areas, their staff members belong to an urban elite of highly educated and relatively affluent people.

In the developing countries, non-professional staff is comparatively inexpensive, and this may account to some extent for the much higher share of non-professionals in the staff of AT organisations in these countries. Conversely, the very high cost of non-professionals in the industrialized countries is a very strong incentive for employing a large proportion of professionals.

These figures on the cost of professional and non-professional staff and the breakdown between these two groups can be related with the median size of AT organisations - 15 people in both industrialized and developing countries - to give an idea of the 'typical' or 'average' AT organisation. In the industrialized countries, such an organisation has a total budget of around $ 380,000 (1977 figure) with ten professional staff members; in the developing countries, it has a budget of some $ 145,000 with five professional staff members. These figures are mere averages, but they do suggest that the cost of building up an AT organisation is very small, and in any case significantly lower than most conventional development projects, and considerably below the initial investments required to start up an industrial firm.

THE ROLE OF FOREIGN EXPERTS

The data presented in Chapter 5 on the funding of AT activities suggested rather clearly that foreign aid, contrary to what is widely believed, plays a rather marginal role in the financing of most AT

organisations. Money, however, is not the only channel through which strategy and policy can be influenced, and the data available on the staffing of AT organisations can help to sharpen, and where necessary to correct, the picture emerging from an analysis of the funding mechanisms.

The organisations responding to the OECD were not specifically asked to mention what proportion of their staff were of foreign origin. However, it is possible to find out, on the basis of direct and indirect evidence, what proportion of AT organisations in the developing countries are headed by foreign experts. The evidence comes from a number of sources. First are the personal relationships between the authors of the present study and a large number of organisations figuring in the OECD Directory. Second is the fact that in the developing countries of Asia and Latin America, most governmental AT centres are legally bound to be headed by a national. Third is the evidence provided by the name of the head of each organisation: a typical English or French first name and family name does not prove that the person in question is a foreigner, but is a fairly strong presumption to this effect. Finally, it is known that most international organisations based in the developing countries are headed by a director who is not a national of the country.

A case-by-case analysis of the 277 organisations figuring in the OECD Directory suggests that if the total number of expatriate staff in the AT organisations of the developing countries is very small, a far from insignificant proportion of AT organisations are headed by foreigners. The number of organisations falling into this category is around 45 per cent in Africa, 10 per cent in Asia and approximately 12 per cent in Latin America, while the average figure for all developing countries is around 23 per cent. These foreign directors of AT organisations belong essentially to three groups: first are the individual entrepreneurs, second the heads of international AT groups or research centres, and third the experts of foreign aid agencies or missionary organisations. This last category seems to be the largest of the three, and is particularly important in the African countries.

These figures are not totally unexpected, given the international nature of the AT movement and the large amount of work done on developing country problems by the AT organisations of the industrialized countries. What is particularly interesting is of course the very high percentage of African AT organisations headed by foreigners: this clearly suggests that in that part of the developing world, AT efforts are greatly influenced by foreign experts, and leads some credence to the view that AT is to a certain extent a foreign import rather than an indigenous creation.

Chapter 7

THE DIFFUSION OF INNOVATION

Most, if not all, of the organisations working in the field of AT are involved in one way or another in the promotion and diffusion of innovation. The small AT groups active in research and development, for instance, usually spend a substantial amount of time and money on the diffusion of their new equipment and new technologies to potential users. As for the AT groups which are primarily information networkers or political lobbyists, they spend almost all their time on the diffusion of knowledge and the dissemination of new ideas, as well as on the promotion of organisational and technological innovations in government departments, industrial firms and international agencies.

The promotion and diffusion of innovation, in fact, permeates practically all the range of activities of AT organisations, from research and development to information and education, and from user-oriented activities and supporting services to political lobbying and commercial production. For this very reason, it was not singled out in the OECD questionnaire as a separate type of activity, and should be viewed as a common denominator or general feature of all activities. This is not to say that all AT organisations are geared solely to this one objective: the small specialised AT organisations may indeed be working primarily on the promotion and diffusion of innovation, but for a number of other organisations, innovation is a side effect of other activities or an instrument for wider goals. This is the case for instance in the international development banks: their central mission is to finance and carry out well-defined development projects, and not simply to promote innovation in AT. If a reliable AT is available, or can be developed fairly rapidly, it will eventually be incorporated into specific development projects, and these projects will serve as an important instrument in the diffusion of this new technology. This, however, is a side effect of projects, and not their main objective. In the same way, the activities of a testing laboratory may eventually result in the widespread adoption of the best among a wide range of rather similar types of equipment incorporating a very appropriate technology (e.g. low-cost water pumps or inexpensive medical equipment), but the main aim is to make comparative technical and economic evaluations, and not to promote innovation *per se*.

Any discussion of the process of innovation raises the inevitable question: what does one mean by 'innovation'? In the pages that follow, the term is taken in a rather wide sense to include any new technology or new way of doing things. It thus covers both hardware (equipment, machinery, components, tools and complete systems) and software (organisational forms, managerial tools, institutional structures, legal provisions, financial arrangements, information and new ideas or new concepts). Innovation implies novelty, but novelty should be considered as something relative: reviving a traditional technology, as in the case of the ancient irrigation systems in Sri Lanka or herbal medicine in Mexico, is an innovation even if the technology itself is very old. In the same way, promoting the diffusion of inexpensive water pumps or simple solar dryers for agricultural crops can be considered as an innovation if these technologies are new to their users or to their promoters.

Using the data provided in response to the OECD questionnaire, this chapter will first seek to identify the major obstacles to the diffusion of innovation. It will then try to determine what are the relationships, or correlations, between the various types of obstacles mentioned by the responding organisations. This analysis will be followed by a closer look at the instruments used by AT organisations to promote the diffusion of their technologies, and the relationships between the structure and sources of financing of AT organisations on the one hand, and their choice of instruments of technology diffusion on the other. The figures used here are essentially macro-economic, and deal with rough averages, and for this very reason do not take into account the specific situation of individual organisations. This limitation should clearly be kept in mind, and it is important to remember that the generalisations made here do not purport to present a comprehensive picture of the innovation processes in AT: they are simply one approach among many others to an understanding of the ways in which AT organisations try to fulfill their innovative function.

THE OBSTACLES TO THE DIFFUSION OF INNOVATION

Each of the organisations responding to the OECD questionnaire were asked to identify the main obstacles they had faced in diffusing their technologies to users and customers (1). The question was phrased in such a way as to elicit fairly detailed answers while at the same time leaving the door open to a wide number of suggestions:

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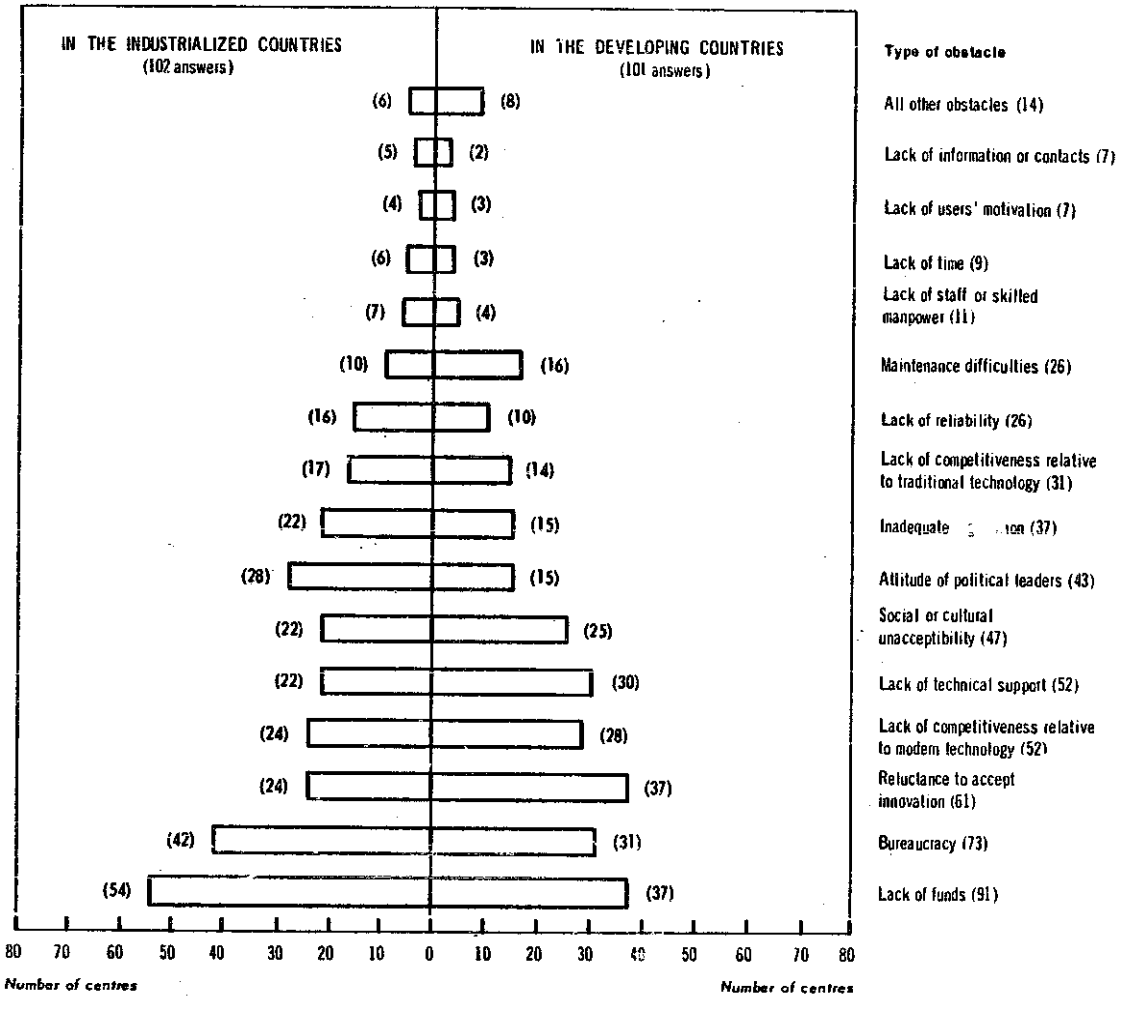
(1) See Appendix 3, question no. 20.

Figure 26 **OBSTACLES TO THE DIFFUSION OF APPROPRIATE TECHNOLOGY (1977)**



in addition to eleven specific obstacles - which appeared to be particularly important from an earlier analysis of the operations of a few selected AT groups - the respondents were invited to list in the 'other' category any other obstacle which, in their experience, had proven to be particularly important. Of the 277 organisations figuring in the OECD Directory, 202 (73 per cent of the total) provided a detailed answer to this question, and their answers are summarized in Figure 26.

Before analysing these results, a few words of caution are necessary. Questionnaires of this kind provide data which have all the appearances of objectivity: numbers always look more scientific than general impressions or value judgements. When dealing with an issue as complex and subjective as the obstacles to the diffusion of innovation, one can obtain very precise figures by simply adding up the number of quotations or number of answers. It is well to note, however, that quoting a particular obstacle involves certain value judgements and qualitative impressions on the part of the respondents. In other terms, the figures obtained by collating the answers to such a question are no more than the sums of individual value judgements made by the respondents, and it would be a mistake to view them as a precise quantitative representation of reality.

Questionnaires, furthermore, are never value-free, and the way in which they are phrased does to some extent condition the nature of the responses. In this particular case, a first test of this unconscious conditioning of the responses by the questionnaire itself was made by comparing the order in which the obstacles to the diffusion of innovation were listed, and the relative importance of each of these obstacles as they emerged from the final tally. As things turned out, the conditioning effect seems to have been fairly small, in the sense that there is no meaningful correlation between the order in which the obstacles were listed in the questionnaire, and their relative ranking shown in Figure 26. This conditioning effect, however, is not totally absent, and a major distinction should be made here between the eleven obstacles which were specifically listed in the questionnaire - and which for this reason probably received the greatest amount of attention - and those which were proposed by the respondents themselves in the category of 'other obstacles'. The obstacles listed in this last category are perhaps inherently less important, but their relative under-representation in Figure 26 should not be taken too literally.

However, even if one takes into account the inevitable biases of a questionnaire of this type, the data summarized in Figure 26 suggest a number of important observations. The most striking is undoubtedly the major importance attributed by AT organisations to the problem of lack of funds: almost half of the respondents identified this as one

of the major obstacles to innovation. Interestingly enough, this obstacle is quoted significantly more often by AT organisations in the industrialized countries than by those in the developing countries. Conventional wisdom would have suggested the opposite: developing countries are poor, their AT organisations have much smaller budgets and their financial system is less well developed, and the problem of funding could be expected to be much more dramatic than in the richer industrialized countries. This global picture is confirmed by the experience of individual countries: most of the AT organisations in the richest industrialized countries (Switzerland, France, Denmark) cite lack of funds as a major obstacle to the diffusion of technology, but those in the poorest developing countries (Bangladesh, India, Indonesia) quote it significantly less often, if at all.

The counter-intuitive nature of these findings lends some credibility to the hypothesis expressed by Professor Stuart Wilson, namely that "the higher the budget of an AT organisation, the greater the probability that it will quote lack of funds as a major obstacle to the diffusion of its technology" (2). A closer look at individual AT organisations suggests that this hypothesis is partly correct: the organisations which seem to have the biggest funding problems are generally the larger ones, but these problems are also frequently quoted by the very small AT organisations. In other terms, funding seems to be a major problem for the largest and the smallest AT organisations, and not for those which lie in between these two extremes.

The importance of the funding issue also seems to vary with the age of an organisation: newly-established AT centres often start with comparatively large amounts of money and little practical experience with the diffusion of technology, and consequently tend to view funding as a rather minor problem. A few years later, however, once the initial enthusiasm of sponsors has worn off and the difficulties of finding a niche in the market begin to appear, funding comes to assume a much greater importance. Not only because of the much larger scale of the organisation's operations, but also because of what might be called its surrogate function: when structural difficulties appear, as they inevitably do, they are often attributed to funding problems, when in fact they are caused by other factors such as the poor competitiveness of the organisation's products, the inappropriateness of its innovation strategies or misjudgements about the requirements of the market.

The major importance attributed by AT organisations to this issue of lack of funds undoubtedly reflects a very real problem. But it would be rather naïve to imagine that money alone is the major obstacle to the widespread diffusion of more appropriate types of techno-

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(2) Personal correspondence with the authors.

logy. This is borne out by the experience of the more mature AT organisations: the real problem is not so much to get more money as to find good projects, develop the adequate organisational and managerial capabilities, and improve the economic and social competitiveness of AT relative to modern and traditional technologies.

The second most important obstacle to the diffusion of innovation emerging from Figure 26 is 'bureaucracy'. If the term is rather vague, the reality of bureaucratic obstacles to innovation is not, and very many organisations have experienced them in their dealings with government agencies, international organisations and university administrations. These obstacles include administrative delays, the complexity of institutional procedures, the reluctance to promote small-scale projects, the lack of confidence in AT and the opposition of the 'establishment' against original or untested technical solutions.

The importance of these bureaucratic obstacles, contrary to what conventional wisdom would suggest, appears to be totally unrelated to a country's size, political structure or level of development: bureaucracy is a slightly more important obstacle to innovation in the industrialized countries, but is quoted with almost the same frequency in rich and poor countries, as well as in democratic and authoritarian countries.

The major importance attributed by AT organisations to this obstacle is interesting for a number of reasons. Bureaucracy is very largely a governmental phenomenon, and the detailed examples given in the replies to the OECD questionnaire suggest that most AT organisations were thinking of governments when they cited bureaucratic obstacles to the diffusion of their innovations. Yet, as noted in Chapter 5, governments are today by far the largest financial supporters of AT activities throughout the world. The situation is thus rather paradoxical: on the one hand, governments are funding a large share of the budgets of AT organisations, but on the other hand they appear to be one of the main obstacles to the diffusion of the innovations promoted by the AT groups they support. This might be seen as a typical example of the right hand ignoring what the left hand is doing, but the problem here is not simply the lack of coordination between government departments. In fact, it probably testifies to a major gap between the theories, the goodwill and the intentions of top level decision-makers in governments and international organisations on the one hand, and the operational realities of innovation as perceived at the grassroots level by the AT organisations on the other hand.

The third most important obstacle cited by AT organisations is the 'reluctance to accept innovation'. This is the most general and far-reaching of all the obstacles listed in the OECD questionnaire, and for this reason is somewhat less instructive than other obstacles such as the lack of funds, the poor competitiveness of AT relative to

modern or traditional technology or the lack of technical support. But what is particularly revealing is that this obstacle, like the first two appearing in Figure 26 - lack of funds and bureaucracy - is an *external* obstacle, i.e. a problem which at first sight has little to do with the strategies, forms of organisation, innovative abilities and management structures of AT organisations. By contrast, obstacles such as the lack of competitiveness relative to modern technology, social and cultural unacceptability or lack of reliability might be described as *internal* obstacles in the sense they are due to, or largely dependent on, the ways in which the AT organisations themselves operate. External obstacles are by definition much more difficult to control and remove than internal obstacles: an AT organisation can improve the reliability of its products or develop a better system of technical support, but it is very difficult for it to fight against bureaucracy or change the attitudes of political leaders. This distinction between external and internal obstacles is, of course, somewhat simplistic, and should be viewed as a question of degree - some obstacles are more typically internal or external than others - rather than as a fundamental difference in nature. But what is interesting here is that the three most important obstacles to innovation listed by AT organisations are all of an external nature. In other terms, these organisations perceive that the main obstacles they face are beyond their control, and not due to their own inadequacies and failings. This may be a natural phenomenon: it is always easier, psychologically and culturally, to attribute one's difficulties to external elements rather than to internal errors. This preeminence of external obstacles does, however, suggest that many AT organisations tend to underestimate their own weaknesses, and overstate the importance of external obstacles to their missionary efforts.

One of the big problems facing AT organisations is that the technologies they have developed must be economically, technically and culturally competitive: their diffusion is possible only if they are better than the modern or traditional technologies they seek to replace or complement. The data summarized in Figure 26 suggest rather clearly that the competitiveness of AT relative to modern technology is a much more important problem than competitiveness relative to traditional technologies. This is confirmed by the experiences of some of the most successful AT organisations in the developing countries: introducing an appropriate or intermediate technology which is better than traditional technologies is much more difficult if equally competitive modern technologies are already available, and these modern technologies are the product of a much more dynamic social system than traditional technologies. The latter can be a very powerful obstacle to innovation because of their cultural and

social legitimacy but they do not have the same evolutionary capacity as modern technologies, and they are, therefore, somewhat easier to circumvent.

Among the many obstacles to innovation cited by the AT organisations figuring in the OECD Directory, one which received an unexpectedly high rating is inadequate legislation: although only in eighth position in Figure 25, it appears to be much more important than either maintenance difficulties or lack of reliability, which are known to be rather critical problems in the diffusion of AT. However, what is interesting about this obstacle is not so much the high frequency with which it is quoted, as the fact that legal issues are an almost totally unexplored subject in the AT community. This is undoubtedly an area that would deserve some careful empirical research, and there are good reasons to believe that efforts to modify the legal system so as to facilitate the widespread adoption of more appropriate types of technology could yield some useful dividends. For the moment, few, if any, AT organisations seem to be doing this, and one could suggest here that this is one of the new frontiers for the AT movement both in industrialized and developing countries.

One of the most surprising features emerging from this survey of the obstacles to the diffusion of innovation is the very low ranking of lack of information and contacts. This may be due in part to the conditioning effect mentioned earlier: lack of information was not cited specifically in the questionnaire, and therefore could not be routinely ticked off like the other eleven obstacles cited in the questionnaire. However, the fact that this particular obstacle was not spelt out individually is also a guarantee of objectivity: the organisations which took the trouble to mention it explicitly are those which in one way or another experienced it as an important problem.

The very low rating of this obstacle is interesting for a number of reasons. First because conventional wisdom, and much of the literature on AT, has always stated that one of the most critical issues facing the AT movement was the lack of information, and more generally the lack of communication and the weakness of the information infrastructure in AT. The evidence clearly seems to indicate that this is not the case. The second reason is that AT organisations, as shown in Chapter 4, devote a considerable amount of time and money to the collection, generation, processing and dissemination of information: these activities account for some 19 per cent of their total activities measured in terms of expenditures and man-months of work. This suggests two conflicting hypotheses. One is that lack of information and contacts is a very minor obstacle to the diffusion of innovation, precisely because so much of the efforts of AT organisations has been devoted to overcoming it. And the other is that AT organisations are

spending too much of their time and money on what is only a very marginal problem. The available evidence indicates that both hypotheses could be correct, but logic suggests that the second is closer to the truth. The reason for this is fairly simple: when mentioning the various obstacles to the diffusion of innovation, AT organisations are referring to their experiences of the past few years, but when giving a description of their current activities, they are referring to the present (or more specifically to the year 1977). In other terms, it is difficult to see how this problem of lack of information as an obstacle to innovation could have been solved in the past few years - as it seems to have been, judging from the data - by the very high amount of information-related work carried out today.

THE CORRELATIONS BETWEEN OBSTACLES TO INNOVATION

The obstacles to innovation listed in the OECD questionnaire are not totally independent of one another: one can sense intuitively that an AT organisation which quotes the lack of reliability of its equipment as a major problem is also likely to be troubled by maintenance problems. In the same way, the negative attitude of political leaders towards AT may go a long way towards explaining the prevalence of bureaucratic obstacles, while the reluctance to accept innovation is rather closely related to the social or cultural unacceptability of a new technology.

Some of these relationships between obstacles are self-evident. Others are not, and it may, therefore, be interesting to try to evaluate the strength of these relationships and go beyond the intuitions of logic or evidence. This can be done by measuring the level of correlation between the various obstacles cited by the AT organisations figuring in the OECD Directory. The results of this statistical analysis are presented in Tables 14 and 15, the first of which covers AT organisations in the industrialized countries, while the second covers the developing countries.

In order to avoid overly detailed figures, the precision of which is open to question, the correlations are presented here in the form of familiar symbols. The sign '0' indicates that there is no meaningful correlation, the plus signs (+) indicate a positive correlation, which can be weak (+), strong (+++) or average (++), and the minus signs (-) indicate a negative correlation.

Correlations do not imply causality: they simply indicate statistical relationships, positive or negative, close or distant, between different elements. Those presented here purport to show which are the main obstacles to innovation that tend to go hand in hand with

Table 14 THE CORRELATION BETWEEN OBSTACLES TO INNOVATION IN THE INDUSTRIALISED COUNTRIES

	Lack of funds	Bureaucracy	Attitude of political leaders	Inadequate legislation	Cultural and social unacceptibility	Reluctance to accept innovation	Lack of competitiveness relative to modern technology	Lack of competitiveness relative to traditional technology	Lack of reliability	Maintenance difficulties
Bureaucracy	O									
Attitude of political leaders	O	+								
Inadequate legislation	−	+	O							
Cultural and social unacceptibility	−−	+	O	O						
Reluctance to accept innovation	O	+	O	+	+					
Lack of competitiveness relative to modern technology	O	+	O	+	+ +	+ +				
Lack of competitiveness relative to traditional technology	+	O	O	+	+	+ +	+ +			
Lack of reliability	−	O	O	O	O	O	+	+		
Maintenance difficulties	O	O	O	O	+ +	O	+ +	+ +	++	
Lack of technical support	−	O	O	++	O	O	+	+ +	+	++

Table 15 THE CORRELATION BETWEEN OBSTACLES TO INNOVATION IN THE DEVELOPING COUNTRIES

	Lack of funds	Bureaucracy	Attitude of political leaders	Inadequate legislation	Cultural and social unacceptibility	Reluctance to accept innovation	Lack of competitiveness relative to modern technology	Lack of competitiveness relative to traditional technology	Lack of reliability	Maintenance difficulties
Bureaucracy	O									
Attitude of political leaders	+	++								
Inadequate legislation	O	++	+++							
Cultural and social unacceptibility	O	+	+	+						
Reluctance to accept innovation	O	O	O	O	+					
Lack of competitiveness relative to modern technology	O	O	O	O	O	O				
Lack of competitiveness relative to traditional technology	O	−	−	O	+	O	+			
Lack of reliability	O	O	O	O	+	O	+	+ +		
Maintenance difficulties	O	−	O	O	O	O	+ +	+ +	+++	
Lack of technical support	O	O	O	O	O	O	O	+ +	+ +	+

Note : See Appendix 1 for details on methodology.

Note : See Appendix 1 for details on methodology.

other obstacles: do the AT organisations quoting obstacle A, for instance, also tend to quote obstacles C and D at the same time? Or does the quotation of obstacle B tend to rule out any mention of obstacles E or F?

A first comparison between these two tables shows a rather high degree of correlation in both industrialized and developing countries between the technical obstacles to innovation: the lack of technical support is closely associated with maintenance difficulties, lack of reliability and the poor competitiveness of AT relative to modern and traditional technology. This is not totally unexpected, and conforms to what logic and common sense would suggest. What is perhaps more interesting than the obvious positive correlations is either the absence of correlation (or a negative correlation) between two elements which at first sight seem to be related, or the major differences in levels of correlation between two different obstacles in the industrialized countries and the developing countries.

The problem of lack of funds is in this respect rather revealing: in the industrialized countries, this obstacle appears to be totally unrelated to the other ten obstacles (the only exception is a very weak positive correlation with the attitude of political leaders), and in the developing countries, it is negatively correlated with four obstacles, and apparently totally unrelated to five others. This obstacle also happens to be the one which was most widely quoted by AT organisations in both industrialized and developing countries. Statistically, this means that the organisations quoting lack of funds as a major obstacle to innovation are generally not those which have experienced maintenance difficulties or which are troubled by the lack of competitiveness of their technologies relative to modern or traditional technology. It also suggests indirectly that lack of funds has little, if anything, to do with technical problems or, conversely, that a greater availability of funds cannot alone solve the technical problems facing AT organisations.

As could be expected, there is a fairly close correlation in both industrialized and developing countries between bureaucratic obstacles on the one hand, and socio-political obstacles such as inadequate legislation and the social or cultural unacceptability of AT. What is more surprising is the absence of correlation in the industrialized countries between the attitude of political leaders and eight out of ten of the other obstacles; as for the two remaining obstacles - bureaucracy and inadequate legislation - their correlation with this attitude of political leaders is not very meaningful (weakly positive in one case, and weakly negative in the other). Interestingly enough, the attitude of political leaders as an obstacle to innovation is cited almost twice as often by AT organisations in the industrialized countries. This could mean that AT organisations in that part of the

world tend to overestimate the influence of political leaders or, conversely, that the role of the latter in stimulating the diffusion of AT is much more limited than generally supposed.

In the developing countries, the attitude of political leaders appears to be totally unrelated to the technical obstacles to innovation, but is very strongly correlated with inadequate legislation, and is more closely correlated with bureaucracy than in the industrialized countries. This would seem to indicate that in the developing countries, the diffusion of innovation in AT is a much more highly political problem than in the industrialized world. It also suggests that the influence of political leaders in fostering or hindering innovation is much greater than suspected.

The only significant negative correlation appearing in these two tables can be found in the industrialized countries in the case of lack of funds on the one hand, and social or cultural unacceptability on the other. This piece of information is difficult to interpret: it could mean that the richest AT organisations are those which tend to promote AT's which are culturally or socially inappropriate, or else that there is a lot of money to finance the diffusion of AT's that may be technically appropriate, but which are not easily accepted by their potential users.

This presentation of some of the most significant correlations between the various obstacles to the diffusion of innovation clearly suggests the existence of three big, and largely unrelated, groups of problems. First are the purely technical obstacles, ranging from maintenance difficulties to the lack of competitiveness relative to modern or traditional technology. Second are the political and socio-cultural obstacles such as bureaucracy, the attitude of political leaders or an inadequate legislation. And third is the lack of money, which AT organisations rate as the single most important obstacle to the diffusion of innovation. Interestingly enough, the technical obstacles tend to be quoted much less often than the lack of funds or the socio-political obstacles, and the evidence indicates that they cannot be alleviated in a significant way through greater financial support or a more favourable social and political environment. There are reasons to believe that most AT organisations tend to underestimate the role played by these technical factors, and that the innovations they promote still have a long way to go before becoming a competitive alternative to the sophisticated technologies of the modern sector, or the well-proven technologies of the traditional sector.

THE CHANNELS OF TECHNOLOGY DIFFUSION

AT organisations use a very wide range of means to promote their ideas and facilitate the diffusion of the technologies they have developed. These means, quite naturally, tend to be closely related to the nature and structure of the organisation: AT groups which are primarily information networkers tend to rely primarily on the written word and on personal communications, AT groups based in universities try to promote on-campus projects and develop new curricula, industrial firms tend to favour commercial production, governmental AT centres try to operate through the planning system, and development banks use development projects.

The organisations contacted in the course of the OECD survey were asked to mention the principal and secondary channels used in the diffusion of their technologies (3). Looking at things in retrospect and in the light of the conclusions emerging from a detailed analysis of the completed questionnaires, it now appears rather clearly that this part of the questionnaire was rather inadequately formulated. For one thing, it gave too great an importance to foreign aid, and too little emphasis to the normal day-to-day activities of AT organisations. Furthermore, this part of the questionnaire was conceived in such a way as to provide a few general indications about the channels of technology diffusion, and not to give a comprehensive picture of the innovation process. Problems of this kind are difficult to avoid altogether: as usually happens with questionnaires of this type, the inadequate nature of the questions only begins to appear once the responses have been completed, and by that time it is, of course, impossible to reformulate the questions.

Table 16 lists for developing countries, industrialized countries and the world as a whole the main channels of technology diffusion as indicated by the respondents to the questionnaire. The nine channels listed here are those which were quoted by at least 5 per cent of the organisations, and the percentages indicate the relative number of organisations quoting any one of these channels. Since many respondents cited more than one channel, the percentages add up to more than 100.

These figures should be considered as an indication of the orders of magnitude, and not as a precise quantification of the relative importance of each channel. The patterns they suggest are nevertheless rather revealing. The first is undoubtedly the major importance of the AT organisations' own activities in the diffusion of technology.

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(3) See Appendix 3, question no. 19.

Table 16

THE MAJOR MEANS OF TECHNOLOGY DIFFUSION

	World	Developing countries	Industrialized countries
1. Organisation's own activities	51%	53%	50%
2. Government agencies	42	48	35
3. International organisations	28	26	30
4. Universities and schools	28	22	34
5. Advertisements and mass media	24	24	24
6. International aid programmes	23	19	27
7. Private voluntary agencies	17	14	20
8. Bank and credit system	10	5	12
9. Big industrial firms	9	9	5

Note: See Appendix 1 for details on methodology.

Second is the rather heavy weight of government agencies in both industrialized and developing countries. This may well be an indirect consequence of the major role now played by governments in the funding of AT organisations. In this connection, the somewhat larger weight of governments as a channel of diffusion in the developing countries is not entirely unexpected, given the very heavy weight of the public sector in the funding of AT organisations in these countries. This role of the governmental channels suggests that many AT organisations have begun to realise that in many cases, the large-scale diffusion of their technologies is possible only if this is done in co-operation with governmental agencies. Not only because many AT's touch upon social problems which are normally the responsibility of governments (e.g. health, housing, transportation, energy, rural development, education or water supply), but also because in many countries, governments are in effect the main driving force in the economic system through their control over financial resources and the authority they exert through the planning mechanisms.

This table also suggests that the educational system (and notably the universities) and private voluntary agencies are a much more important channel of technology diffusion in the industrialized countries than in the developing countries. This is not totally unexpected, given the strength of the private voluntary sector in the first group of countries, and the major organisational and financial problems facing universities in the second.

What is undoubtedly rather striking is the small role played by the financial system (banks and other credit institutions) and by big industrial firms. This can be explained in part by the fact that these two groups of institutions are culturally, socially and organ-

isationally rather far away from the centre of the AT movement. The banks, and notably the big international development banks, which have made major contributions to the development and diffusion of AT have usually done so in the framework of their own development projects, and without much contact with the specialised AT groups. The same is largely true of the big industrial firms: their innovations in the field of AT result for the most part from their own perception of market demand and commercial opportunities, and not from a desire to promote AT for its own sake, or for philanthropic reasons. Conversely, most AT organisations tend to be rather distrustful of big industrial firms, which in their mind epitomize the sort of production system to which they are seeking an alternative, and are often rather ignorant of the centrally important role played by the financial system in the processes of technological innovation.

This situation now seems to be changing, and several of the older and better known AT organisations (e.g. the Intermediate Technology Development Group in the United Kingdom, and Volunteers in Technical Assistance in the United States) have begun to work much more closely with private industrial firms and with the big international development banks. This change is certainly one of the most encouraging and potentially important developments to have occured in the AT movement in the last few years. However, it is only just beginning, and the general picture given in Table 15 clearly suggests that AT organisations still have a long way to go, and that the conventional mechanisms of technology diffusion provided by banks or industrial firms are still vastly under-utilised and under-exploited.

A confirmation of this can be found in the fact that very few AT organisations deliberately try to help their clients find the outside funding required to promote innovation on a large scale. Most organisations seem to assume that if an AT is good (which often it is not), it will somehow manage to finance itself on the basis of its own merits, or that potential users will be so eager to use it that they will not have difficulty in securing whatever financial resources are required for its diffusion.

THE LINKAGE WITH INSTITUTIONAL FACTORS

The analysis of the obstacles to innovation and of the channels of technology diffusion presented in the preceding sections is essentially macro-economic, and does not take into account the specific situation of individual AT organisations. It also leaves a number of questions unanswered. Is there, for instance, any linkage between an organisation's sources of financing and its channels of technology diffusion? Do AT organisations in certain parts of the world tend

to use very different channels from their counterparts elsewhere? Does the structure of an organisation have any relationship with the type of obstacles it encounters in diffusing its innovations?

These questions are no doubt important, but the answers are often far from clear. This is the case, for instance, of the relationship between an organisation's degree of specialisation and the level of diffusion of its technologies. Intuitively, one senses that a highly specialised AT group should be able to diffuse its technologies much more widely and more effectively than an organisation working simultaneously in a very large number of fields. Exploiting a market niche may well be an effective strategy for a few individual organisations, but the global data supplied in response to the OECD questionnaire show that there is in fact a zero correlation between the level of dispersion of activities in AT organisations, and the extent to which their technologies are diffused nationally and internationally. In other terms, the highly dispersed AT organisations (i.e. those working in ten different fields or more) do not seem to be less effective in promoting the widespread diffusion of their innovations than the very highly focused AT groups.

In the same way, there does not appear to be any relationship between the channels of technology diffusion chosen by an organisation, its degree of specialisation and the type of obstacles it encounters in diffusing its technologies: these three elements are totally independent. Governmental AT organisations, for instance, are just as likely to face such obstacles as the attitude of political leaders or inadequate legislation as an independent AT group financed through its own activities or through voluntary help. In fact, the only two rather minor correlations which emerge from a detailed analysis of these three factors concern the 'missionary-type' AT organisations and the 'university-type' organisations: the former tend to be troubled by a slightly above-average number of technical problems (maintenance difficulties, poor technical support, lack of competitiveness relative to modern and traditional technology), while the latter seem to be better than average at overcoming social and cultural obstacles to innovation.

A region-by-region analysis of the channels of technology diffusion suggests that there are no meaningful correlations between the location of AT organisations and their choice of channels of diffusion. There are nevertheless a number of rather striking patterns which deserve to be noted, and which come out clearly from the figures presented in Table 17. What this table shows are the unusual or unexpected cases: in which regions of the world do local AT organisations show a much greater preference for, or obvious neglect of, the various channels of diffusion quoted in the OECD questionnaire? Preference and neglect are measured here in the form of a simple index based on the average use of each of these channels in the region.

Table 17

PREFERENCE AND NEGLECT IN THE CHOICE OF TECHNOLOGY DIFFUSION CHANNELS

Region	Channels of technology diffusion	Index
Strong preference		
Pacific OECD	Small and medium-size business	3.5
International agencies	Big industrial firms	3.4
International agencies	International aid programmes	2.9
Asia	Small and medium-size business	2.8
Pacific OECD	International aid programmes	2.6
International agencies	Banks	2.5
North America	Banks	2.3
Europe	Literature	1.8
Strong neglect		
International agencies	Small and medium-size business	0.0
Africa	Banks	0.0
North America	Schools and universities	0.1
Europe	Banks	0.2
Latin America	Private voluntary agencies	0.2
International agencies	Organisation's own activities	0.3
Latin America	International agencies	0.3
Asia	Banks	0.4
North and Latin America	Big industrial firms	0.4

Note: See Appendix 1 for details on methodology.

The patterns emerging from Table 17 are self-evident. If some of them confirm our conventional wisdom - this is the case, for instance, of the strong preference given by AT organisations in Asia to small and medium-size business as a channel of technology diffusion - others are rather more unexpected. Thus, for instance, the rather small role played by big industrial firms in North America, and the neglect of small and medium-size business by international agencies. This last case is, incidentally, a good illustration of the gap between rhetoric and reality: many international organisations are strongly committed to the development of small-scale industries, but the figures show that when it comes to setting up projects and promoting the diffusion of AT, their most likely partners are the big international firms.

This picture of the relative importance of the various channels of technology diffusion in different parts in the world and in international organisations can be further elaborated by a comparison between the relative importance of the various sources of financing of AT organisations on the one hand, and the choice of channels of diffusion which are institutionally related to these sources of financing on the other hand. In general, there is a fairly close positive correlation between these two factors: in regions where governments are a major source of financial support for AT activities, a large number of AT organisations tend to use governmental channels for the diffusion

of their innovations; conversely, these organisations tend to neglect the industrial and banking channels in those regions where industrial firms and development banks contribute little to the financing of AT activities. There are, however, a few significant exceptions to this general pattern, and these are summarized in Table 18.

Table 18

THE RELATIVE IMPORTANCE OF SOURCES OF FUNDING AS CHANNELS OF TECHNOLOGY DIFFUSION

Region	Channel of diffusion & source of funding	Index
Low index		
Africa	Banks	0.0
North America	Universities and schools	0.1
Latin America	International aid programmes	0.1
North America	Industry	0.2
Africa	International aid programmes	0.4
Asia	Governments	0.5
Industrialized countries	Universities and industry	0.5
High index		
International agencies	International aid programmes	4.1
International agencies	Banks	2.4
Developing countries	Universities and schools	2.2
Africa	Universities and schools	2.0
Africa	Industry	1.9
Latin America	Industry	1.8
Asia	Universities and schools	1.6

Note: See Appendix 1 for details on methodology.

A low index can be viewed as an indirect indicator of the independence of AT centres relative to their sources of financing: in Asia, for instance, governments make a very important financial contribution to the budgets of these organisations, but the latter tend to give a rather large importance to non-governmental channels when promoting their innovations. By contrast, a high index suggests two possibilities: either that the funding institutions are not as effective an instrument of technology diffusion as the size of their financial contribution would suggest, or else that they are willing to subsidise the activities of AT organisations on a rather large scale without being particularly concerned about the ways in which new technologies resulting from this research work are brought to their users.

As noted earlier, the conclusions that can be drawn from an analysis of global data of this kind are of a rather general nature, and tell us little, if anything, about the operations of individual AT organisations, or the situation prevailing in specific countries. They do nevertheless bring to light some of the less conspicuous features of the innovation process, and suggest that the diffusion of innovation in the field of AT is at least as complex as in industry, public services, or the social system in general.

Chapter 8

THE COMMUNICATIONS NETWORKS

AT organisations throughout the world spend a considerable amount of time and effort on the collection, processing and dissemination of information, and one of the most striking features of the AT movement is undoubtedly the intensive nature of its communications networks: most AT organisations are in close professional contact with one another and receive a large number of visitors, and their staff members travel a lot and take an active part in international meetings. This intensity of communications can be attributed to a number of factors. First is the 'missionary' nature of most AT organisations: promoting new ideas and new technologies is not simply a professional activity, but the expression of a quasi-religious belief in the virtues of AT. Second is the non-proprietary nature of AT: the great majority of the new technologies developed by AT groups are non-patentable, and when they could be, are generally left without any legal protection (1). One should add to this the fact that most AT organisations are non-profit institutions which tend to see publicity as a virtue and secrecy as an obstacle to their mission. Third, and perhaps most important, is the youth of the AT movement and the general lack of experience as to the ways in which innovation in AT can best be encouraged: newly-created AT organisations, unlike new industrial firms or new educational institutions, do not have at their disposal the established sources of funding, the well-tested managerial techniques, the institutional support and the collective experience which can be found in the more conventional fields of human activity. There are no books and very little literature on how to manage an AT organisation, few established training schemes, and little empirical knowledge as to how to proceed. When setting up a new AT organisation, the most usual pattern is simply to copy what others have done, and the best way to do this is to establish close professional relations with the older and more experienced AT organisations. For the latter, these contacts are also

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(1) The only significant exception to this pattern can be found in the field of solar energy, and notably in the high-technology end of the research spectrum in this field.

a major means for promoting their ideas and multiplying the impact of their innovations, and this convergence between the missionary zeal of the old-timers and the need for support on the part of the newcomers accounts in large part of this major importance of international communication in the AT movement.

The present chapter will attempt to present a global picture of the communications networks and information flows within the AT movement. This analysis is based for the most part on the data supplied in response to the OECD questionnaire by the 277 organisations figuring in the Directory. In question 13, the respondents were invited to cite by order of importance the five AT organisations, local or foreign, with which they had the closest working relationships. Several respondents cited less than five co-operating institutions, while a small number indicated that they did not have any such relationship with other AT organisations.

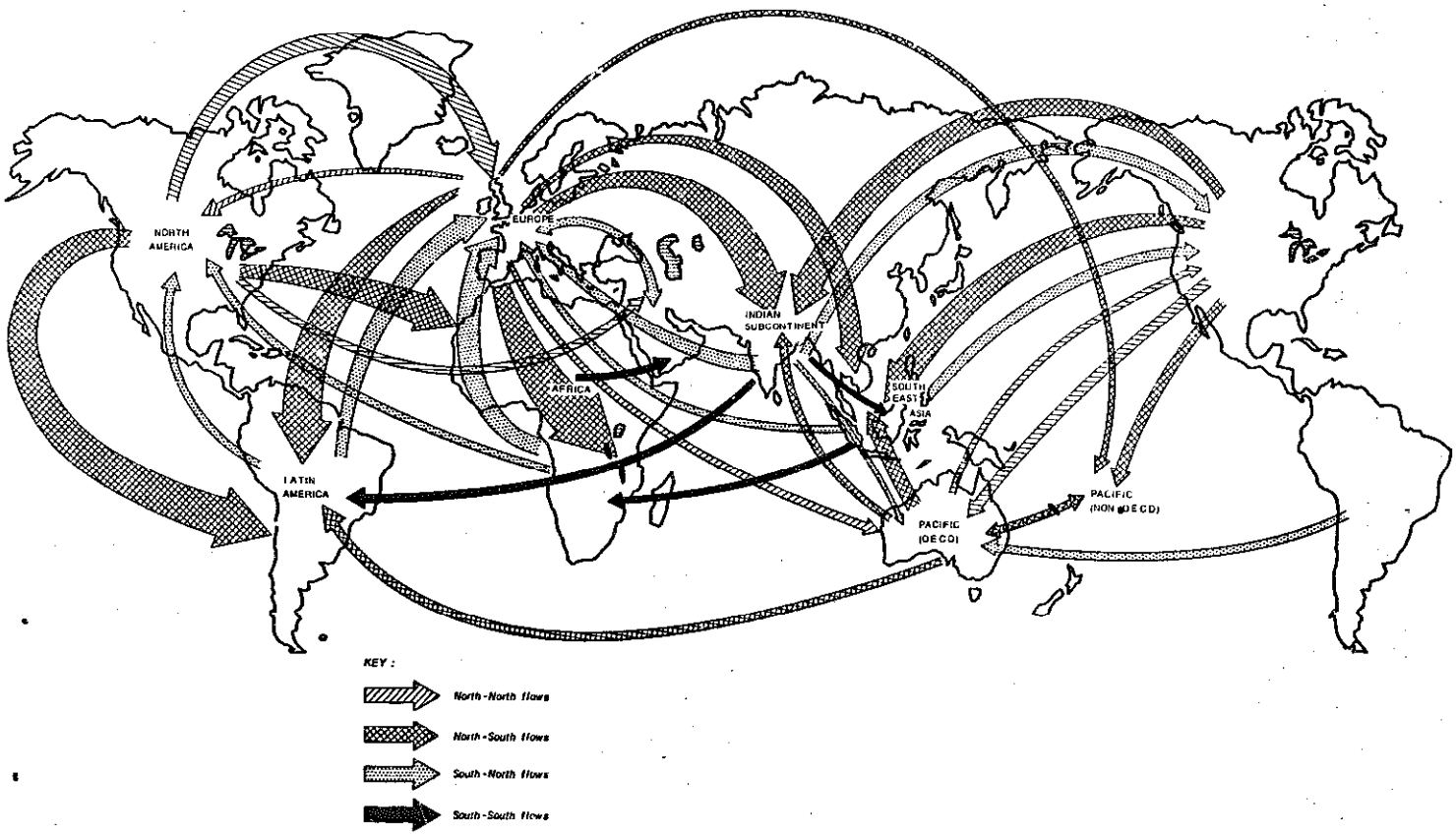
It may be interesting to note here that over 80 per cent of the AT organisations cited in the responses to this question were among the 277 organisations figuring in the Directory. This suggests that if the Directory itself is far from complete, it does at least cover the great majority of the main AT organisations throughout the world. Citation analyses of this kind are a purely quantitative instrument but as with similar analyses of scientific publications, for instance, quantitative phenomena can give an indirect indication of qualitative factors: the author or the organisation which happens to be cited the most frequently is not necessarily the best, but as a whole, those which are quoted most often are usually among the best and the most influential, and are at the forefront of their discipline.

The data provided in response to the OECD questionnaire have been used here for three different purposes. The first is to provide a general picture of the information flows between the major regions of the world. The second is to bring to light which are the most important, best known and most active of the 277 organisations figuring in the Directory. And third to draw a general map of the regional networks within the AT movement and of the working relationships between these networks.

THE INFORMATION FLOWS BETWEEN MAJOR REGIONS

The world map of Figure 27 presents in graphical form the main information flows between the different parts of the world. These flows have been shown in the form of arrows, the size of which is roughly proportional to the volume of communication between the various regions: the arrow going from region A to region B, for instance, indicates the total number of AT organisations in region A

Figure 27 **MAIN INFORMATION FLOWS BETWEEN GEOGRAPHIC AREAS, 1976-1978**



which are cited by those in region B, while the arrow in the opposite direction gives an idea of the flow from B to A. The arrows linking two regions are not necessarily of the same size: the AT organisations in North America, for instance, only infrequently cite their counterparts in Europe - which indicates that the information flow from Europe to North America is rather modest - but the European organisations quote their North American colleagues rather frequently. In the same way, it is well to note that in a few cases, the flow is in one direction only: Latin American AT organisations sometimes quote AT groups in the Indian subcontinent, but none of those in the latter region mention any close working relations with Latin American organisations.

It may be argued here that the number of citations is a rather imperfect approximation of the volume of information flowing from one region to the other. Information flows could undoubtedly be measured more accurately with the help of such indicators as the volume of correspondence, the amount of international travel, the number of telephone calls, the exchange of published materials or the trade in patents, licenses and blueprints. Such indicators are unfortunately not available or rather difficult to compute, and are unlikely to show a substantially different picture from the one presented here. Furthermore, one should keep in mind the fact that if citations are a rather incomplete representation of reality, they are inherently more valuable than purely quantitative data since they correspond to a well-established working relationship between two organisations and to an effective transfer of operational knowledge.

This world map shows a number of interesting and rather unexpected features. One is the relatively large importance of South-North information flows: contrary to the conventional wisdom which assumes that information tends to flow almost exclusively from North to South (i.e. from industrialized to developing countries) and from North to North (i.e. between the industrialized countries themselves), AT organisations in the industrialized countries receive a substantial amount of information from, and maintain close working relations with, their counterparts in the developing world. The information flow from Africa to Europe, for instance, is almost half as large as the flow in the opposite direction, and the same is true of the relationship between Europe and Latin America. Information flows and working relationships may tell us little about the effective importance of technology transfers between the different regions of the world, but these figures indirectly suggest that there is a considerably larger volume of South-North technology transfers than was generally thought to be the case until now, and that technology flows between industrialized and developing countries do not go in one way only - from North to South.

This map, however, confirms the relative weakness of South-South relations (i.e. between developing regions): the flows between Africa, Asia and Latin America, marked here in the form of black arrows, are significantly smaller than those linking the other major regions of the world, and many of these flows are uni-directional. Southeast Asian AT organisations, for instance, have some contact with their Indian counterparts, but none of the latter cite any of former. What is more, most South-South communications take place within the same continent: 93 per cent of the developing country AT organisations cited by their counterparts in other developing nations are located in the same continent as the organisation which cites them.

As for the North-South relationship, it clearly appears to be more complex than generally supposed. As could be expected, there is a lot of information flowing from North America to Latin America, and only a rather minor flow in the opposite direction, but the flow from Europe to Latin America is almost as great as that from North America. In other terms, Latin American AT organisations are much less dependent on American and Canadian AT institutions than history or international economic relations would suggest. A similar pattern can be found in the case of Africa: as could be expected, this continent gets most of its information from Europe, but this is balanced to a large extent by an almost equivalent flow from North America.

The complexity of the North-South equation is well illustrated by the South-North flow. AT organisations in North America, for instance, get as much information from Africa as they do from Latin America, and these two flows are somewhat less important than those stemming from the Indian sub-continent and Southeast Asia. As for European AT organisations, they get a lot of their information from African organisations, but this particular South-North flow is not significantly greater than that originating in Latin America, or from the sum of the flows from all the other developing regions of the world.

THE LEADING APPROPRIATE TECHNOLOGY ORGANISATIONS

Another approach to an understanding of the communications system and information flows in AT is to look not at major regions but at individual organisations. Table 19 lists the fifteen most frequently-cited AT organisations, ranked according to total number of citations, weighted number of citations and average ranking of citation. The last two indicators are given here to correct or qualify the first (2),

(2) The weighted number of citations is calculated by giving 5 points to a first-rank citation, 4 to a second-rank citation, 3 to a third-rank citation, and so forth. This weighting is justified by the fact that respondents were asked to quote by order of importance the AT organisations with which they had the closest working relationships.

but largely confirm the evidence stemming from the total number of citations given in the first column of Table 19.

Table 19

THE 15 MOST FREQUENTLY CITED APPROPRIATE TECHNOLOGY ORGANISATIONS

	Total number of citations	Weighted number of citations	Average ranking of citation
Intermediate Technology Development Group - ITDG (United Kingdom)	59	256	1.7
Volunteers in Technical Assistance - VITA (United States)	39	147	2.2
TOOL Foundation (Netherlands)	21	83	2.0
Brace Research Institute (Canada)	21	51	3.6
Groupe de Recherches et d'Echanges Technologiques - GRET (France)	19	67	2.5
International Rice Research Institute - IRRI (Philippines)	11	42	2.2
Development Technology Centre (Indonesia)	9	34	2.2
Technology Consultancy Centre (Ghana)	88	25	2.8
ENDA Technology Relay (Senegal)	6	22	2.3
National Center for Appropriate Technology - NCAT (United States)	6	21	2.5
Appropriate Technology for Developing Countries - ATOL (Belgium)	5	17	2.6
New Alchemists (United States)	5	15	3.0
Farallones Institute (United States)	4	16	2.0
U.S. Agency for International Development - USAID	4	15	2.3
Appropriate Technology Development Association (India)	4	14	2.5

Note: See Appendix 1 for details on methodology.

In the same way that the global citation analysis used in the preceding section cannot be construed as an entirely accurate representation of international information flows, the number of times each individual AT organisation is quoted tells us little about the intrinsic quality of an organisation or the effectiveness of its innovation strategies. It does, however, give a fairly good idea as to which are the most influential AT organisations, and which are those gravitating at the centre of the AT network.

A few notes of caution should be added here. The first is that the rate at which an organisation is cited is influenced to a certain extent by its age: an organisation which has been operating for over ten years tends to be much more widely known than a larger and possibly more effective, but much younger organisation. Second is that

the 'missionary-type' AT organisations, precisely because of their missionary nature, tend to be much more widely known, and hence more frequently quoted, than the more inward-looking or commercially oriented organisations. Third is that the rate of citation is not entirely unrelated to the amount of time and effort an organisation spends on public relations, participation in international meetings and the diffusion of its own publications.

This being said, the fact remains that citation analyses are a rather good, if indirect, approximation of an organisation's reputation and the latter, in turn, is fairly closely related to the quality and relevance of the organisation's work. The figures presented in Table 19 clearly bring to light the leading role played by the Intermediate Technology Development (ITDG), and to a lesser extent by Volunteers in Technical Assistance (VITA) in the AT movement. Although only five of the fifteen organisations listed here are based in the developing countries, it is interesting to note that eight of the ten others belong to what we have called the 'developing country family', i.e. organisations which are concerned for the most part by developing country problems. This, incidentally, can help to explain why AT so often tends to be associated with foreign aid.

The ranking of AT organisations by weighted number of citations is, with one significant exception (that of Brace Research Institute), practically the same as the ranking by total number of citations. The figures in the last column of this table show, furthermore, that the total or the weighted number of citations is almost totally unrelated to the average ranking of citations: an organisation which is less frequently quoted by the AT community as a whole is no less important to the organisations with which it works than the more frequently cited institutions.

The case of Canada in general, and Brace Research Institute in particular, raises an important question. Canada, as noted in Chapter 2 (see Table 3), is the country where national expenditures on AT have been growing at the lowest rate, and Brace Research Institute, which was one of the pioneers in the AT movement, has a significantly lower rating by weighted number of quotations than its total number of quotations would warrant. It also has the lowest average ranking of citations (3.6, as against between 2.0 and 3.0 for all other organisations except ITDG). The two phenomena - low growth of AT expenditures in Canada, and lower than expected ranking of Brace Research Institute - are probably not unrelated, and suggest that both Canada and its leading AT organisation are not keeping up as well as they might be with the rapid rate of growth of AT activities throughout the world.

Of the fifteen organisations quoted here, fourteen figure in the OECD Directory, and the only one which does not - the United States Agency for International Development (USAID) - was identified as an

important AT organisation but failed to respond to the questionnaire despite repeated efforts on the part of the authors. What is interesting about the list presented in Table 19 is not only the relative ranking of the fifteen most widely quoted AT organisations, but the absence of a number of other institutions: there is not a single international organisation (the International Rice Research Institute belongs to the category of agricultural research centres), not a single profit-oriented AT organisation (industrial firm or independent consulting group), not a single bank and only one foreign aid agency. Furthermore, with one exception (USAID), all the fifteen organisations listed here are what we have called 'specialised AT groups', i.e. organisations which are concerned primarily if not exclusively with the promotion of AT.

The absence of international organisations from this list is rather striking: these organisations are known to be spending very large amounts of money on the promotion and diffusion of AT, their work is often highly visible, but somehow it seems to have very little impact upon the AT community as a whole. This is not to say that it is irrelevant, quite the contrary: the World Health Organisation, for instance, is now playing a major part in the creation of low-cost health services which are likely to have a profound impact upon the developing countries, the Food and Agriculture Organisation (FAO) of the United Nations has done a lot of very good work in food processing and food storage, and the United Nations Industrial Development Organisation (UNIDO) is one of the most active promoters of appropriate industrial technologies.

The same is largely true of the big international development banks: most of them are actively trying to integrate AT's into the design of their projects, and one of them - the World Bank - has become *de facto* the world's largest AT organisation, and is undoubtedly the leader in a number of specific AT areas such as labour-intensive civil works construction or low-cost water supply and waste disposal systems.

The fact that an organisation has a low citation index, or is not cited at all, does not mean that it is not doing any good work in the AT field: what it simply means is that this organisation lies outside the usual communications channels of the AT movement. This is clearly the case of all the international governmental organisations, of the major international development banks, and most probably of industrial firms as well.

Table 19 probably gives a fairly good idea of who are the leaders among the specialised AT organisations, but tells us nothing about the leaders among the 'general organisations', i.e. the institutions which work only subsidiarily on the development and promotion of AT. This table suggests rather clearly that the distinction made in Chapter 2

between specialised AT organisations and general organisations is not simply semantic or organisational: it corresponds to a very basic dichotomy within the AT movement, and this dichotomy is characterised, or at last was characterised until fairly recently, by an almost total absence of communication between these two groups of institutions. A confirmation of this can be found in the analysis, presented in the following section, of the national and international communications networks.

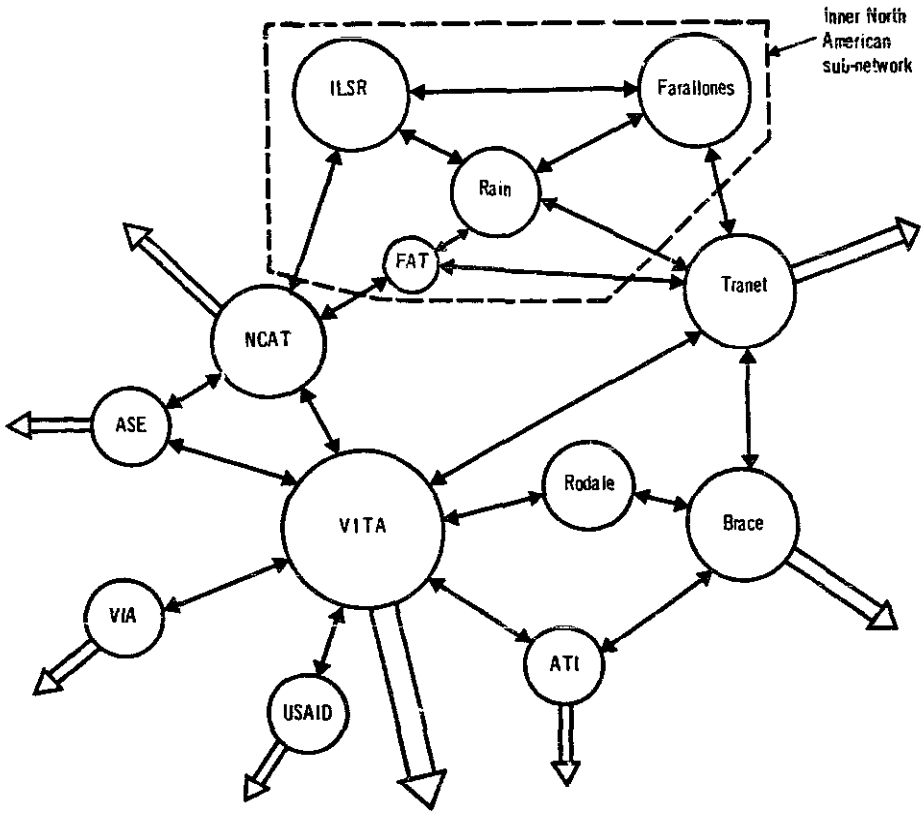
THE NATIONAL AND INTERNATIONAL NETWORKS

The citations provided in response to the OECD questionnaire can be used to identify and map out the national and international communications networks in the field of AT: by looking at the organisations which quote one another, one can find out which are the closest working relationships within the AT community of each country or each major region, and locate the organisations which are at the centre of each network. In the following 'maps' (Figures 28 to 35), each organisation or group of organisations has been drawn according to scale - the largest organisations are those which are quoted the most frequently - and the size of the arrows linking the various organisations is roughly proportional to the volume of communication: individual organisations are linked with one another by narrow arrows (or as the case may be, by dotted arrows when the interaction between two organisations appears to be rather weak, or unconfirmed by the citation data), while the outgoing arrows - from a particular organisation to institutions in other countries or regions - indicate the approximate level of communication with these other institutions.

These maps are obviously somewhat impressionistic, but represent a first attempt to translate the citation data into graphical information. They are also somewhat incomplete, in the sense that they do not cover all the important AT organisations in a given country or region. Some countries, furthermore, have been left out: this is the case of India, for instance, where the coverage of the Directory was too narrow to allow for any meaningful representation of the local communications network. Despite these limitations, these maps nevertheless show a number of interesting patterns, and can help to elaborate upon the conclusions emerging from our earlier analysis of the regional information flows and of the leading AT organisations.

In the map of the North American network presented in Figure 28, one finds most of the major American and Canadian AT organisations identified in Table 19, and VITA clearly stands out not only as the largest organisation, but also as the one which has the largest amount of contacts with the outside world. What comes out also rather clearly

Figure 28 **THE NORTH AMERICAN NETWORK IN APPROPRIATE TECHNOLOGY**



Abbreviations :

ASE :	Alternative Sources of Energy
ATI :	Appropriate Technology International
FAT :	Friends of Appropriate Technology
ILSR :	Institute for Local Self-Reliance
NCAT :	National Center for Appropriate Technology
USAID :	US Agency for International Development
VIA :	Volunteers in Asia
VITA :	Volunteers in Technical Assistance

from the data is the existence of an inner-American network of AT organisations which communicate exclusively with other North American institutions. This sub-network, delineated in Figure 28 with the help of a 'frontier', is extremely important, even if only a few of its members have been shown here. It represents, in effect, the core of AT organisations working on the rather specific problems of AT in a post-industrial society.

Within Western Europe (Figure 29) the most important sub-network is that of the United Kingdom, and it is interesting to observe the radial shape of the whole European network: every one communicates with the United Kingdom, and notably with the Intermediate Technology Development Group, but there is relatively little communication within the continent. The Dutch and Belgian AT organisations work closely with one another, as do the German and the Swiss, but there seems to be very little communication between these two groups, and none with AT organisations in Denmark or Italy.

In the United Kingdom, France, Belgium and the Netherlands, the heart or centre of gravity of each network is occupied by the leading organisations figuring in Table 19, and each of these four organisations - ITDG, GRET, TOOL and ATOL - all have very strong links with the outside world. As could be expected, the outside links of the Belgian AT organisations are particularly close with institutions in the former Belgian colonies (Zaire, Rwanda and Burundi), while the Dutch AT organisations have very close links w their counterparts in Indonesia (see Figures 30, 31 and 32).

The patterns in the other regions are somewhat less characteristic, and often difficult to interpret. In Latin America, for instance, many leading AT organisations are connected not with other AT organisations - either of the 'specialised' or 'general' type - but with foundations, charitable organisations or missionary institutions which lie totally outside the framework of the AT movement (e.g. Caritas International, the Interamerican Foundation, Misereor or Brot für die Welt). The same appears to be the case of India and Sri Lanka: local AT organisations, with the exception of those whose primary mission is to foster cooperation within the AT movement, tend to have close working relations with voluntary associations (such as the Gandhian movement in India or the Sarvodaya movement in Sri Lanka) and small industry development institutions, rather than with other AT organisations.

Judging from the evidence of the citations, it would seem that in Latin America and India, the AT movement is significantly less well structured than in the industrialized countries, in the sense that AT organisations tend to communicate much less with other AT organisations than with such institutions as foundations, development agencies, missionary organisations or voluntary associations. By

Figure 29 **THE WEST EUROPEAN NETWORK IN APPROPRIATE TECHNOLOGY**

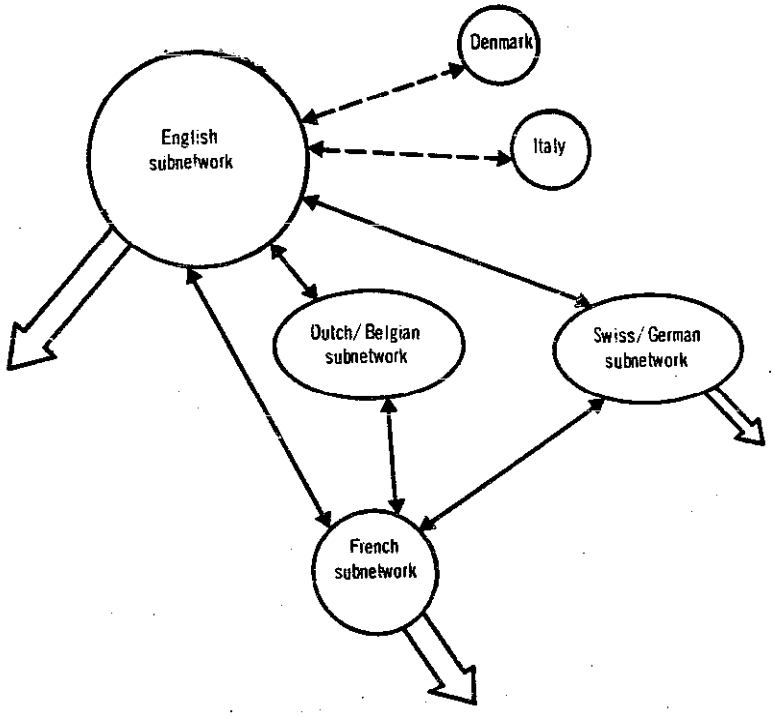
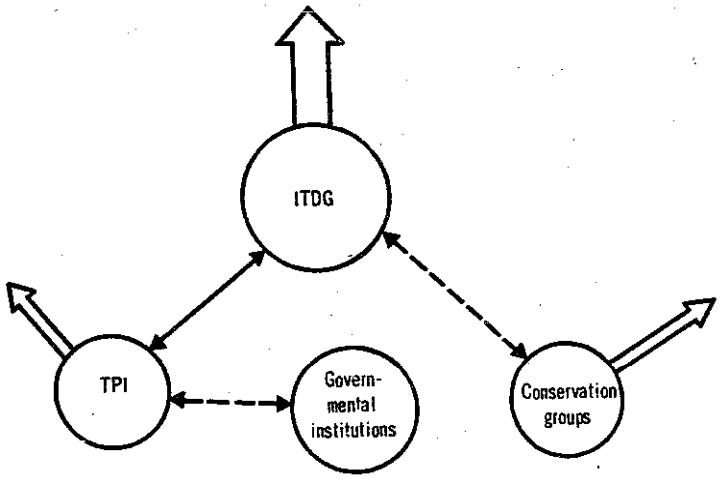
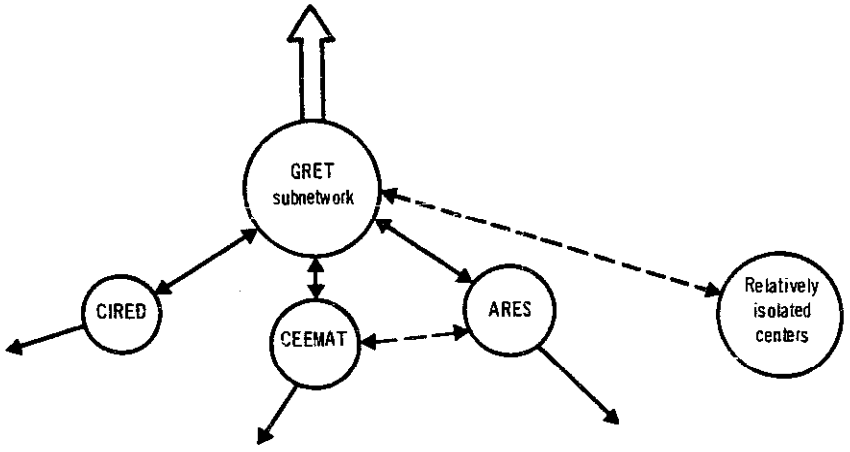


Figure 30 **THE BRITISH SUB-NETWORK IN APPROPRIATE TECHNOLOGY**



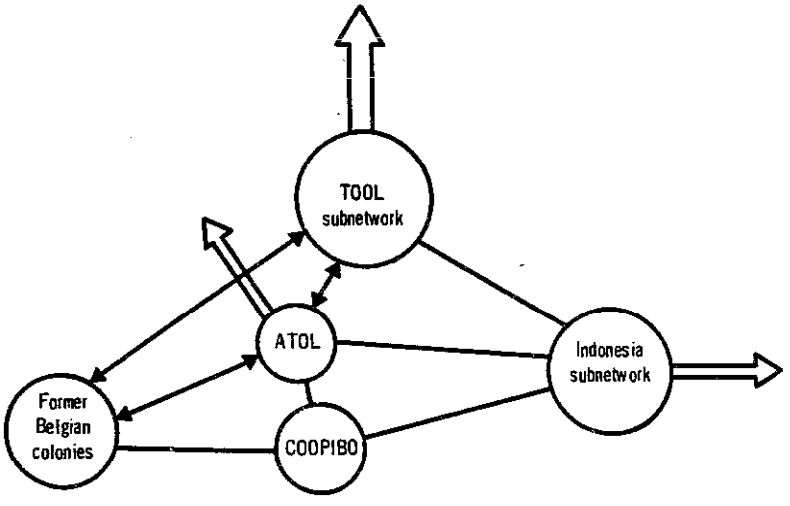
Abbreviations : ITDG : Intermediate Technology Development Group
TPI : Tropical Products Institute

Figure 31 **THE FRENCH SUB-NETWORK IN APPROPRIATE TECHNOLOGY**



Abbreviations : ARES : Applications de Recherches sur l'Energie et la Société
CEEMAT : Centre d'Etudes et d'Expérimentation du Machirisme Agricole Tropical
CIRED : Centre International de Recherches sur l'Environnement
GRET : Groupe de Recherches et d'Echanges Technologiques

Figure 32 **THE DUTCH AND BELGIAN SUB NETWORKS IN APPROPRIATE TECHNOLOGY**



Abbreviations : ATOL : Appropriate Technology for Developing Countries
COOPIBO : International Association of Building Fellows
TOOL : Foundation for Technical Development with Developing Countries

contrast, AT organisations in the industrialized countries are much more closely linked with one another, but this strength has its drawbacks, one of them being a certain aloofness vis-à-vis what happens outside of the AT movement.

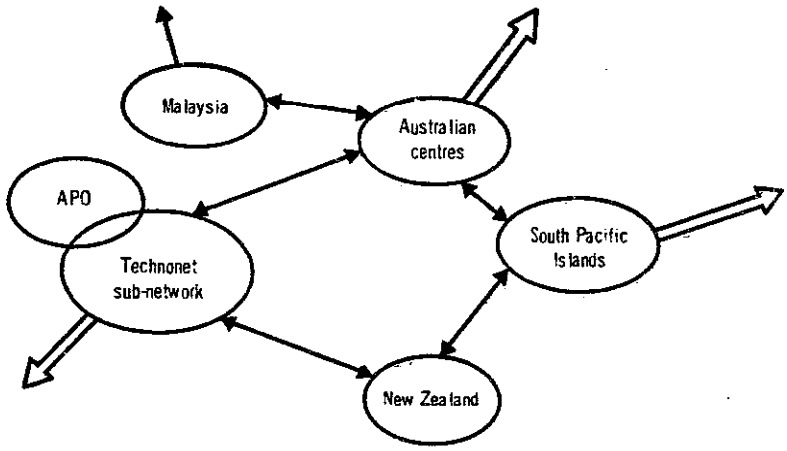
This characteristic of the AT movement in Latin America and India can also be found to some extent in Southeast Asia and Africa, and this accounts in part for the apparent inconclusiveness of the communications maps for these two regions (Figure 33 and 34). Africa has over 40 AT organisations figuring in the Directory, but none appears to occupy the same commanding position as VITA in the United States or ITDG in Western Europe. In Southeast Asia, the Technonet network is of central importance, but its main focus in on the development of small industry rather than on the promotion of AT.

What is interesting to observe is that none of these regional networks, either in the industrialized world or the developing world, has any relations with international organisations. This can be seen as yet another confirmation of the dichotomy, noted above, between international organisations and the rest of the AT movement. Conversely, international organisations have little contact with the specialised AT institutions. The picture, however, seems to be changing: AT groups such as VITA and ITDG are now working much more closely with international agencies such as the World Bank or the Asian Development Bank, but this is not yet apparent from the citation data used here, which all refer to the year 1977, and in some cases to 1976.

The communications network linking the main international agencies (Figure 35) suggests that the World Bank is indeed the main AT promoter within this group. This position could, however, be due in part to the very wide range of its project-lending activities, and hence of the scope of its promotional activities in the AT field: unlike FAO or WHO, it does not deal primarily with agriculture or health, and the breadth of its working relations with other international agencies is not unexpected.

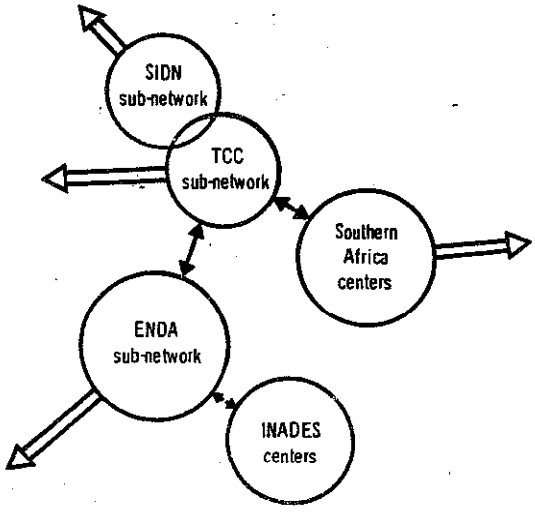
In order to be complete, these regional maps of the communications networks in AT should be followed by a number of subject maps: alongside these national and regional networks, there are a number of smaller but no less important networks linking AT organisations with a professional interest in specific subjects. One case in point is the international health network, centered on WHO's Appropriate Technology for Health Programme and the United Kingdom's Appropriate Health Resources and Technologies Action Group (AHRTAG). Another is the housing network, which links both a number of fairly large housing research institutions and a number of small specialised AT groups interested in slum upgrading, sites and services and new construction methods. These specialised, technically-oriented networks are extremely active, but their visibility is generally poor: because they are small and highly

Figure 33 **THE SOUTHEAST ASIA AND PACIFIC NETWORKS IN APPROPRIATE TECHNOLOGY**



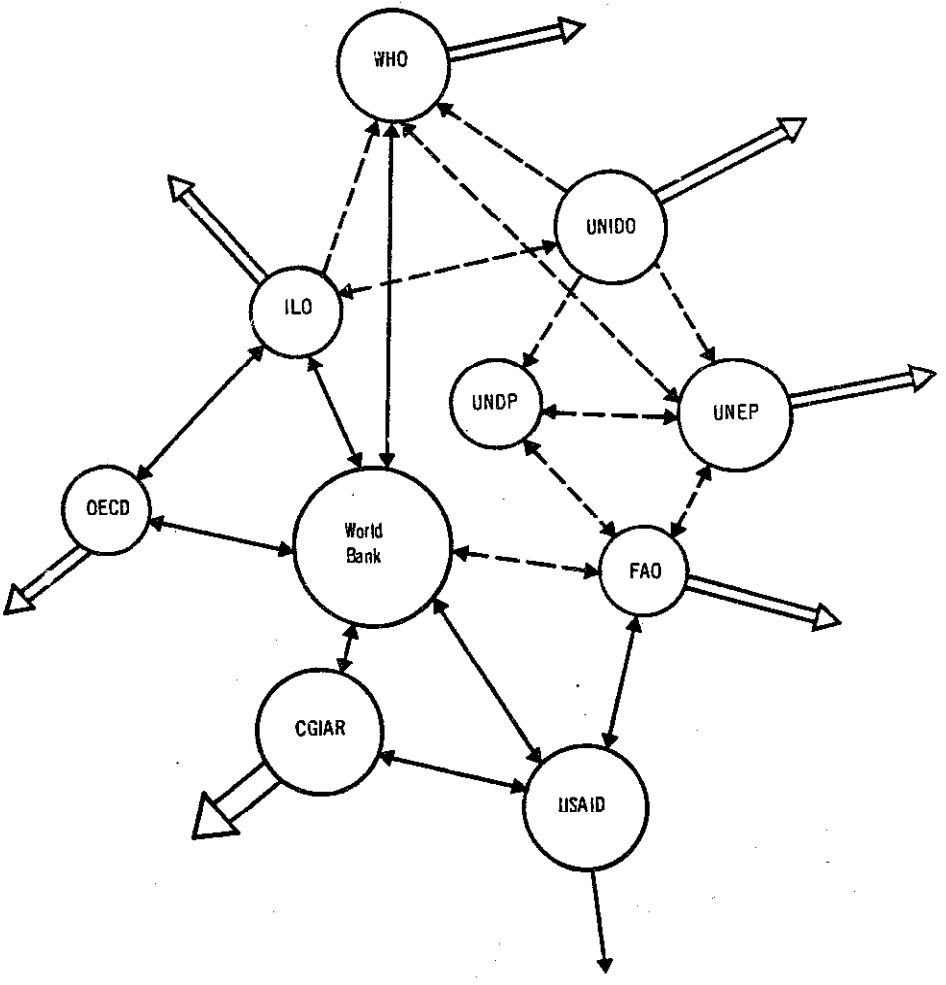
Abbreviation : APO : Asian Productivity Organisation

Figure 34 **THE AFRICAN NETWORK IN APPROPRIATE TECHNOLOGY**



Abbreviations : ENDA : Environnement et Développement Africains
INADES : Institut Africain pour le Développement Economique et Social
SIDN : Small Industry Development Network
TCC : Technology Consultancy Centre

Figure 35 **THE INTERNATIONAL ORGANISATIONS NETWORK IN APPROPRIATE TECHNOLOGY**



Abbreviations :
CGIAR : Consultative Group on International Agricultural Research
FAO : Food and Agriculture Organisation
ILO : International Labour Organisation
OECD : Organisation for Economic Co-operation and Development
UNDP : United Nations Development Programme
UNEP : United Nations Environment Programme
UNIDO : United Nations Industrial Development Organisation
WHO : World Health Organisation

specialised, they are seldom quoted by organisations interested in the broader aspects of AT, and their effectiveness, therefore, tends to be understated. Their importance, however, is far from marginal, and these networks are one testimony, among others, of the growing complexity of the AT system throughout the world.

INTERACTION AND COOPERATION BETWEEN THE MAIN NETWORKS

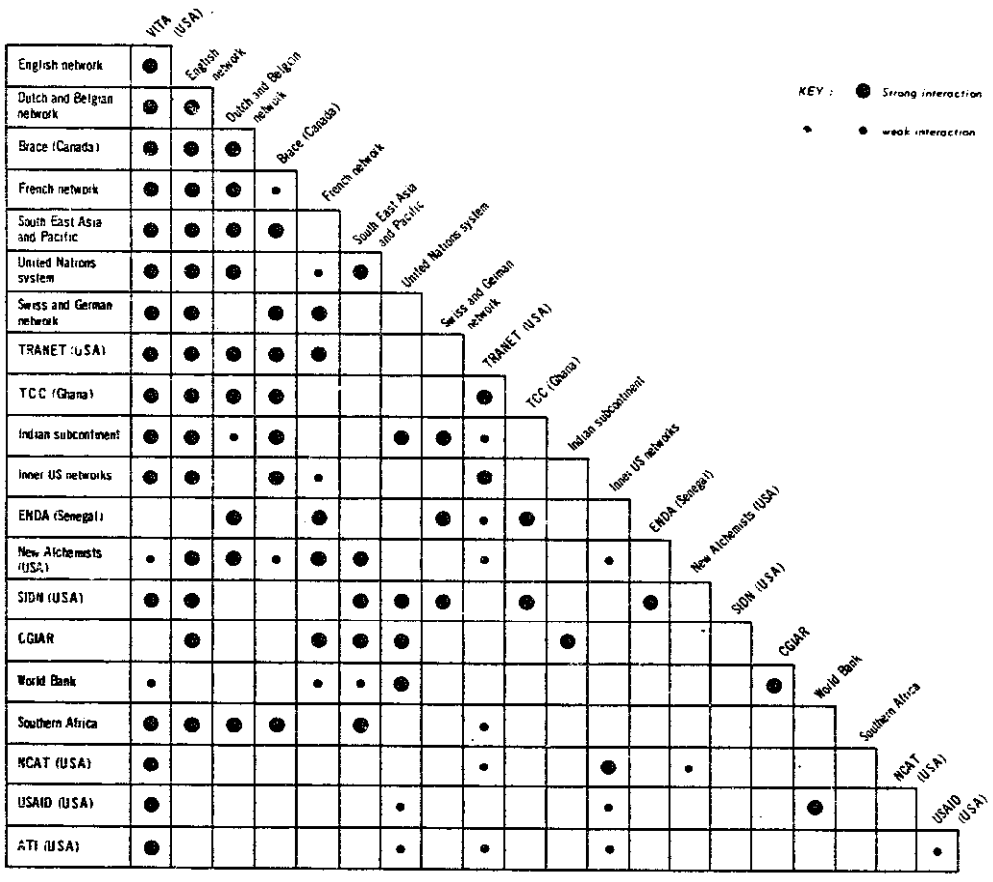
All the regional and national networks described here maintain close working contacts with AT institutions and networks in other regions and countries, and the only significant exception to this pattern appears to be the inner North American network. How closely do these various networks interact with one another? A first answer to this question can be found in the world map of global information flows presented in Figure 27, which showed, among other things, an unexpectedly high level of interaction between European and Latin American AT organisations, as well as major information flows from developing to industrialized countries. This global picture does not, however, indicate which are the main actors in the system, nor does it show the critical channels in the diffusion of technology and information.

It may, therefore, be useful here to focus on an intermediate level of analysis and look at the working relationships between the leading AT organisations and the leading networks in the system. The picture of these working relationships presented in Figure 36 is somewhat more qualitative than that given by the network maps and the world map outlined in the earlier parts of this chapter, in the sense that it distinguishes simply between strong and weak interactions, and does not try to assess how strong or weak these relationships really are. The methodology used here is, however, the same, and the original data upon which this figure is based are the same citation indexes used elsewhere in this chapter.

The data presented here confirm a number of well-known patterns: organisations such as VITA in the United States, ITDG in the United Kingdom (included in this figure in the British network) or Brace Research Institute in Canada appear once again to be the organisations with the largest number of working relationships with other AT organisations and networks, and the weakness of the interactions between Indian and Southeast Asian AT organisations is clearly brought to light once again.

The picture presented here does, however, also suggest that the conclusions emerging from an analysis of the various regional networks need some elaboration. If most individual organisations within the United Nations system, for instance, tend to communicate very little

Figure 38 **INTERACTIONS AND COOPERATION BETWEEN THE MAIN APPROPRIATE TECHNOLOGY NETWORKS**



Abbreviations :
- ATI : Appropriate Technology International
- CGIAR : Consultative Group on International Agricultural Research
- ENDA : Environnement et Développement Africains
- NCAT : National Center for Appropriate Technology
- SIDN : Small Industry Development Network
- TCC : Technology Consultancy Centre
- USAID : US Agency for International Development
- VITA : Volunteers in Technical Assistance

with the specialised AT groups, the total number of contacts between the latter and the United Nations system as a whole is far from negligible. In the same way, if the inner North American network as a whole tends to have very little contact with AT organisations in the rest of the world, at least one of the organisations belonging to this group - The New Alchemists - is beginning to establish a number of important working relationships with AT groups in the United Kingdom and the European continent.

Given the very large amount of time and effort spent by AT organisations on information and communication, and the very high rate of growth of the AT movement throughout the world, the patterns of communication presented in this chapter can be expected to change rather rapidly. What has been presented here is simply a photograph of the system at a particular moment in its history. This photograph is far from perfect, and necessarily very incomplete; for this reason it should not be considered as an accurate representation of reality, but as a mere attempt to bring to light some of the less conspicuous features of the AT system throughout the world.

Chapter 9

THE TYPOLOGY AND EVOLUTION OF APPROPRIATE TECHNOLOGY ORGANISATIONS

In order to understand the structure of the AT movement, it is important to keep in mind that the small specialised AT groups which launched the idea of intermediate or appropriate technology, and which for this reason enjoy a high degree of visibility, are far from being the only institutions involved in the development and promotion of AT. They represent a minority within the movement, and the relative size of this minority is gradually becoming smaller, not so much because of a slow growth rate among these specialised groups - the evidence presented in Chapter 2 brings to light what is in fact an exceptionally high rate of growth - but rather because an increasingly large number of other organisations, from industrial firms to consulting groups, and from rural development agencies to voluntary associations, are suddenly coming to discover that they have been working on AT without really knowing it, and now consider themselves as members of the AT movement.

The distinction made earlier in this book between the specialised AT groups and the 'general organisations' (i.e. institutions which devote only a part of their efforts to the promotion of AT, and which are not primarily AT organisations in the narrow sense of the world) is, therefore, of major importance. It is not, however, the only important classification instrument, and if one is to understand how the AT movement functions today, and how it might change in the next few years, it is necessary to use other analytical instruments.

This chapter will attempt to go beyond this important but rather straightforward distinction and look into a number of other structural features which are perhaps less conspicuous, but equally significant. One of these is the institutional affiliation of AT organisations: what is the proportion of the organisations listed in the OECD Directory which are affiliated with government agencies or with universities? Are the voluntary help groups as important as the profit-oriented AT centres? Do foundations play an important role in the AT movement? The second structural feature, or rather set of features, which will be examined here, is the relationship between an organisation's size, its age, its budget and the dispersion or concentration of its act- .

ivities. These four variables can help to draw up a basic typology of AT organisations, and this typology in turn can be used to identify a number of patterns of evolution. This structural analysis based on the data supplied in response to the OECD questionnaire can be completed by a more impressionistic look into a typical AT organisation's mix of activities through time.

THE INSTITUTIONAL AFFILIATIONS

The institutional affiliation of AT organisations appears at first sight as a deceptively simple issue. If a small, independent, non-profit AT group is easy to distinguish from a large international organisation, many other institutions are more difficult to fit into a precise category. The problem here is two-fold: first is the difficulty of determining what might be the most meaningful categories or classification criteria, and second is the rather complex nature of institutional affiliations for a large number of AT groups. Should an AT organisation located on a university campus but financed by a foreign aid agency and a government department be considered as a university-based organisation? Does a quasi-governmental AT organisation with a rather large budget for supporting other institutions belong to the category of governmental organisations, to that of non-profit institutions or to that of grant-making agencies? There are many such instances of AT organisations which could legitimately be ranged in more than one institutional category, and this is reflected in the figures summarized in Table 20: the total number of organisations figuring in each of the institutional categories is greater than the number of organisations figuring in the Directory, since the figures reflect the fact that over 60 of the 277 organisations are classified under more than one heading. In the same way, the percentages given in the last two columns of the table add up to more than 100.

The different institutional categories used here are based on a somewhat impressionistic perception of the main institutional affiliations of AT organisations throughout the world, and do not correspond to a standardized economic or sociological classification. They are nevertheless rather revealing of a number of structural features of the AT movement. First and foremost is the very large importance of the governmental sector: over a third of the 277 organisations listed in the Directory are linked in one way or another with national governments, and their number is significantly larger than that of the 'missionary-type' AT organisations which were at the origin of the AT movement, or that of the non-profit AT organisations. If anything, this confirms that national governments have become one of the main driving forces in the AT movement, and that their role is not limited to financial support alone.

Table 20

THE INSTITUTIONAL AFFILIATIONS OF APPROPRIATE TECHNOLOGY ORGANISATIONS

	Total number of organisations	Percentage breakdown
1. Governmental organisations	95	34%
- Integral part of government	50	18%
- Foreign aid agencies	26	9
- Affiliated with public agency	19	7
2. University organisations	81	29
- Integral part of university	53	19
- Affiliated with university	28	10
3. Missionary-type organisations	57	21
- Voluntary help groups	28	10
- Linked with church	16	6
- Operational foundations	7	3
- Grant-making foundations	6	2
4. Profit-oriented organisations	38	14
- Consulting firms	16	6
- Specialised AT centres	13	5
- Industrial firms	9	3
5. Non-profit organisations	88	32
6. International non-governmental organisations	37	13
7. United Nations organisations	30	11
8. Other international agencies (including CGIAR centres)	7	3

Note: See Appendix 1 for details on methodology.

Another striking feature is the very large number of AT organisations affiliated with universities. While it was known that quite a few of the pioneering organisations in the AT movement were based in universities (e.g. Brace Research Institute in Canada or the Technology Consultancy Centre at the University of Science and Technology of Kumasi in Ghana) the total number of such AT organisations was somewhat unexpected. This involvement of universities in the AT movement is undoubtedly a very positive phenomenon, were it only because of its impact upon the training of the scientists and engineers who will eventually form the main basis of tomorrow's technological system. It does, however, bring to light what is one of the major problems facing the AT movement, namely the difficulty in making the transition from small-scale pilot experiments to the massive diffusion of innovation. Universities can be a fertile breeding ground for new ideas, new technologies and new approaches to economic and social development, but they are not well equipped to prepare and handle large-scale projects or to translate a new technology into a successful commercial or social innovation.

In fact, it would probably be unrealistic to expect university-based AT groups to do more than they are doing at present. Many of them, however, are falling prey to the temptation of getting into development projects for which they are ill equipped, and there are some signs that too little attention is currently being paid to the ways in which AT can best be introduced into the academic curricula, and thereby shape the attitudes of those who, two or three decades later, will be holding the levers of power.

Two of the smaller institutional categories outlined in Table 20 deserve to be noted. First is that of the church-affiliated AT groups, and second is that of the profit-oriented consulting firms. The involvement of the churches, protestant or catholic, in the promotion of AT is linked for the most part to their charitable activities in developing countries. Although not concerned with the promotion of AT for its own sake, they have come to realise that in many cases the improvement of living conditions among the poorest and most underprivileged social groups calls for the diffusion of very low-cost, intermediate technologies. The work carried out by some of the AT groups linked with churches or missions is now widely recognised as being among the most effective and successful. One might mention here for instance the Salvadorian Foundation for Development and Minimum Housing, which is probably one of the world's leaders in very low-cost housing technology, the pioneering work on the diffusion of intermediate agricultural technologies carried out in several African countries by the Institut Africain pour le Développement Economique et Social (INADES), or the now famous 'Liklik Buk' (Little Book in pidgin English) - a compendium of intermediate or low-cost technologies - published in Papua New Guinea by the Melanesian Council of Churches.

AT in effect seems to have become the channel through which the churches are returning to a long-standing but half-forgotten tradition of direct involvement in technological matters. In the Middle Ages, the Church was the leading technological institution, not only in all the fields which were closely related to its spiritual mission (e.g. cathedral-building, clock-making or the casting of bells), but also in a number of areas - crop storage, agricultural implements, hydraulic energy, land reclamation or education - which in modern times came under the responsibility of nation-states, municipalities, commercial or industrial firms, universities and individual entrepreneurs. The growing involvement of churches in AT today is thus not as radical a departure from tradition as it would seem at first sight.

The emergence of profit-oriented consulting firms within the AT movement is a small but very important trend which deserves to be underlined. One of the big, although largely unrecognised, problems in the large-scale diffusion of innovation of AT is that the established

consulting engineering firms which prepare development projects for governments, development banks or aid agencies tend to be rather unfamiliar with AT and with the possibilities of using smaller-scale or more labour-intensive technologies. And when they happen to be familiar with them, they are generally not asked by their clients to prepare projects in such a way as to make use of these alternative technologies. In the same way, the project sponsors - development banks or government departments, for instance - are either unaware of the possibility of using more appropriate types of technologies, and in this case will not ask the consulting firms to look into the possibility of using such technologies; or else they are aware or in favour of using AT, but cannot find the consulting firms with a sufficient amount of experience in this field. The vicious circle can, of course, be broken, and one of the preconditions for this is the development of reputable and competent consulting firms with a certain amount of practical experience in the applications of AT. In this perspective, the emergence of profit-oriented AT consulting firms is of major importance. As shown in Table 20, the number of such firms is still small, but the very fact that they exist - and seem to be in the process of expanding rather rapidly - is a very positive development within the AT movement.

THE TYPOLOGY OF APPROPRIATE TECHNOLOGY ORGANISATIONS

AT groups, like industrial firms, government departments or professional organisations, each have a distinctive culture, history and psychological profile, and these elements are crucial to an understanding of the ways in which an organisation operates, of its development strategies and of its likely reactions to different situations. All organisations are different from one another, as are individual human beings, but in the same way that psychology can help to understand human behaviour by distinguishing between a certain number of basic types of character, the study of organisational psychology, or behaviour, has a lot to tell us about the ways in which organisations function.

To the best of our knowledge, neither the AT movement as a whole nor individual AT organisations have yet been the subject of any detailed behavioural or psychological investigation (1), but this is likely to change, both as a result of the growing interest in AT and

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(1) One significant exception in this respect is the work done by Denton E. Morrison on the sociology of the AT movement. See in particular his paper on "Energy, Appropriate Technology and International Interdependence", The Woodrow Wilson International Center for Scholars, Washington, 1978 (mimeo).

in response to the rapid growth of the AT movement. Some of the basic cultural and psychological features of the small specialised AT groups are in fact already well known, and there is no need here to elaborate upon the strong missionary nature of these organisations, their distrust of governments, their reluctance to establish close relationships with industrial firms or their deliberate cultivation of an anti-establishment image. These organisations, however, are not the only ones within the AT movement, and there are good reasons to believe that many of the features commonly attributed to AT organisations rest upon an image which may have been correct ten or fifteen years ago, but which today no longer corresponds to reality.

If one is to go beyond the traditional image of the AT movement and beyond the practical distinctions made earlier in this book between 'specialised' and 'general' AT organisations or between the 'developing country family' of AT organisations and the 'industrialized country family', a somewhat more systematic approach is required. What we shall, therefore, try to do here is to establish a basic typology of AT organisations based on a number of easily verifiable data. Our aim here is not simply to introduce yet another instrument of classification, but rather to distinguish between a few basic structural types of AT institutions and provide a better understanding of the ways in which such institutions might develop in the future.

The typology of AT organisations sketched out in Figure 37 rests upon four basic variables: an organisation's age, the size of its budget, the number of its staff members and the rate of dispersion of its activities. These four variables, or basic features, have an obvious advantage in that they are easily quantifiable. This, however, is not the only reason for choosing them: these variables, taken individually or in groups of two or three, are a fairly good approximation of the character of an organisation. In a fast-growing micro-society such as the AT movement, the age of an organisation, for instance, is of paramount importance: the older organisations are highly visible, they tend to have very far-reaching contacts with other AT organisations, and their influence both on the AT movement and on the decision-makers in governments or industry is quite out of proportion with their size. In the same way, the level of dispersion of activities (i.e. the total number of subject areas in which an organisation is actively engaged) can indirectly give a rather good idea of its development strategy and of the nature and effectiveness of its operations. As for budgets or total number of staff members, they can serve as a good indicator of the relative affluence, or poverty, of an organisation, and can also be used to distinguish between the 'missionary-type' AT organisations, which pay low salaries and often employ quite a few voluntary workers, and the 'establishment-type' organisations with much higher expenditures per staff member.

These four variables can also be analysed by groups of two or three: a high rate of dispersion combined with a small number of staff members, for instance, is usually typical of AT organisations working primarily on information networking, but in the case of a less specialised organisation, can serve as an indirect indication that its activities in each field are below the minimum threshold of effectiveness. By contrast, a relatively mature organisation with a small staff and only one or two fields of activity is most probably a highly professional organisation with a large amount of experience in its field. These four indicators, or variables, are not, of course, the only ones that can be used to develop a typology of AT organisations, and their importance should not be overestimated. Although far from perfect, they are nevertheless a useful instrument of analysis.

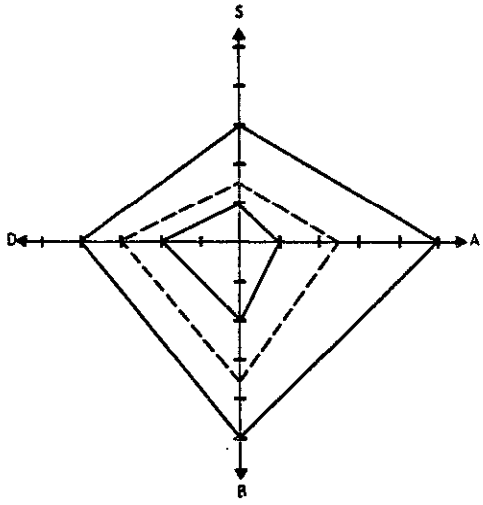
In Figure 37, these four variables are presented along four axes in the form of lozenge-shaped figures representing the general profiles of the 277 organisations described in the Directory. With the exception of a very small number of intermediate-type organisations, all of those figuring in the Directory fall into seven different structural types. Each of these types has been given here a very brief description (e.g. "small and dispersed" in the case of Type 2 organisations, or "large, specialised and mature" for Type 4 organisations) so as to facilitate the understanding of what may appear at first sight as a rather unconventional representation of an organisation's character.

The choice of seven basic types, rather than twelve or sixteen, is not arbitrary, but corresponds to the findings emerging from a detailed analysis of the 277 AT organisations in the Directory: these seven types are the only ones which can be found in the AT movement today. There are thus no organisations which are characterised at the same time by affluence (measured in terms of size of budget relative to number of staff), maturity and a high degree of specialisation; nor are there any highly specialised organisations with a very large budget.

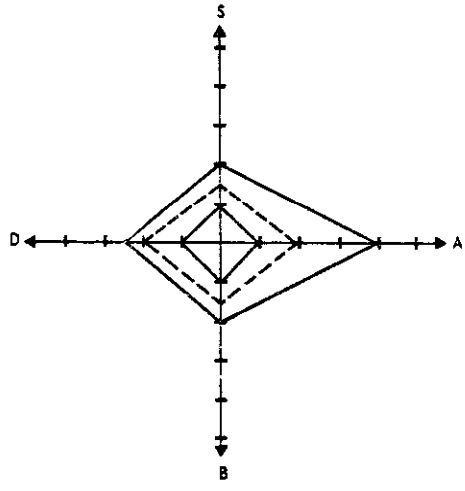
These seven basic types of AT organisations can be illustrated with the help of concrete examples: Table 21 lists four organisations for each of these seven types. These examples are taken from both industrialized and developing countries, and from among the specialised AT organisations as well as from among the so-called 'general' organisations.

A closer look at a list of the organisations falling under each of these seven types suggests that the AT movement is truly a worldwide movement, and that the conventional distinction between developing country organisations and industrialized country organisations is not as clear-cut as generally believed. Small, specialised AT groups can be found in both rich and poor countries, and if the

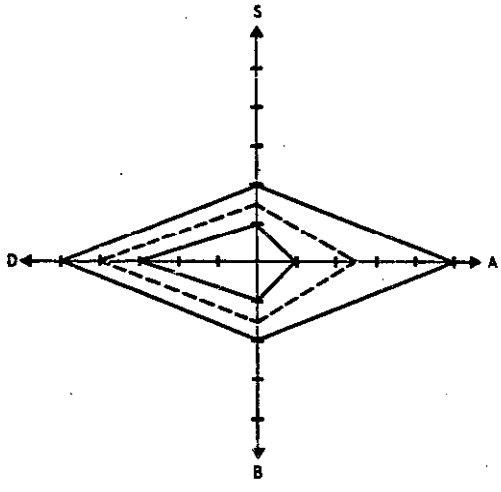
Figure 37 **TYPOLOGY OF APPROPRIATE TECHNOLOGY CENTRES**



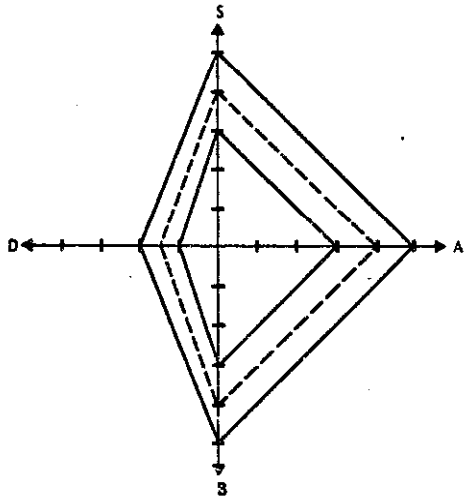
TYPE 1 : «RICH, MODERATELY DISPERSED MIDDLE AGE»



TYPE 2 : «SMALL AND SPECIALIZED»

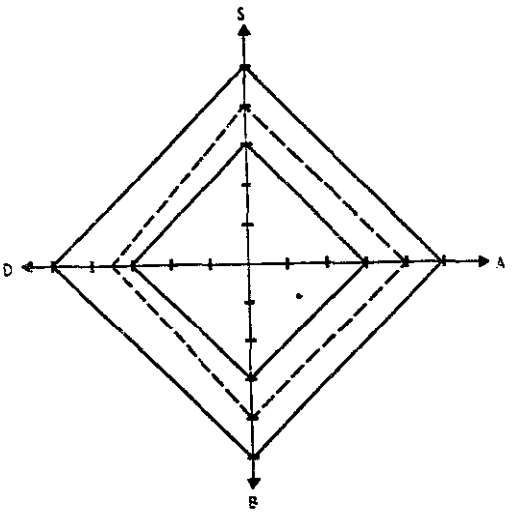


TYPE 3 : «SMALL AND DISPERSED»

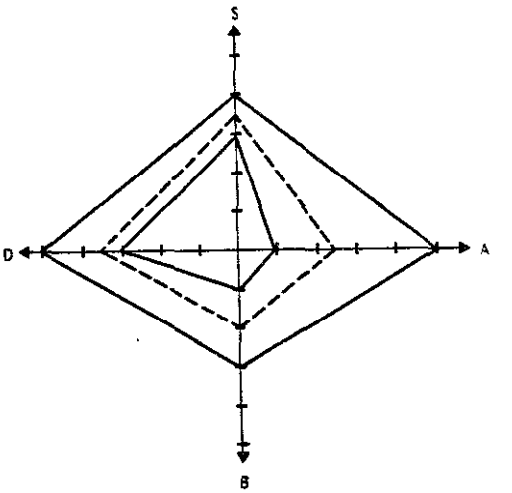


TYPE 4 : «LARGE, SPECIALIZED AND MATURE»

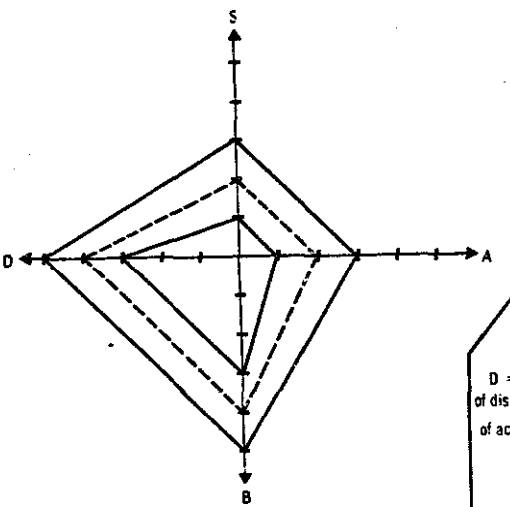
Figure 37 (Cont'd)



TYPE 5 : «LARGE, MODERATELY SPECIALIZED AND MATURE»



TYPE 6 : «POOR, DISPERSED AND WITH LARGE STAFF»



TYPE 7 : «YOUNG, RICH AND FAIRLY DISPERSED»

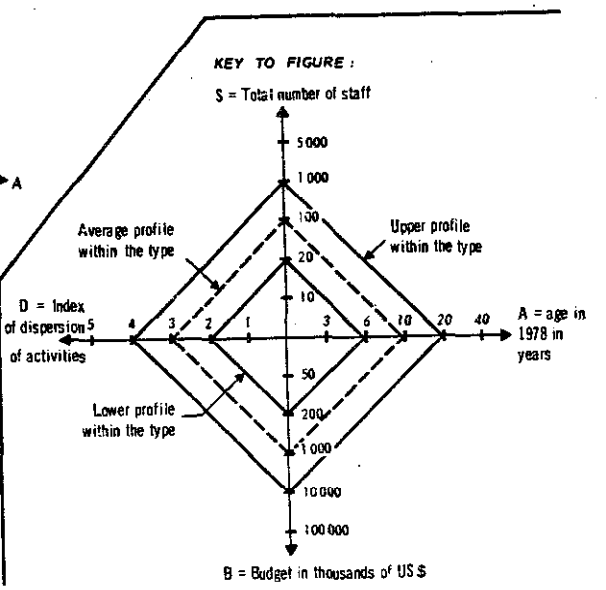


Table 21

EXAMPLES OF THE SEVEN DIFFERENT TYPES OF APPROPRIATE TECHNOLOGY ORGANISATIONS

TYPE 1: Affluent, mature and moderately dispersed

- Brace Research Institute (Canada)
- World Health Organisation (Switzerland/International)
- Mexican Foundation for Rural Development (Mexico)

TYPE 2: Small and specialised

- Minimum Cost Housing Group (Canada)
- International Forest Science Consultancy (United Kingdom)
- Group for the Development of Chemical Technology (Mexico)
- Housing Research and Development Unit (Kenya)

TYPE 3: Small and dispersed

- TRANET (United States)
- National Centre for Alternative Technology (United Kingdom)
- Appropriate Technology Development Association (India)
- Village Technology Unit (Indonesia)

TYPE 4: Large, specialised and mature

- Transport and Road Research Laboratory (United Kingdom)
- International Solar Energy Society (Australia)
- Nutrition Institute of Central America and Panama (Guatemala)
- African Medical and Research Foundation (Kenya)

TYPE 5: Large, moderately specialised and mature

- National Center for Appropriate Technology (United States)
- Tropical Products Institute (United Kingdom)
- Las Gaviotas (Colombia)
- International Rice Research Institute (Philippines)

TYPE 6: Poor, dispersed and with large staff

- Agromisa (Netherlands)
- Movement for the Promotion of Balanced Technologies (France)
- Development Technology Centre (Indonesia)
- Marga Institute (Sri Lanka)

TYPE 7: Young, affluent and fairly dispersed

- Danish Invention Centre (Denmark)
- California State Office of Appropriate Technology (United States)
- Environment Liaison Center (Kenya/International)
- Technical Development Division, National Training Centre (Colombia)

developing countries have a somewhat lower proportion of type 7 organisations, all the big regions of the world have a few AT organisations of each of the seven types (except for the OECD Pacific area, which has a very small total number of organisations listed in the Directory).

This typology can be viewed simply as an attempt to describe the AT movement and outline the basic structural profiles of individual AT organisations. However, it may also be used as an instrument for analysing the operations of individual organisations. If one looks, for instance, at the type 3 organisations ("small and dispersed"),

one can observe that quite a number of them belong to the category of networking institutions: their main function is to collect and disseminate information, encourage contacts between various AT groups and promote AT in a rather general way. This accounts in large part for the very high dispersion of their activities. In other terms, the profile corresponds fairly well to the function. There are, however, several AT organisations with the same basic profile which are in fact developing new technologies, carrying out development projects and trying to do the same amount of work as much larger and more specialised organisations. The wide dispersion of their activities, combined with a relatively small budget and limited staff resources, makes it difficult for them to reach their rather ambitious objectives, and this missmatch between profile and function can be a useful pointer to major organisational problems, and possibly to a need for major strategic reorientations.

In the same way, organisations belonging to type 6 ("poor, dispersed and with large staff") are likely to face difficulties that are very different from those confronting type 2 organisations ("small and specialised"). Most conspicuous of these difficulties are the lack of professionalism, the need to spend a considerable amount of time and effort on fund-raising and the lack of leverage on, and contact with, the main decision-makers in governments and industry. Type 2 organisations, by contrast, are generally widely recognised for their professionalism, but their smallness and high degree of specialisation makes it difficult for them to break out of their usual circle of contacts and expand into other fields of activity.

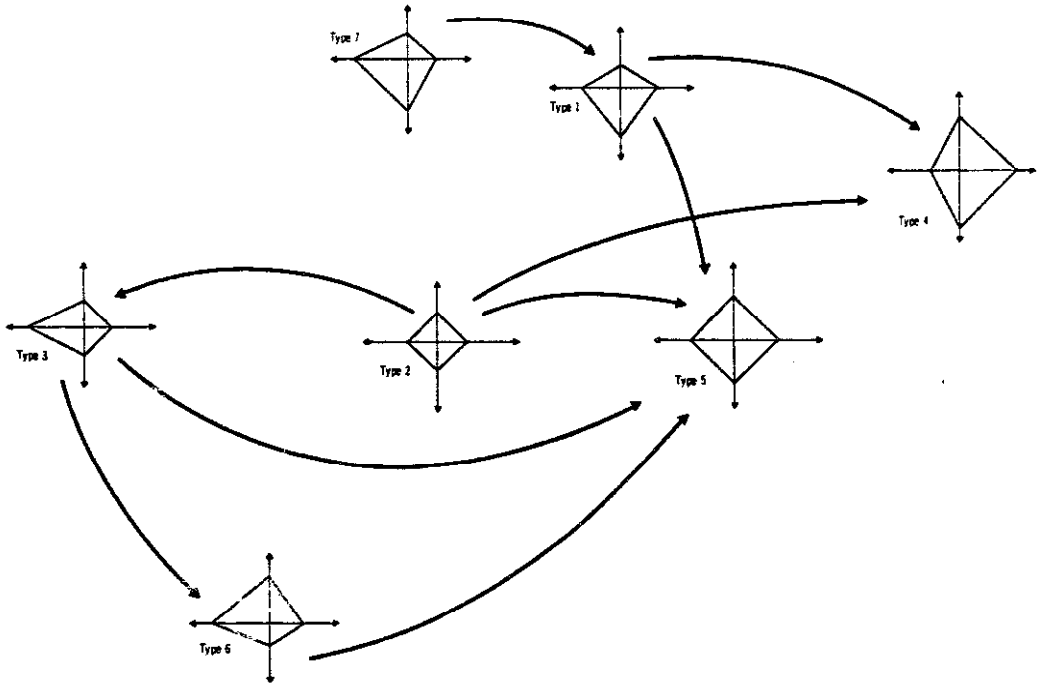
THE PATTERNS OF STRUCTURAL EVOLUTION

The typology presented in Figure 37 is essentially a photograph of the AT movement at the end of the 1970's, and it would be a mistake to assume that an organisation fitting into any one of these categories is bound to remain indefinitely in that category. Organisations grow larger and older, and the difficulties they face in the course of their work can bring about major reorientations in their strategies or forceful changes in their mode of operation.

Is there a 'normal' evolutionary path in the development of AT organisations? Do the overly dispersed organisations tend to move towards a higher degree of specialisation? Do the young and fairly affluent AT groups run the risk of turning into mature but increasingly impoverished organisations? Do some of the structural types outlined here represent an evolutionary dead end? Are others on the contrary more open-ended and more likely to serve as a fertile breeding ground for expansion and diversification?

There are quite obviously no simple answers to these questions. One can nevertheless try to outline in a rather impressionistic and necessarily sketchy way the paths of evolution from one type to the other. The diagram presented in Figure 38 is based essentially on a detailed analysis of the history of a fairly small sample of the 277 organisations figuring in the Directory, as well as on a rather subjective appreciation of the problems facing the AT movement as a whole. As such, it is not a scientific presentation, let alone a normative judgement as to what individual AT organisations should be doing in the future, but simply a general indication of the evolutionary patterns in the AT movement.

Figure 38 POSSIBLE TRANSITIONS BETWEEN DIFFERENT TYPES OF CENTRES



This diagram suggests three important observations. The first is that evolution and change are one of the distinctive features of the AT movement, and that the structure of an organisation is not determined once and for all at the moment the organisation is set up. The second is that certain structural types are probably inherently more evolutionary, or more open to change, than others. Type 2, for instance, ("small and specialised") can lead quite naturally to type 4 ("large, specialised and mature"), type 5 ("large, moderately specialised and mature") or type 3 ("small and dispersed"); by contrast,

type 4 or type 5 represent the final stage of an evolution, rather than a stepping stone towards a different structure. The third observation is that the patterns of evolution generally go in one way only - an organisation of type 2 can evolve into a type 4 institution, but the opposite is much less likely - and seem to follow certain logical sequences. Type 1, for instance, ("affluent, mature and moderately dispersed") is one of the major transitions between type 7 on the one hand ("young, affluent and fairly dispersed"), and type 4 and 5 on the other.

THE EVOLUTION IN THE MIX OF ACTIVITIES

The structural evolution of AT organisations presented in Table 38 can be completed by a diachronic picture of the relative importance of their different types of activity. Here again, this is a somewhat impressionistic view based on a relatively small number of organisations in both industrialized and developing countries. Despite its obvious limitations, it probably corresponds fairly well to the type of evolution through which many AT organisations have gone, notably in their early years (see Figure 39).

The two most important types of activity of AT organisations, as shown in Chapter 5, are research and development (R & D) and information-related activities, and this is reflected in the location of the two curves relating to these activities in Figure 39. What is important to note is that these two activities tend to decline in relative importance as an organisation matures. The decline, however, is not dramatic, and is only relative: the absolute number of man-months spent on R & D or information will be increasing substantially if the organisation itself is growing rapidly.

The other types of activities appear to be much more unstable, particularly in the early years of an organisation's history. After an initial decline, user-oriented activities (2) tend to pick up after five or six years, and in mature organisations become almost as important as R & D or information. This phenomenon, which can be observed in a number of the older AT groups, seems to be due to several factors. First is the pressure of necessity: once an organisation has developed a series of new technologies - and this can take several years - it often finds that the diffusion of these technologies is very difficult, unless a substantial effort is made to build up extension services and promote innovation in an active way. By that

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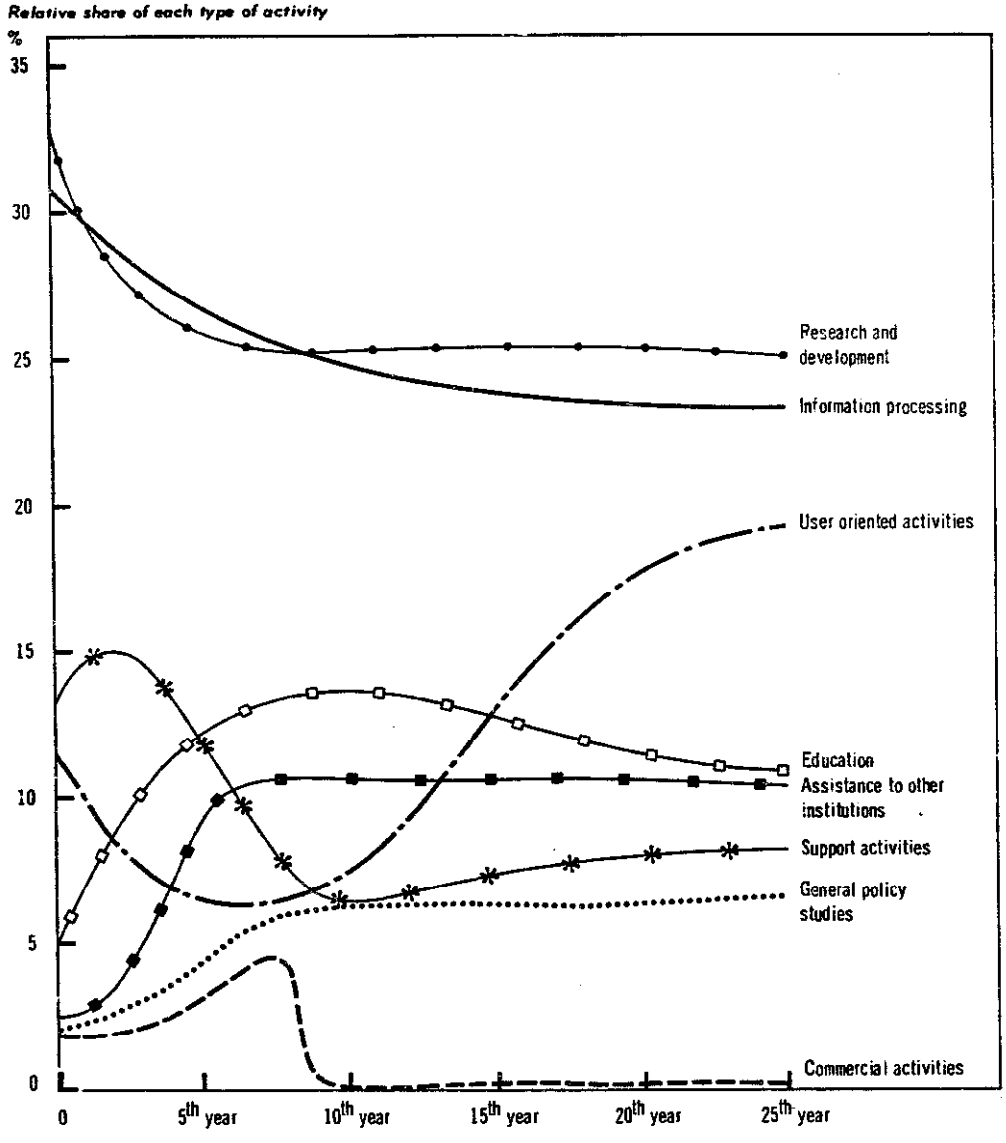
(2) The category of user-oriented activities includes technology-extension services, technology diffusion activities, the promotion of local technological traditions, demonstration work and exhibits.

Figure 39 **TYPICAL EVOLUTION IN TIME OF AN APPROPRIATE TECHNOLOGY CENTRE'S MIX OF ACTIVITIES**



time, many years may have elapsed since the organisation was established. This suggests that there is often a major time lag between the development of new products and the building-up of the infrastructure which is necessary to ensure the successful diffusion of these new products or new technologies.

A second reason which can help to explain the rather particular shape of the user-oriented activities curve is that, in the first few years of operation of an AT organisation, these activities, which are

known to be important, are in fact somewhat irrelevant, since the organisation has few new technologies to diffuse precisely because it is still so young.

The rapid growth of assistance to other AT institutions in the first few years of an organisation's life is very typical of the missionary nature of the AT movement, and this growth is matched by a similar expansion of educational activities, which themselves are often of a missionary nature. What may appear somewhat surprising is the evolution of commercial activities and support activities. Contrary to what the bottom curve in Figure 39 would suggest at first sight, commercial activities do not cease suddenly somewhere around the 10th year. What usually happens in fact is that these activities are transferred to a commercially-oriented subsidiary, or else are spun off to another organisation. Whether this is the most appropriate solution is debatable. It does, however, suggest rather clearly that even when they are successful from a commercial point of view, most AT organisations are not really equipped to handle the organisational, financial and managerial problems which go hand in hand with a fast-growing and successful commercial operation.

The decline of support activities (e.g. testing of new equipment, feasibility studies, consulting and engineering services) is also rather revealing of the structural problems facing AT organisations as they develop. These activities are known to be important, and are probably one of the most critical dimensions in the large-scale diffusion of AT. Yet somehow most AT organisations seem to have some difficulty in developing them, either because they are not fully equipped to do so (this is the case, for instance, of testing services), or else because they are better carried out by other types of organisations (e.g. engineering consulting firms).

Chapter 10

GENERAL CONCLUSIONS

The analysis presented in this book is essentially a picture of the AT movement at the end of the 1970's, and not a description of the ways in which the movement developed or a speculation as to the directions it might follow in the future. This photograph, like all photographs, is a static view of things and has obvious limitations as to depth of field and breadth of vision, but its 'statistical grain' is nevertheless sufficiently fine to reveal a number of patterns, trends, landscape features and personalities which have gone largely unnoticed until now, and which would deserve to be investigated in further detail. In this concluding chapter, we shall attempt to draw all the threads together and raise some of the issues which were not touched upon in the preceding chapters, or which appeared only in filigree in the analysis of the AT movement's growth, its fields and types of activities, its funding and staffing problems, its innovation diffusion mechanisms or its institutional nature.

Three sets of issues will be raised here. The first touches upon the revolutionary nature of the AT movement and the ways in which the cultural revolution it embodies is gradually penetrating into the top decision-making circles. The second is concerned with the strengths and weaknesses, structural and organisational, of the AT movement. And the third focuses on the processes of decision-making in technology, and notably on the ways in which AT groups could exert a greater influence on the technological system.

APPROPRIATE TECHNOLOGY AS A CULTURAL REVOLUTION

Technological and cultural revolutions often go unnoticed by those societies, institutions and individuals which are most directly concerned by them. One of the reasons for this is that, unlike political revolutions, they take place in a more gradual way and are somewhat less conspicuous than a brutal change of government or a military invasion. Another reason is that the threat they present is often deliberately ignored or underestimated, not because of will-

full blindness, but because it generally represents a very deep, and indeed inconceivable challenge to the existing order of things.

These revolutions in culture or technology usually have very profound effects on society and its main institutions, as clearly shown in recent times by the impact of the ecological movement and the consumerist movement on such industries as pharmaceuticals or automobile manufacturing, or by the effects of micro-electronics on employment, privacy, education and work relations. These revolutions, like political revolutions, are often crystallised and sometimes ignited by the written word, and notably by a best-selling book of major symbolic significance which captures the spirit of an emerging but still inchoate shift in values, and provides it with both legitimacy and substance. One such case was Thomas Paine's widely read book, *Common Sense*, which played a major part in the outbreak of the American Revolution of 1776. Another was Karl Marx's *Manifesto of the Communist Party*, whose influence will have shaped the history of the world for several generations, and a third is Theodor Herzl's *The Jewish State* which captured the spirit of Jewish nationalism at the turn of last century by proposing the inconceivable. Closer to our times, and in a somewhat different sphere, one might single out Rachel Carson's *Silent Spring* or Ralph Nader's *Unsafe at Any Speed* as the bellwethers of the now all-powerful ecological and consumerist movements. Little does it matter whether such books are right or wrong, or even entirely novel. In fact, what they have to say is seldom totally original, and other authors may have written much the same thing before. But somehow, by their timing, by their wording or by pure coincidence, they happen to match almost exactly the underground movements of society, and serve both as the detonators of revolution and as the catalysts of new cultural and political paradigms.

E.F. Schumacher's best-selling book *Small is Beautiful* quite clearly belongs to this small group of truly revolutionary books, and if the AT movement and its ideas have managed to acquire such prominence, it is due in very large to Schumacher's word. One is, of course, entitled to question whether the AT movement really represents the vanguard of a cultural and technological revolution, or whether the concepts and ideas it is trying to promote are anything else but a reformulation of something familiar. The difficulty here is that revolution is not always a verifiable event, especially when observed at the time of its occurence. Revolution, in fact, is often an interpretation of history given with the wisdom of hindsight and distance, and mankind's collective memory embodied in history is both subjective and selective.

Contrary to what most of its proponents would like to believe, the AT movement's revolutionary nature is not due to the technological innovations to which it is now giving birth, but rather to two other

less conspicuous but much more important factors. The first is the very far-reaching nature of its ideological and cultural critique of the prevailing economic system throughout the world. What the AT proponents are saying, or trying to say, is that the economic, technological and industrial evolution of the last hundred years, or more, has pushed us into the wrong directions altogether. The critique is no doubt exaggerated, and often unjustified, and it would be easy to fault it for its oversimplifications, its missreadings of history, its deliberate ignorance of the very positive achievements of our present technological system and its unawareness of the fact that technology is the product of a cultural demand, and that if the technology is wrong, the fault does not lie exclusively in the hands of those who developed it. What is important about this critique, however, is neither its correctness nor its mistaken nature, but the very fact it is addressed to the basic values and operating rules of the system - from the profit motive to the primacy of economic efficiency, and from the ethics of growth to the belief in the universality of contemporary technology. Revolutions do not happen because of a few piecemeal failings in the system: they occur when its ground-rules are put into question.

The second important factor lies in the position and influence of the critics. As Tocqueville correctly observed in his less well known but equally important book, *L'Ancien Régime et la Révolution*, revolutions do not occur when the existing political or social system is challenged by outsiders - be they poor farmers or the urban proletariat - but only when it is put into question by the ruling elites themselves, or at least by a significant minority within these elites, and notably by its intelligentsia. Sociologically speaking, the AT movement has many features in common with the intellectual elites that brought about political revolutions in other places and other times. Not only because of the educational level of its members, the urban location of its activities or the intensity of its communications networks, but because of a much more subtle phenomenon of termite-like penetration into the decision-making circles of governments, industry, banks, political parties and trade-unions. This penetration, like that of termites in a wooden building, can go unnoticed for a number of years, and it is, therefore, rather difficult to measure its progression. The signs that it has gone rather far are nevertheless unmistakable; when the chairman of a national Atomic Energy Commission in a major OECD country reveals himself to be a major supporter of AT, when the president of a high technology multinational corporation sets up a subsidiary to work on small-scale farming methods, when one of the world's leading newspapers regularly devotes two or three pages of its Sunday supplement to alternative life styles, or when a multi-billion dollar commercial bank establishes specialised

subsidiaries to make fifty- and hundred-dollar loans to small farmers and poor urban craftsmen in the developing countries, then it is no longer possible to dismiss revolution as mere wishful thinking on the part of its prophets and visionaries.

These few examples, chosen from among dozens of other similar instances, suggest that the ideas of the AT movement have penetrated much deeper, and much higher, than the critics of AT would like to believe. For the moment, of course, the practical achievements of this revolution are still modest, and they are no match for the existing technological system as we know it today. But what is important is that this revolution portends what may be a radical shift in the cultural demand for technology. Technology is the product of a culture, and its evolution is determined less by what is technically feasible than by what is socially acceptable and culturally desirable. What is now happening is that the AT movement, consciously or not, has helped to crystallise a social demand for new types of technology which are less capital-intensive, smaller in scale, more sparing of natural resources and less uncongenial to man and his cultural environment. The technological system, represented by large industrial corporations, conventional research centres, investment institutions, planning agencies and educational establishments, has yet to adapt to this new demand. This takes time, and indeed a very long time, not because of ill-will, incompetence or sheer blindness, but simply because of the rather long lead-times between the emergence of a new demand and its satisfaction through new products or new services. What we have today is a basic missmatch between what society requires and what the technological system has to offer, and the size of this missmatch is due in no small part to the rapidity with which this cultural demand for technology has changed in the last few years.

THE STRENGTHS AND WEAKNESSES OF THE APPROPRIATE TECHNOLOGY MOVEMENT

The AT movement is both much stronger than generally believed, and much weaker than its rapidly growing size would suggest. As we have tried to show in the preceding chapters, the rate of growth of the movement, the scale of its activities, the size of its research effort and the volume of its financial resources are considerably larger than was thought to be the case until now. This quantitative expansion exceeds by far the wildest dreams of the lone pioneers of the 1960's, but growth alone cannot solve everything, and a number of fundamental problems remain.

The first, but not necessarily the most important, of these problems is the high amount of 'noise' within the AT system: as a result both of the very rapid growth of the movement and the generalised lack

of experience as to how to start up and develop meaningful activities in this field, the best of the specialised AT groups spend an inordinately large amount of their time and effort on communication with, and technical assistance to, newcomers and fresh converts. This work is undoubtedly important, and is in line with the missionary nature of these groups. It does, however, tend to detract from the ultimately more important task of developing new technologies, promoting new projects and working out the ways in which innovation can be most successfully diffused. It is interesting to observe in this connection that some of the AT groups which are known to be among the most effective and the most original have recognised this danger, and have in fact virtually cut themselves out of the international communications system in order to devote all their energies to experimentation, research and pilot projects. Some others, which are not necessarily among the best but which have a certain reputation, based in part upon their early entry into the AT field, have gone the opposite way, and spend most of their time on interaction and conference-mongering. The balance between missionary work, splendid isolation and noise-making is certainly not easy to draw, given both the tremendous interest in AT and the absence of any real market mechanisms (e.g. bankruptcy) to validate the social utility of an AT group's work. With a few exceptions, the AT movement has yet to solve this problem.

A second, and ultimately more serious, problem is the complexity of the R & D process and the inability of the great majority of the specialised AT groups to master the difficult and painstaking problems that face any technological innovation, from the initial idea to a successful commercial or social application. Contrary to what is widely believed, AT's are generally neither easy to design, nor simple to develop. This is true even of such apparently straightforward and well-known products as hand-operated water pumps or cheap household water storage tanks. Products intended for use by very poor people or which have to operate under harsh conditions (geographic isolation, absence of repair and maintenance facilities, difficult climate) need to be immensely more reliable than most AT proponents deem necessary. The design and engineering challenges are often formidable, but tend to be vastly underestimated by the majority of the specialised AT groups. This raises a critical question: are these groups really the most appropriate type of institution to carry out the complex research and design work which is necessary if AT is to remain more than an idea, or a demonstration project without any real future? Two approaches can be envisaged here. The first would be for AT groups to build up and expand their research, testing and engineering capability. The second would be to have this work carried out by the institutions which have the experience and the manpower to do it, namely industrial firms and conventional research centres.

The first solution is the more appealing one to the AT movement, given its early anti-establishment ideology and its distrust of both governments and industry. The second is probably the more realistic one, and this is why the involvement of industrial firms, government research centres or private consulting groups in the AT movement is so important: these are precisely the institutions which have the technical capacity, the organisational infrastructure and the professional experience to do what the specialised AT groups might like to do themselves, but usually cannot because of their small size and their necessarily limited technical expertise.

A third problem facing the AT movement in general, and the specialised AT groups in particular, is the weakness of its linkage with the investment system. What one often tends to forget is that the successful diffusion of innovation, be it in the form of a new product (e.g. the automobile or the computer) or a new service (e.g. centralised water-borne sewerage systems, or sophisticated health care) depends not only on the availability of technology and organisational capabilities, but on the willingness of the investment system - from finance ministries and private banks to individual investors and pension funds - to put its money into these new ventures. This may sound like a statement of the obvious, and indeed it is. Yet this is one of the fundamental aspects of the innovation system which the specialised AT groups, as well as a fair proportion of the 'general' organisations within the AT movement, have almost totally neglected. Why this should be the case is in itself rather symptomatic of the AT movement's internal problems and blind spots.

AT may have a lot to offer, and many of the concepts promoted by the movement are basically sound. It stands to reason that in a very poor country, the cost of creating new jobs should somehow be related to the average level of income, in the same way that the operating costs and initial investment in a public service should be in line with the ability of its beneficiaries to pay for it, directly or indirectly. What is not sufficiently realised is that even the lowest-cost technologies, if they are to be diffused on a massive scale, call for truly staggering investments. Take the cost of water supply or waste disposal for instance. We know that it is technically and economically feasible to develop such services for an initial investment cost of around one hundred dollars per person, and for an annual operating cost of approximately ten dollars. This may look inexpensive, but when put in relation with the needs of a large city, the sums involved are quite unrelated to the normal scale of operations of an AT organisation: for a metropolis of 5 million people, such services would each require a total initial investment in the region of 500 million dollars.

The problem facing the AT movement here is somewhat similar to the one concerning the expansion of research activities: either the AT groups try to expand their activities and become part of the group of institutions in the financial system, or else they try to focus their effort on influencing the existing investment system and shifting its financial flows to projects and services which embody AT's, and which for this reason are more in line with the imperatives of social equity.

This problem of linkages with the investment system and the research system suggests that the greatest strength of AT organisations does not lie in their ability to duplicate what others have done, or are doing every day, but rather in their aptitude to carry on what they have done so well until now, namely to initiate and sustain a revolutionary change in our culture, our attitudes towards technology, our perception of man's relationship with nature and his fellow men, and our awareness of the difficulties of tomorrow. To start a revolution is one thing; to keep it going is another, and the ways in which this can be done are still far from clear.

If one accepts the view that the specialised AT groups as we know them today will continue to remain fairly small, but will become much more numerous and more highly diversified, which could be their most productive fields of cultural subversion? The answer is far from clear, but one of them could well be a contribution to fairly radical changes in the technological decision-making process.

THE PROCESS OF TECHNOLOGICAL DECISION-MAKING

In its early days, the AT movement assumed almost as a matter of faith that the social and technological problems facing both industrialized and developing countries were linked with the use of inappropriate technologies. The obvious response to this problem was to try to develop, and experiment with, new technologies which were more simple, better adapted to the local environment, less costly in terms of investment resources and more easily understandable by those who were eventually to use them. This search for alternatives was very productive, not only because of the specific innovations to which it gave birth, but also and perhaps even more because of the questions it raised and because of the encouragement it gave to entirely new lines of research.

The dominant idea underlying this search for alternatives had a compelling logic: if such alternatives were one day to play a major role, they first had to be proven viable, and the only way to do so was to develop them so as to prove the validity of the concept. Hence the major emphasis given to the invention of new devices, new types of equipment, new machinery and new tools.

This search for alternatives and this priority given to the demonstration effects was essentially the hallmark of what we have called the 'developing country family' of AT organisations. Parallel to this, but somewhat later in time, came the AT groups with a much more direct interest in industrialized country problems, and whose main concern was the development of an alternative technological system which was to be institutionally and organisationally completely detached from the existing economic system - as illustrated by the creation of communes, independent community organisations and self-sufficient farming groups.

Both approaches were probably justified ten or fifteen years ago. But what has happened in the meantime is that the ideas and concepts of the AT movement, which represented a rather minor counter-culture with a strong anti-establishment bias, have come to acquire a popularity and prominence which is far greater than the early pioneers of the movement had ever dreamed of. The reasons for this rather sudden and rapidly growing acceptance of the AT movement's ideas are rather complex, and still far from being fully understood. What probably played a major part was the oil crisis of 1973 and the generalised economic slowdown throughout the world that followed it, but there is little doubt that the explanation, if there is one, is not purely economic, but social and cultural. In any event, what seems to have happened some time in the course of the 1970's is that the ideas promoted by the AT movement have rapidly come to acquire a high degree of political and cultural legitimacy within the establishment. In other terms, the cultural revolution is in the process of succeeding.

This has come to pose a set of problems which are entirely new, and which most AT groups are still largely unaware of: the issue today is not to develop new pieces of hardware to prove the validity of the AT concept, or to create a micro-society of anti-establishment institutions, but rather to develop the methodologies, institutions and mechanisms which will allow the 'system' (i.e. government agencies, research centres, educational institutions, banks, industrial firms or community organisations) to translate its commitment to AT into new technologies, new ways of doing things and new organisational structures.

We know today that it is technically feasible to develop a wide range of new technologies which are smaller in scale, less capital-intensive or better adapted to the local environment than the mainstream technologies which form the basis of our current economic system. We also know from the penetration of the AT movement's ideas and concepts into the decision-making elites of industry and government in both developing and industrialized countries that there is an unexpectedly high degree of interest in, and receptivity to, this need for using more appropriate types of technology. The ways in which

interest and receptivity can be expressed in the form of innovation, new institutions or more appropriate projects is, however, far from clear, and one might suggest here that this problem is probably the most important challenge facing the AT movement at this point in time.

One line of action might be to work much more seriously than is now the case on the decision-making processes in technology. Contrary to what conventional economic studies on the subject would suggest, the process of technological decision-making is not simply the result of an economic or technical decision taken at a clearly identified moment in the innovation process, but the expression of complex iterative process of interactions between values, personalities, objectives, policies and constraints. Decision-making, contrary to what the term indicates, is not an act but a process, and it is important to understand how the process functions if its results - the 'decision' in the narrow sense of the word - are to be modified.

The problem can perhaps best be understood by looking in a rather schematic way at the project cycle, i.e. the various phases of development of a project, from its conception to its operational implementation and final evaluation. The type of project cycle used here for demonstration purposes is that followed by development banks, but it should be stressed this mechanism is not basically different in other types of institutions, be they government departments or industrial firms. Our reason for focusing on the project cycle rather than broad policies or specific technologies is that projects are in effect the operational units in the technological system, and are both sufficiently broad to serve as the overall carriers of innovation, and sufficiently narrow to allow for specific modifications and reorientations. It is not, of course, the only conceivable level of analysis, and it is important to keep in mind that the project cycle, however important, is not the only element in the technological system.

By far the most important phase in the project cycle is the appraisal stage. Appraisal, in effect, is the detailed description of a project, of its economic justification, of its technical parameters and of its social or commercial utility. The object of the appraisal, which is physically embodied in a usually rather lengthy report, is to present the economic rationale for the project to the people - board of directors, president or executive directors - who have the authority to take a final decision, positive or negative, about its execution. In most cases, the decision is positive, not because the board of directors is a mere rubber-stamping group - but simply because the projects which are unlikely to get their approval are eliminated in the earlier phases of the cycle. By the time a project has reached the appraisal stage, it cannot be modified in any significant way: its technical parameters are frozen, its size is determined, and its institutional set-up is pre-ordained. Even when the appraisal

report does contain a detailed examination of alternative technological options, this examination is not presented as a set of options open for discussion or choice, but rather as an indication that alternatives options have been taken into account, but finally rejected for a number of economic, technical or institutional reasons. In other terms, the choice of technology has already been made, and if such choices are to be modified, this can only be done in earlier stages of the cycle.

One, therefore, has to look at the earlier stages, and the examination of the ways in which these technological decisions are taken shows that the choice is much less straightforward than the classical analyses of technology choices in the economic literature would suggest. It is in fact a complex social and cultural process where rationality and logic are not the only determinants. Two of the critically important project phases in this respect are those of project identification and project preparation.

Project identification, as the term clearly suggests, is the moment in time where the generalists from banks, planning ministries or other agencies, identify a need, or market opportunity, which can be translated into a viable and clearly identifiable project. A number of factors come into play here. One is the experience of the project identifiers as to what would be required by the market at this particular stage of development. Another is the feedback from national planning authorities, which gives an often rather detailed idea of the directions in which the economy should be moving in the next few years. And a third, but much less conspicuous, factor is the system of values, the culture and the professional yardsticks of the organisation which will ultimately be financing or executing the project.

In most cases, there is no conscious or clearly expressed technological decision in this identification stage: the identifiers have a fairly good idea of what is technically or organisationally feasible, and their mission is essentially to set the broad parameters of the project. It is important to realise that this process of project identification entails a number of implicit technology choices. If the project is identified at this stage as a fairly big project, for instance, it will almost automatically follow that the technologies used in it will be of a capital-intensive and rather complex nature. This will almost necessarily rule out the selection of more labour-intensive and perhaps more appropriate types of technology. In the same way, the subtle pressures put on the project identifiers by the sponsoring organisations to meet the growth and development objectives both of the organisation and of the country in which the project is to be carried out act, in effect, as a very strong deterrent against the use of AT. Added to this is the risk element: a project must be successful, and one of the best ways to ensure this is to stick to well-

known technologies which have been proven elsewhere, and refrain from using AT's which are untested, complex to manage or difficult to duplicate.

All these elements amount to a very effective deterrent against the use of AT. What is more, even when the project identifiers are aware of alternative technologies and would like to foster their application, there are very strong institutional, political and managerial pressures acting in the opposite direction. The project identification stage is not, of course, the only point in time in which important if implicit technological decisions are made. It is, however, one of the most important stages in this respect, and one which has received very little attention on the part of the AT movement. One might, therefore, suggest that this critical moment in the innovation process is potentially one of the most rewarding, if complex, fields of activity for AT groups throughout the world.

The second critically important stage from a technological point of view is that of project preparation. This work, carried out for the most part by independent consulting and engineering firms, consists essentially in working out the technical, economic and institutional details of the project, setting out the technical parameters and specifications of the various types of equipment that will be used in it, and outlining the detailed procedures in which the project will eventually be carried out. The firms chosen to do this preparation work are usually selected after a process of competitive international bidding. This means in practice that they are usually rather large and reputable groups based in the industrialized countries, and with a much greater experience of the technologies used in these countries than with the more appropriate and more labour-intensive technologies which AT groups are seeking to promote.

As we have seen in the previous chapter, there are a few specialised AT consulting and engineering firms, but their number is still small, and their experience is no match for the larger international consulting groups against whom they are pitted in the competitive bidding process. One of the most effective ways to promote the more widespread use of AT in projects might therefore be to encourage the development of AT-oriented consulting and engineering firms, and act simultaneously on the existing international consulting firms which now dominate the 'market' for project preparation.

The consulting and engineering firms involved in project preparation are, of course, not entirely free to select the types of technologies they want, or deem most appropriate. The reason for this is that they have to conform to the broad project parameters established at the identification stage by the development banks or government departments. Within this framework, however, there is still a fairly wide range of technological options, and some of these may be in line

with the principles and ideas of the AT movement. In fact, several of the large engineering and consulting firms have shown a distinct interest in AT and are trying to promote the use of more appropriate types of technology in the projects they prepare. The problem, however, is not that they are totally unaware of AT or unwilling to give it a chance, but rather, in their opinion, that the project identifiers seldom, if ever, ask them to look into the possibility of using alternative technologies. The degree of technological initiative enjoyed by the consulting firms which prepare projects is in fact probably somewhat greater than they imagine, and the constraints outlined at the identification stage are perhaps not as rigid as they are generally assumed to be. The fact remains that consulting firms with a much stronger AT orientation could probably come to play a more active role in the promotion of AT, and this may well be another of the promising lines of action for the specialised AT groups now active throughout the world.

A third stage in the project cycle with an important, if indirect, influence in the technological decision-making process is that of evaluation. This is the stage which comes at the end of the cycle, once the project has been completed. Its basic purpose is to evaluate how well the project has conformed to initial expectations, and notably whether it has met its economic and financial objectives. In the great majority of cases, the evaluation is economic and financial and not technological, and no attempt is made to measure the project's impact on the development of local technological capabilities or the appropriateness of the technologies upon which it is based, let alone to draw any technological lessons for the development of future projects. This evaluation process, if carried out in other than a purely financial and economic perspective, can yield a number of important insights into the problems of technology choice and diffusion and serve as the basis for developing more effective innovation strategies, as well as a much better understanding of what constitutes a truly appropriate technology. This, however, is seldom done, and there are good reasons to believe that a concerted action on this phase of the project cycle could be very rewarding.

These three examples - project identification, project preparation and project evaluation - suggest that the technological decision-making process is rather complex and much less rational than it appears to be at first sight. At the same time, they suggest that the opportunities for influencing this process, or reorienting it into more desirable directions, are quite significant, and would deserve to be explored in a much more systematic way. Developing technologies which are more appropriate is one thing; finding more money to promote AT projects is another. But perhaps the most important thing is to try to act on the nodes, or inflection points, of the technological system, i.e. on the processes of decision-making.

APPENDICES

Appendix 1

NOTES ON METHODOLOGY AND SOURCES

This Appendix is intended to provide the reader with further details about the methodology used in compiling the tables and figures presented in the book. Wherever necessary, it indicates the degree of reliability of the data, their coverage and the abbreviations used.

Unless otherwise specified, all the data have been drawn from the responses to the OECD questionnaire, the full text of which is reproduced in Appendix 3. The full list of organisations covered in this survey is given in Appendix 2.

The base year for the data is 1977.

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Table 1

RESPONSES TO OECD QUESTIONNAIRE - BREAKDOWN BY GEOGRAPHIC AREA AND TYPE OF ORGANISATION

This Table was originally published in the *Appropriate Technology Directory*. The classification of AT centres by type of organisation is based on the indications provided by the centres in their response to the questionnaire. Centres which did not respond, or which provided only incomplete answers, were ranged on the basis of direct and indirect evidence (name of centre, physical location, etc.) in the category which appeared as closest to their effective affiliation. Centres belonging to two or more categories (e.g. an AT unit tied to a university and working primarily on the promotion of small-scale industry) were attributed to the category which appeared historically and institutionally as the most important.

Figure 1

THE WORLD-WIDE COVERAGE OF OECD'S APPROPRIATE TECHNOLOGY DIRECTORY

Key to abbreviations of map:

AFG Afghanistan
ALB Albania
ALG Algeria
ARG Argentina
AUS Austria
BAR Barbados
BDI Burundi
BEL Belgium
BEN Benin
BHU Bhutan
BOL Bolivia
BOT Botswana
BUL Bulgaria
CAM Cameroon
CAR Central African Republic
CHD Chad
CNG Congo
COL Colombia
COS Costa Rica
CVI Cape Verde
CYP Cyprus
CZE Czechoslovakia
DEN Denmark
DOM Dominican Republic
DRY Democratic Republic of Yemen
ECU Ecuador
ELS El Salvador
FIN Finland
GAB Gabon
GAM Gambia
GBI Guinea-Bissau
GDP Guadeloupe
GDR German Democratic Republic
GER Federal Republic of Germany
GHA Ghana
GRE Greece
GUI Guinea
GUY Guyana
HAI Haiti
HON Honduras
HOK Hong Kong
HUN Hungary
ISR Israel
IVC Ivory Coast
JAM Jamaica
JOR Jordan
KEN Kenya
KUW Kuwait
LEB Lebanon
LES Lesotho
LIB Libya
LIR Liberia
MAG Madagascar
MAL Malaysia
MAR Mauritius
MAU Mauritania
MLI Mali
MLW Malawi
MOR Morocco
MOZ Mozambique
NAM Namibia
NER Niger
NET Netherlands
NHE New Hebrides/Vanuatu
NIC Nicaragua
NOR Norway
PAK Pakistan
PAN Panama
PAR Paraguay
PNG Papua-New Guinea
POL Poland
POR Portugal
PUE Puerto Rico
REU Réunion
ROM Romania
RWA Rwanda
SAU Saudi Arabia
SEN Senegal
SIL Sierra Leone
SOM Somalia
SWA Swaziland
SWE Sweden
SWI Switzerland
SYR Syria
TAZ Tanzania
TOG Togo
TRI Trinidad and Tobago
TUN Tunisia
TUR Turkey
UAE United Arab Emirates
UGA Uganda
UKK United Kingdom
UPV Upper Volta
URU Uruguay
VEN Venezuela
YEM Yemen
YUG Yugoslavia
ZAM Zambia
ZIM Zimbabwe

Notes:

The three letter codes, or country abbreviations, used in this figure are the same as those used in the *Appropriate Technology Directory*.

The areas of countries are proportional to their 1977 population as given in the *Atlas* of the World Bank, Washington, 1979; for the sake of clarity, some smaller countries with relatively important AT activities are drawn somewhat larger than they really are. Countries with a population of less than 500,000 have been left out of this map, except if they had important AT activities.

The country coverage of the *Appropriate Technology Directory* and of the statistical analysis presented in the present book is shown in the form of four different shadings. Blank areas indicate that the country in question was either not covered in the Directory because of lack of responses to our questionnaire (e.g. socialist countries of Eastern Europe, Soviet Union or China) or else was presumed, on the basis of the available evidence, not to be currently engaged in significant AT activities (e.g. Afghanistan, Burma or Paraguay). The three different shadings used for countries which were covered should be considered primarily as indicative, owing to the difficulty of identifying the total volume of AT activities in any given country.

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Figure 2

RATE OF CREATION OF NEW APPROPRIATE TECHNOLOGY CENTRES, 1945 - 1978

This figure is based on the responses to questions 5a and 5b of the questionnaire. It covers 117 centres in the developing countries and 114 centres in the industrialized countries, i.e. 83 per cent of the 277 organisations listed in the Directory. The total for 1975-1978 is an estimate which understates the number of new centres established in that period.

The graph is very well adjusted by an exponential curve and satisfies the following formula:

$$N = 2.7 \times 2^{t/6.418}$$, where

N = number of new centres established in years $1945 + t$ and $1948 + t$

This corresponds to a growth of approximately 12 per cent a year, and a doubling in the total number of organisations every 6 years and 5 months.

In order to get an annual estimate of the newly-created AT centres, it can be assumed either that there is the same annual growth within each 3-year period, or that the same exponential

growth occurs. Both assumptions give rather similar results, which leads to the following formula:

$$n = 0.9 \times 2^{t/6.418}$$, where

n = estimated number of centres established in year 1945 + t

The cumulative number of AT centres is then N_c

$$N_c = 8.3 \times 2^{t/6.418}$$

This formula gives N_c = 286 for 1978, which is only slightly higher than the total of 277 organisations covered in the Directory.

On the average, all the developing country organisations started to work on AT some 4.2 years after being set up. The corresponding figure for the industrialized country organisations is 5.9 years.

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Table 2

THE APPROPRIATE TECHNOLOGY MOVEMENT IN 1977: NUMBER OF ORGANISATIONS, BUDGET AND MAN-MONTHS OF WORK ON APPROPRIATE TECHNOLOGY

The budget figures are drawn from the responses to questions 7 (total budget of centre, or b_7), 14 (budget breakdown by sources of funding, or b_{14}) and 15 (budget breakdown by types of activities, or b_{15}). In order to take into account all the centres in the Directory, including those which did not respond to all three questions, a weighted average of the budgets of each region was calculated according to the following formula:

$$B = \frac{B_7 + B_{14} + B_{15}}{n_7 + n_{14} + n_{15}} \times n$$, where

B = total corrected budget of the region

n = total number of centres in the region

$B_7 = \sum b_7$ = total budget given in answer to question 7

n_7 = number of answers to question 7, with similar definitions for B_{14}, n_{14} (question 14) and B_{15}, n_{15} (question 15)

The same calculation was done for international organisations. Since several of them did not give any details about the relative size of their AT activities, these were assumed to amount to approximately 10 per cent of their total budgets.

For the calculation of the total number of staff working on AT, a correction was made to the basic data for each region (answers to question 6) in order to take into account the in-

complete responses. The non-respondents were considered as 'average' centres as far as staff numbers are concerned. This average was calculated on the basis of the figures provided by all the responding centres of the region, but excluding the upper and lower 5 per cent of centres (very small and very large organisations).

The same corrections were made for calculating the total number of man-months of work on AT.

Page 28 Table 3

RELATIVE SIZE OF APPROPRIATE TECHNOLOGY ACTIVITIES IN SELECTED COUNTRIES

The data of GNP growth rates are drawn from the second edition of the *World Tables*, the World Bank, Washington, 1980.

In the calculation of the real growth rates of AT budgets, inflation was taken into account in two ways. For the majority of organisations which gave their budgets in US dollars, the figures were adjusted in line with the international depreciation of the dollar (5.5 per cent a year). For those which gave their budgets in national currency, the figures were adjusted in line with the national rate of inflation as given in the *World Tables*, and the change in value of the national currency relative to the dollar.

In the calculation of the size of AT activities relative to GNP, the figures resulting from the questionnaire were adjusted upwards to take into account the rate of coverage for each country, i.e. if the rate of coverage was C per cent, the figures were multiplied by 100/C.

The index in the fourth column of the table expresses the rate of growth of AT budgets relative to GNP growth. Let

g = annual growth rate of GNP (in per cent)

a = annual growth rate of AT budget (in per cent)

AT budgets and GNP at year t are related with their counterparts in year t - 1 in the following way:

$$GNP_t = (1 + g/100)\ GNP_{t-1}$$

$$\text{AT budget}_t = (1 + a/100)\ \text{AT budget}_{t-1}$$

The index is computed as $\text{index} = 100 \times \frac{(1 + a/100)}{(1 + g/100)}$

so that $\text{AT budget}_t = \text{constant} \times GNP_t^{\text{index}/100}$

The index is 100 if both rates are equal; if it is 200, then the AT budgets grow as the square of the rate of growth of GNP.

In the AT budget figure for France, the CNEXO (Centre national pour l'exploitation des océans) was excluded. The figure for Switzerland includes the AT activities of agencies of the United Nations system located in that country. For Colombia, Mexico, Nigeria and the Philippines, the figures include the AT activities of the research centres of the CGIAR network (Consultive Group on International Agricultural Research).

Pages 30 and 31 — Figures 3 and 4

THE TRANSITION TO APPROPRIATE TECHNOLOGY IN THE DEVELOPING COUNTRIES AND IN THE INDUSTRIALIZED COUNTRIES

These two figures show the correspondence between the year of creation of 231 organisations (out of a total of 277) and the year in which they began to work on AT (response to questions 5a and 5b). Each dot represents one or several organisations created in the year given on the X-axis and which started to work on AT in the year given on the Y-axis. The size of the dots is proportional to the number of organisations.

Page 32 — Table 4

THE BASIC TYPOLOGY OF APPROPRIATE TECHNOLOGY ORGANISATIONS

No comments

Page 34 — Figure 5

THE FOCUS OF ACTIVITIES OF CENTRES IN THE INDUSTRIALIZED COUNTRIES (1977)

The main focus of activities of each organisation was determined by the description of its activities, its main fields of work and the geographic region on which its technologies are focused (questions 12, 16 and 17). The activities of organisations which did not provide any explicit information were considered as focusing both on industrialized and developing country problems, as were those of organisations clearly working on both types of problems. The data are based on the number of organisations, not on their manpower, their budgets or their man-months of work on AT. Coverage: 64 organisations in North America, 67 in Western Europe.

Page 35 Figure 6

MAIN LOCATIONS OF APPROPRIATE TECHNOLOGY CENTRES IN 1977

This map covers all the cities which have at least two AT organisations figuring in the Directory. "City" is defined here as the metropolitan area.

Page 36 Table 5

SPATIAL DISTRIBUTION OF APPROPRIATE TECHNOLOGY ORGANISATIONS

In the decentralisation index, "main towns" are defined as cities of more than 200,000 inhabitants in the case of countries with a population under 10 million. For countries with a population above this figure, a main city is a town with over 500,000 people. Coverage: 277 organisations.

Page 39 Figure 7

DISTRIBUTION OF CENTRES BY NUMBER OF FIELDS OF ACTIVITY (1977)

The different fields of activity taken into account in this figure are those listed in question 16. In each of the 'main' or 'general' sectors of activity (energy, health, water, etc.), the category 'other fields of activity', if it was mentioned by a respondent, was counted as one of its fields of activity. Those organisations which mentioned only one or several general fields of activity were assumed to be working in all the sub-fields under that heading.

Page 41 Figure 8

THE MAIN FIELDS OF ACTIVITY OF APPROPRIATE TECHNOLOGY CENTRES (1977)

This figure is based on the answers to question 16. Activities which were mentioned as 'important activities' were given a weighting of 3, and those which were described as an 'occasional activity' were given a weighting of 1. This weighting is somewhat subjective, but has no direct influence on the relative position of the different fields of activity, or on the relative interests of developing and industrialized countries in specific subjects.

Pages 47 and 48

Figure 9

RELATIVE IMPORTANCE OF FIELDS OF ACTIVITY IN INDUSTRIALIZED AND DEVELOPING COUNTRIES (1977)

The percentage of organisations working in each field was calculated on the basis of the same weighted average between 'important' and 'occasional' activities as in Figure 8.

Pages 50 and 51

Figures 10 and 11

RELATIVE IMPORTANCE OF MAIN FIELDS OF ACTIVITY IN THE INDUSTRIALIZED COUNTRIES AND IN THE DEVELOPING COUNTRIES IN 1977

The relative importance R of each main field of activity i in region j is calculated according to the formula

$$R = 100 \times \frac{a_{ij}}{A_i} \Big/ \frac{c_j}{C}$$, where

a_{ij} = number of centres working on subject i in area j

A_i = number of centres working on subject i in the world

c_j = number of centres in area j

C = total number of centres in Directory (277)

The world average corresponds to R = 100

Page 56

Table 6

MAIN AREAS OF SPECIALISATION IN APPROPRIATE TECHNOLOGY OF SELECTED COUNTRIES

The index of specialisation S of a country's appropriate technology activities is calculated according to the formula

$$S = \frac{a_i}{A} \Big/ \frac{c_i}{C}$$, where

a_i = number of centres working on a subject in country i

A = number of centres working on this subject in the world

c_i = number of centres in country i

C = total number of centres in Directory (277)

The subjects listed in this table are those in which the country in question has a share at least 50 per cent larger than it should be relative to its size measured according to the total number of centres in the country, i.e. those with an index of specialisation $S \geqslant 1.5$.

Page 60 Table 7

CLIMATIC AND GEOGRAPHIC FOCUS OF APPROPRIATE TECHNOLOGY ACTIVITIES

This table is based on answers to question 17 and on data from a wide range of sources concerning the major biome and climatic zones of the earth. The index of specialisation compares the percentage of organisations (or specialised 'units' - see definition below) focusing their activities on a particular climatic/geographic zone and the relative importance on this zone in the world. The organisations which focus their activities on several different climatic/geographic zones are counted as the equivalent number of specialised "units", and the percentages are based on the total number of such units active on the special problems of each zone. The relative importance of each zone in terms of area is computed according to the five zones considered here.

$$\text{Index of specialisation} = \frac{\text{Percentage of 'units' focusing on this zone}}{\text{Percentage of area occupied by this zone in the 5 zones}}$$

The index of general interest is computed in the same way, but the number of 'units' is taken as the sum of the number of specialised centres and the number of centres (106) with a general interest in all climatic zones, or without any specific climatic/geographic focus.

Page 60 Table 8

APPROPRIATE TECHNOLOGY ORGANISATIONS WITH A FOCUS ON ARID AND SEMI-ARID ZONES

The index of specialisation is the ratio between the number of organisations in the region focusing on arid and semi-arid zone problems, and the relative size of these zones in the area. The index is equivalent to 1 if, for instance, 10 per cent of the organisations in the region are working on arid and semi-arid zone problems, and if that region represents 10 per cent of the world's arid and semi-arid zones.

The index of general interest is calculated in the same way as in Table 7 above, but takes into account the organisations which have a general interest in all the different climatic/geographic zones.

Page 64 Figure 12

WORLD-WIDE EXPENDITURES ON APPROPRIATE TECHNOLOGY, 1975 TO 1977

This figure is based on the 'corrected' AT budgets of each of the regions of the world (see Table 2, page , and the methodological notes to this table in the present appendix). These corrected budgets of the 277 organisations figuring in the Directory have in turn been corrected to take into account the rate of coverage of the Directory in each country and each region. Thus if the coverage is A per cent for country Y, the corrected budget for that country has been multiplied by 100/A, to give that country's total 'virtual' expenditure on AT.

Page 66 Figure 13

BREAKDOWN OF WORLD-WIDE EXPENDITURES IN APPROPRIATE TECHNOLOGY BY MAIN TYPES OF ACTIVITY (1977)

This breakdown is based on the 'corrected' budget data for each country (see methodological notes of Table 2) and takes into account the fact that the answers to question 15 (budget breakdown by types of activities) were sometimes incomplete (some organisations simply indicated that they were working on particular types of activity without saying what percentage of their total work was devoted to this type of activity).

The total budget b'_{ij} of activity i in region j is calculated according to the following formula:

$$b'_{ij} = b_{ij} + (B_j - b_j)\, q_{ij} \,/\, q_j, \text{ where}$$

b_{ij} = budget of activity i in region j as given in answers to question 15

b_j = total corrected budget of region j

B_j = total budget as given in answer to question 15 ($b_j = \sum b_{ij}$)

q_{ij} = number of quotations of activity i in region j

q_j = total number of quotations of all types of activities in region j

Page 67 Figure 14

BREAKDOWN OF WORLD-WIDE MAN-MONTHS OF WORK IN APPROPRIATE TECHNOLOGY BY MAIN TYPES OF ACTIVITY (1977)

The total man-months of work on AT is based on the answers to questions 6 (total man-months, or m_6) and 15 (breakdown of man-months of work by types of activity, or m_{15}). A correction

similar to the one made in Figure 13 was necessary in order to take into the incomplete answers. The total man-months of work M on all types of AT activities in a region is calculated according to the following formula:

$$M = \frac{M_6 + M_{15}}{n_6 + n_{15}} \times n, \text{ where}$$

$M_6 = m_6$ = total man-months as given in answer to question 6

n_6 = number of answers to question 6

and similar definitions for M_{15} and n_{15}

The breakdown of man-months by types of activities is calculated in the same way as the budget breakdown by types of activity (see note to Figure 13). The number of man-months m'_{ij} devoted to activity i in region j is given by the formula

$$m'_{ij} = m_{ij} + (M_j - m_j)\, q_{ij} / q_j \text{ , where}$$

m_{ij} = number of man-months devoted to activity i (question 15)

m_j = total number of man-months spent on all AT activities in region j

m_j = total number of man-months (question 15)

q_{ij} and q_j have the same meaning as in Figure 13

Page 68

Table 9

THE DIFFERENT TYPES OF ACTIVITIES OF APPROPRIATE TECHNOLOGY ORGANISATIONS

No comments

Pages 71 and 72

Figure 15

MAIN TYPES OF ACTIVITY OF APPROPRIATE TECHNOLOGY CENTRES

In each region, the part played by each type of activity was estimated according to three criteria: the proportion of total budget devoted to this activity (i.e. b'_{ij}/B_j), the proportion of time or number of man-months spent on each activity (i.e.m'_{ij}/Mj) and the proportion of quotations for each activity (i.e. q_{ij}/q_j). The percentages given in this figure are based on a weighted average between these three proportions. Man-months have been given a weighting of 3, budget of 2 and quotations of 1. These weightings have been chosen to reflect the fact that the most important indicator of the effective level of activity in a particular field of activity is essentially indicative. The proportion P_{ij} (size

of effort in each type of activity) is given by the formula

$P_{ij} = 1/6\ (3\ m'_{ij} / M_j + 2\ b'_{ij} / B_j + q_{ij} / qj)$

Page 76 Table 10

COST-RATIOS OF DIFFERENT TYPES OF ACTIVITIES IN APPROPRIATE TECHNOLOGY

The cost of each specific type of activity in AT is obtained by dividing the total corrected budget devoted to that activity by the number of man-months of work on that activity. The cost-ratio index is obtained by dividing the cost of one man-month of work on a particular activity in the industrialized countries by the cost for the same activity in the developing countries. The higher the index, the less expensive it is to carry out that activity in the developing countries.

Page 80 Figure 16

SOURCES OF FUNDING OF APPROPRIATE TECHNOLOGY ACTIVITIES IN INDUSTRIALIZED AND DEVELOPING COUNTRIES AND IN INTERNATIONAL ORGANISATIONS IN 1977

This figure is based on the data provided in answer to questions 7 (total budget in 1977) and 14 (breakdown of budget by sources of funds) and the methodology is the same as the one used in Figure 13.

The budget b'_{ij} coming from source of funding i in region j is given by the following formula:

$b'_{ij} = b_{ij} + (B_j - b_j)\ q_{ij} / q_j$, where

b_{ij} = budget coming from source i as given in question 14

B_j = total corrected budget of AT organisations in region j (see comments of Figure 12)

b_j = total budget resulting from answer to question 14

q_{ij} = number of times source i is quoted in region j

q_j = total number of quotations of all sources of funds in region j

Pages 83 and 84 Figure 17

SOURCES OF FUNDING OF APPROPRIATE TECHNOLOGY ACTIVITIES IN EACH MAJOR REGION IN 1977

The percentage breakdowns shown here are based on the same data as Figure 16. The percentage a_{ij} of total budget coming from source i in region j is given by the following formula:

$a_{ij} = 100 \times b'_{ij} / B_j$, where

b'_{ij} and B_j have the same meaning as in Figure 16

Pages 86 and 87

Figure 18

RELATIVE CONTRIBUTION OF THE VARIOUS SOURCES OF FUNDING TO THE BUDGET OF APPROPRIATE TECHNOLOGY CENTRES IN 1977

This index (world average = 100) has two definitions which give identical results. It is (a) the ratio between the contribution of source of funding i in region j and its world-wide contribution to the budgets of all AT organisations, and (b) the ratio between the percentage of budgets coming from source i and allocated to region j on the one hand, and the contribution of region j to world-wide AT budgets on the other.

The relative contribution of source of funding i to the budget of AT organisations in region j is given by the following formula:

$$a_{ij} = 100 \times \frac{b'_{ij}}{B_j} \Big/ \frac{b_i}{B} \quad \text{where}$$

b'_{ij} = corrected budget coming from source i in region j

$b_i = \sum_j b'_{ij}$ = world-wide budget coming from source i

$B_j = \sum_i b'_{ij}$ = total budget of region j

$B = \sum_i b_i = \sum_j B_j$ = world-wide AT budget

Then $a_{ij} = 100 \times \frac{\text{percentage of total budget of region j coming from source i}}{\text{percentage of world-wide budget coming from source i}}$

or $a_{ij} = 100 \times \frac{\text{percentage of budget coming from source i \& going to region j}}{\text{share of budget of region j in world-wide budget}}$

Pages 89 and 90

Figure 19

THE SHARE OF GOVERNMENTS IN THE BUDGETS OF APPROPRIATE TECHNOLOGY ORGANISATIONS

This figure shows the distribution of AT organisations according to the share of government funding in their total budgets. The share of budgets provided by governments and given on the x-axis of the six charts represents direct government funding as given in answer to question 14. The proportion of AT organisations shown on the y-axis is based on the number of organisations which provided a complete answer to question 14 (between 70 and 100 per cent of the total number of organisations in each region of the world)

Page 92 Figure 20

THE SHARE OF FOREIGH AID IN THE BUDGETS OF APPROPRIATE TECHNOLOGY ORGANISATIONS

See remarks on Figure 19. The data given here are based on direct funding by foreign aid agencies. In the industrialized countries, most of this foreign aid funding of AT organisations comes from a national agency. In the developing countries, it comes exclusively from abroad through bilateral and multilateral aid programmes financed by national or international aid agencies.

Page 94 Table 11

DIVERSITY AND INDEPENDENCE IN THE FUNDING OF APPROPRIATE TECHNOLOGY ORGANISATIONS

This table is based on the responses provided to question 14 by 270 of the 277 organisations figuring in the Directory. A 'dominant' source of funding is one which accounts for two thirds or more of the budget of an AT organisation. Organisations with highly diversified sources of funding are those which have two sources of funding or more, and with an approximately equal share of their total budget accounted for by two or three major sources of funding. 'Establishment sources of funding' include governments, industry, universities, foreign aid programmes, banks and other financial institutions, and international governmental organisations.

Page 97 Figure 21

BUDGET DISTRIBUTION OF APPROPRIATE TECHNOLOGY CENTRES IN 1977

These distribution charts are based on the original (i.e. non corrected) data supplied by some 203 AT organisations. The organisations which did not answer question 7 about budgets and question 14 about sources of funding are thus not accounted for, but the general shape of the distribution is fairly representative of the AT movement as a whole. The budgets are shown on the x-axis with a log scale.

Page 98 Table 12

SIZE OF BUDGETS, EXPENDITURES PER STAFF MEMBER AND COST OF STAFF RELATIVE TO PER CAPITA GROSS NATIONAL PRODUCT

These data are based on the corrected budgets and corrected number of staff members in each region of the world (see notes "

to Table 2 for details on calculation of corrections).

Average budget per organisation: $a_j = B_j / n_j$

Average budget per staff member: $P_j = a_j / S_j$

Budget per staff/per capita GNP ratio: $r_j = P_j / G_j$, where

B_j = total AT budget in region j

n_j = total number of AT organisations in region j

S_j = total number of staff members in region j (see comments of Figure 22)

G_j = GNP per capita in region j (source: *World Bank Atlas 1977*)

Page 101 Figure 22

TOTAL NUMBER OF STAFF MEMBERS IN APPROPRIATE TECHNOLOGY CENTRES IN 1977

The two charts in this figure are based on the data provided by the organisations which gave a complete response to question 6. Coverage: 123 organisations in developing countries, 111 organisations in industrialized countries. The number of staff members on the x-axis is given on a log scale.

Page 102 Figure 23

AVERAGE BUDGET PER PERSON IN 1977

This chart is based on the data provided by the organisations which gave a complete response to questions 6 and 7. Coverage: 104 organisations in developing countries, 83 organisations in industrialized countries. The data shown on the x-axis are percentages, and not absolute figures, and the shape of the distribution is therefore fairly representative, despite the fact that it does not cover the totality of the organisations figuring in the Directory. The budget per person per year on the y-axis is shown on a log scale.

Page 104 Figure 24

SHARE OF PROFESSIONALS IN TOTAL STAFF OF APPROPRIATE TECHNOLOGY CENTRES IN 1977

Same remarks as for Figure 22. Coverage: 110 organisations in developing countries, 87 organisations in industrialized countries.

Page 105 Figure 25

AVERAGE BUDGET PER PERSON PER YEAR AND SHARE OF PROFESSIONALS IN TOTAL STAFF IN SELECTED COUNTRIES AND GEOGRAPHIC AREAS IN 1977

For each country and geographic area, the average budget per person per year and the average share of professionals in total number of staff members were computed as

$b = B / S$ and $p = P / S$, where:

B = total AT budget of the country or geographic area

S = total number of staff members

P = total number of professionals

The organisations which did not give complete data were not taken into account, but their omission does not appear to have a major influence on the overall figures which are averages.

The two regression lines, 'industrialized country average' and 'developing country average', are based on individual data for each organisation in each of the two groups of countries. These lines represent equations which relate the average budget per person per year to the share of professionals, by $b = xp + y$. x and y were computed by using a least square regression on the b_i's and P_i's. Indirectly, this formula allows a computation of the theoretical cost of a professional and of a non-professional:

$$b = xp + y = (x + y)\, p + y\, (1 - p)$$

$x + y$ is thus the cost of a professional ($p = 1$) and y is the cost of a non-professional ($p = 0$).

Page 108 Table 13

THE COST OF PROFESSIONAL AND NON-PROFESSIONAL STAFF

The data shown here are those represented by the two regression lines of Figure 25. The average share of professionals in total staff is computed for each group of countries as the average between the share of professionals in each organisation ($1 / n \sum P_i / S_i$) and not as the rough total share of professionals (which would be $\sum P_i / \sum S_i$).

Page 112 Figure 26

OBSTACLES TO THE DIFFUSION OF APPROPRIATE TECHNOLOGY

This figure is based on the answers provided to question 20. Total number of respondents: 101 in the developing countries, 103 in the industrialized countries.

Pages 119 and 120

TABLES 14 and 15
THE CORRELATION BETWEEN OBSTACLES TO INNOVATION

Correlations coefficients were calculated for each couple of obstacles in the industrialized countries, the developing countries and the whole world (the results for the latter are not shown here). For a couple of obstacles (X, Y), there are two sets of random variables:

$$X_i = \begin{cases} 1 & \text{if organisation i has quoted obstacle X} \\ 0 & \text{if it has not quoted this obstacle} \end{cases}$$

$$Y_i = \begin{cases} 1 & \text{if organisation i has quoted obstacle Y} \\ 0 & \text{if it has not quoted this obstacle.} \end{cases}$$

The correlation coefficients $\rho_{x,y}$ is defined as $\rho_{x,y} = \frac{E(X\,Y) - E(X)\,E(Y)}{Var(X).\,Var(Y)}$ where X and Y are the sums of the random variables X_i and Y_i respectively and is calculated according to the following formula:

$$\rho_{x,y} = \frac{N\,N_{XY} - N_X\,N_Y}{\sqrt{N_X\,N_Y\,(N - N_X)\,(N - N_Y)}}\text{, where}$$

N = total number of organisations considered
N_X = number of organisations quoting obstacle X
N_Y = number of organisations quoting obstacle Y
N_{XY} = number of organisations quoting both obstacles

The exact values of the correlation coefficients are not interesting in themselves. The tables therefore give only the qualitative values based on the following rules:

0 indicates independence ($-0.1 \leq \rho \leq 0.1$)
+ indicates weak positive correlation ($0.1 < \rho \leq 0.25$)
++ indicates average positive correlation $0.25 < \rho \leq 0.4$)
+++ indicates strong positive correlation ($\rho > 0.4$)
- indicates weak negative correlation ($-0.1 < 1 \leq -0.25$)
-- indicates average negative correlation ($-0.25 < \rho \leq -0.4$).

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Table 16
THE MAJOR MEANS OF TECHNOLOGY DIFFUSION

Each of the organisations included in the Directory was asked to indicate which were its major and secondary means of technology diffusion (question 17). The major means of diffusion were given a weighting of 3, and the secondary means a weighting of 1. Total number of respondents to question 17: 239.

Page 126 Table 17

PREFERENCE AND NEGLECT IN THE CHOICE OF TECHNOLOGY DIFFUSION CHANNELS

The index is calculated by dividing the percentage of organisations in the region in question using a particular channel of technology diffusion by the percentage of organisations using this same channel world-wide. The latter percentage is the same as the one used in the first column of Table 16.

Page 127 Table 18

THE RELATIVE IMPORTANCE OF SOURCES OF FUNDING AS CHANNELS OF TECHNOLOGY DIFFUSION

Channels of technology diffusion and sources of funding of the same nature (i.e. governments, banks, universities, industry and international aid programmes) were compared by using the following index:

$$\text{Index} = \frac{\text{percentage of organisations in area using this channel}}{\text{percentage of budget coming from this source of funding}}$$

An index of 1 indicates that the weight of this type of institution in the funding process is equivalent to its importance as a channel of technology diffusion. An index below 1 indicates that the importance of this type of institution as a channel of technology diffusion is much lower than its relative weight as a source of funding, while an index above 1 points to the opposite situation. The percentages used here are the same as those that can be found in Table 16 and in Figure 17.

Page 130 Figure 27

MAIN INFORMATION FLOWS BETWEEN GEOGRAPHIC AREAS, 1976 - 1978

This figure, as well as the others shown in this chapter, is based on the answers to question 13 as well as on additional information provided by several of the organisations listed in the Directory (personal contacts, newsletters, articles, press releases about joint projects, etc.).

The width of the arrows shown in Figure 27 is roughly proportional to the intensity of the information flows from one continent to the other. It should be noted that this figure does not take into account the flows within each region (e.g. between Latin American AT organisations, or between North American AT organisations). The intensity of the information flow from region A to region B is measured by totalling the number

of organisations in region B which indicated that they had close working relationships with organisations in region A or which declared that they received regular information from organisations in that region.

Page 133 Table 19

THE 15 MOST FREQUENTLY QUOTED APPROPRIATE TECHNOLOGY ORGANISATIONS

This ranking is made on the basis of two criteria: (a) the total number of quotations of an AT organisation by other AT organisations figuring in the Directory (first column), without taking into account the ranking of the quotation; (b) a total number of quotation points (second column) - a first rank quotation receiving five points, a second rank quotation receiving four points, and so on. The average rank of quotations is given by the following formula:

$$\text{Rank} = 6 - \frac{\text{total number of quotation points}}{\text{total number of quotations}}$$

Pages 137 to 143 Figures 28 to 35

THE REGIONAL AND NATIONAL NETWORKS IN APPROPRIATE TECHNOLOGY

These charts, which reflect the general structure of the national and regional communications networks in AT, are based on the same data as Figure 27 and Table 19 (see also comments on Figure 36 below). Plain lines correspond to strong interactions between two organisations or sub-networks, and dotted lines to weak interactions. The width of the outgoing arrows is roughly proportional to the intensity of an organisation's communications with organisations outside the network, either at home or abroad.

Page 145 Figure 36

INTERACTIONS AND COOPERATION BETWEEN THE MAIN APPROPRIATE TECHNOLOGY NETWORKS

This figure is based both on quantitative information (number of quotations) and qualitative information (personal contacts, joint projects, etc). A strong interaction is characterised among other things by joint projects, exchanges of personnel, financial support and regular working visits. A weak interaction is generally limited to exchanges of information, occasional visits and general contacts, and excludes any joint projects.

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Table 20

THE INSTITUTIONAL AFFILIATIONS OF APPROPRIATE TECHNOLOGY ORGANISATIONS

This table is based on the answers to question 8, as well as on additional information provided by annual reports. Some 60 of the 277 organisations figuring in the Directory have been included in more than one category.

Pages 154 and 155

Figure 37

TYPOLOGY OF APPROPRIATE TECHNOLOGY CENTRES

This typology has been established in a rather qualitative way by using four parameters to describe an AT organisation: age, budget, index of dispersion of activities and total number of staff. The value of each of these parameters is placed on the corresponding axis, and each AT organisation is represented by the quadrangle formed by joining the four points representing the parameter value. The seven types correspond to seven groups of organisations with similarly shaped quadrangles, and the profile of which are located between the lower and upper profile limits within the type. The scales used on the axes have been chosen in such a way as to ensure that the seven different types of quadrangles have approximately the same size.

On the A-axis (age of organisation), point 1 indicates that the organisation started working in the field of AT after 1975, point 2 that it did so between 1972 and 1975, point 3 between 1968 and 1972, point 4 between 1958 and 1968, and point 5 before 1958.

On the D-axis (index of dispersion of activities), point 1 indicates that the organisation is specialised in one very specific topic, point 2 that it is working on a few specific topics within one general field, point 3 that it is working on two or three interconnected problems or topics, point 4 that it is working on several topics which are not necessarily related to one another, and point 5 that it is working on almost all AT topics.

On the S-axis (total number of staff), the figure 10 corresponds to a total number of staff of less than 10 people, 20 to a total number between 10 and 20, 100 to a total number between 20 and 100, 1000 to a total number between 100 and 1000, and 5000 to a total number above 1000.

On the B-axis (budget), 50 corresponds to a total budget of less than $ 50,000, 200 to a budget between $ 50,000 and $ 200,000, 1,000 to a budget between $ 200,000 and $ 1 million, 10,000 to a budget between $ 1 million and $ 10 million, and 100,000 to a budget above $ 10 million.

Page 156 Table 21

EXAMPLES OF THE SEVEN DIFFERENT TYPES OF APPROPRIATE TECHNOLOGY ORGANISATIONS

The examples given in this table have been chosen in equal number from industrialized and developing countries, and under each type we have tried to give examples of both 'specialised' AT groups and 'general AT organisations'.

Page 158 Figure 38

POSSIBLE TRANSITIONS BETWEEN DIFFERENT TYPES OF CENTRES

The transition patterns shown in this figure are based for the most part on AT organisations which have an 'intermediate' profile, i.e. a profile which falls somewhat between two profiles. These organisations have been assumed to be in a transition stage between two types. It should be noted here that the patterns of evolution are unidirectional, since one of the parameters (the age of an organisation) goes in one way only.

Page 160 Figure 39

TYPICAL EVOLUTION IN TIME OF AN APPROPRIATE TECHNOLOGY CENTRE'S MIX OF ACTIVITIES

This chart reflects the mix of activities of AT organisations of different ages and rests on the assumption that the average share of each type of activities of an organisation after n years of activity is practically equivalent to the present distribution of activities in organisations which are n years old. This assumption appears to be valid for activities which amount to at least 10 per cent of total activities. In the case of commercial activities, the evolution of the curve after year 8 appears to be somewhat hypothetical, since none of the organisations figuring in the Directory had been engaged in commercial activities for more than eight years at the time the Directory was compiled (1977-1978).

Appendix 2

LIST OF ORGANISATIONS INCLUDED IN OECD SURVEY

AUSTRALIA
- Appropriate Technology and Community Environment
- Appropriate Technology Development Group
- Architectural Science Unit
- Australian Innovation Corporation
- Intermediate Technical Development Group
- International Solar Energy Society

AUSTRIA
- United Nations Industrial Development Organization

BANGLADESH
- Agricultural Development Agencies in Bangladesh
- Appropriate Agricultural Technology Cell
- People's Health Centre

BARBADOS
- Appropriate Technology Resources Service

BELGIUM
- Appropriate Technology for Developing Countries
- Post Graduate Centre of the University of Leuven

BOLIVIA
- Social and Economic Development Centre

BOTSWANA
- Kweneng Rural Development Association
- Pelegano Village Industries

BRAZIL
- Laboratory of Sun Energy
- Technology Center of Minas Gerais

CAMEROON
- Panafrican Institute of Development
- Swiss Association for Technical Assistance

CANADA
- Association of Geoscientists for International Development
- Brace Research Institute
- Canadian Hunger Foundation
- Institute of Man and Resources
- Minimum Cost Housing Group
- Saskatchewan Research Council
- Sudbury 2001

CAPE VERDE ISLANDS
- Ministry of Rural Development

CHILE
Industrial Corporation for Metropolitan Development
Industrial Corporation for the Development of the Biobio Region

COLOMBIA
International Center for Tropical Agriculture
Las Gaviotas
Research Centre for Integral Development
Technical Development Division - National Training Service
Technological Research Institute

COSTA RICA
Food Technology Research Centre

DENMARK
Danish Invention Center
Zac-Consult

DOMINICAN REPUBLIC
Solidarios - Council of American Development Foundations

ECUADOR
Comprehensive Agricultural Training Centre
Ecuadorian Development Foundation
Technical Information Service

EGYPT
The Engineering Industrial Design Development Centre

EL SALVADOR
Salvadorian Foundation for Development and Minimum Housing

ETHIOPIA
International Livestock Centre for Africa
Village Technology Programme of the Training and Research Centre for Women

FIJI
Institute of Natural Resources

FRANCE
Applications of Research on Energy and Society
Centre for the Study and Experimentation of Tropical Agricultural Machinery
Centre for Study and Research on New Energy Sources for Buildings
French Association for the Study and Development of Solar Energy Applications
French Committee for Inventions and Innovations Adapted to Developing Regions
Hydro M - Water Study and Management Research Centre
International Research Centre on Environment and Development
La Roquette Laboratory
Mediterranean Co-operation for Solar Energy
Movement for the Promotion of Balanced Technologies
National Centre for the Exploitation of the Oceans
OECD Development Centre
Research Group for Solar Furnaces Applied to Tropical Conditions
Third World Innovation Group

GERMANY
Institute for Production Techniques and Automation
Interdisciplinary Project Group for Appropriate Technology
Research Institute for International Techno-Economic Co-operation
Scientific Research Institute for Wind Energy Techniques

GHANA
Technology Consultancy Centre

GREECE
Thessaloniki Agricultural and Industrial Institute

GUADELOUPE
Antilles and Guyana Agronomic Research Centre

GUATEMALA
Centre of Middle-American Studies and Appropriate Technology
Experimental Station Choqui
Nutrition Institute of Central America and Panama

HONDURAS
Industrial Information Centre
International Voluntary Services in Honduras

HONG KONG
Hong Kong Productivity Centre

INDIA
Agro-Industrial Service Centre
Appropriate Technology Development Association (India)
Appropriate Technology Unit
Cell for the Application of Science and Technology to Rural Areas
Centre of Science for Villages
Garg Consultants
Institute of Development Studies
International Crops Research Institute for the Semi-Arid Tropics
Protein Foods and Nutrition Development Association of India
Regional Centre for Technology Transfer
Science Education Centre
Small Industry Extension Training Institute
Sri A. M. M. Murugappa Chettiar Research Centre
Water Development Society

INDONESIA
Appropriate Technology Group - Dian Desa
Batik and Handicraft Research Institute
Chemical Research Institute
Development Technology Centre
Health Services Research and Development Centre
Institute for Social and Economic Research, Education and Information
Leather Research Institute
Materials Testing Institute
Project for the Promotion and Development of Small Scale Industries
Village Technology Unit - BUTSI
Volunteers in Asia - Regional Asian Office

IRAN
Building and Housing Research Centre

IRELAND
Low Energy Systems

ISRAEL
Applied Research Institute
Institute of Agricultural Engineering
Institute of Desert Research

ITALY
CTIP Solar S.p.a.
European Centre for Agrarian Training
Food and Agriculture Organization of the United Nations
Italian Centre for Co-operation in the Building Development of Emerging Nations

IVORY COAST
INADES-Formation

JAMAICA
Caribbean Food and Nutrition Institute
Scientific Research Council

JAPAN
OISCA Training Center

KENYA
African Medical and Research Foundation
Environment Liaison Centre
Housing Research and Development Unit
Ukamba Agricultural Institute
United Nations Environment Programme
Village Technology Unit

LEBANON
International Center for Agricultural Research in the Dry Areas

LESOTHO
Thaba Kupa Farm Institute

LIBERIA
Home Economics Division

MADAGASCAR
FOFATA - Rural Formation Centre

MALAWI
Viphya Logging Oxen Training Centre

MALAYSIA
Malaysian Agricultural Research and Development Institute

MALI
Agricultural Machinery Division
Solar Energy Laboratory of Mali

MAURITIUS
School of Industrial Technology

MEXICO
Centre for Economic and Social Studies of the Third World,
General Studies Center/Local Productivity
Group for the Development of Chemical Technology
INFOTEC-CONACYT
International Centre for Maize and Wheat Improvement
Mexican Foundation for Rural Development

MOZAMBIQUE
National Documentation and Information Centre of Mozambique

NEPAL
Research Centre for Applied Science and Technology

NETHERLANDS
Agromisa
Appropriate Technology Department - Eindhoven University of Technology
Center for Appropriate Technology
Medical Working Group for Developmental Co-operation
Technical Working Group for Development Co-operation
TOOL Foundation
Twente University of Technology
The Utrecht Pilot Plant

NEW HEBRIDES
Kristian Institute Technology of Weasisi

NEW ZEALAND
Seed Technology Centre

NICARAGUA
Evangelical Committee for Development

NIGERIA
Intermediate Technology
International Institute of Tropical Agriculture
Projects Development Agency

OMAN
Khabura Development Oman

PAKISTAN
Appropriate Technology Development Organisation
IRRI-PAK Agricultural Machinery Program

PAPUA NEW GUINEA
Appropriate Technology Development Unit
Liklik Buk Information Centre

PERU
Huaylas Project
International Potato Centre

PHILIPPINES
Asian Development Bank
Centre for the Development of Human Resources in Rural Asia
Economic Development Foundation
Institute for Small-Scale Industries
International Rice Research Institute
Regional Adaptive Technology Center
Regional Network for Agricultural Machinery

RWANDA
Centre for the Study and Application of Energy in Rwanda
INADES-Formation
Rwandese Association of Building Fellows

SENEGAL
ENDA Technology Relay

SIERRA LEONE
Advisory Services Unit for Technology Research and Development

SINGAPORE
Singapore Institute of Standards and Industrial Research
Technonet Asia

SRI LANKA
Appropriate Technology Group of Sri Lanka
Marga Institute
Peradeniya Faculty of Engineering
Sarvodaya Appropriate Technology Development Programme

SWAZILAND
National Industrial Corporation of Swaziland
Small Enterprises Development Company Ltd.

SWEDEN
Swedish Council for Building Research

SWITZERLAND
- Association for the Development of African Architecture and Urbanism
- Helvetas-Swiss Association for Technical Assistance
- International Federation of Organic Agriculture Movements
- International Labour Office
- Latin American Institute
- Swiss Association for Appropriate Technology
- Swiss Association for Intermediate Technology
- World Council of Churches
- World Health Organization

TAIWAN
- Asian Vegetable Research and Development Center
- Taiwan Livestock Research Institute

TANZANIA
- Arusha Appropriate Technology Project
- University of Dar-es-Salam

THAILAND
- Asian Institute of Technology
- SEATEC International

TUNISIA
- Association for Rural Development and Animation
- Rural Engineering Research Centre

UGANDA
- Department of Agricultural Engineering

UNITED KINGDOM
- The Acton Society Trust
- Appropriate Health Resources and Technologies Action Group
- BP Research Centre
- Consumers' Association Testing Department
- David Livingstone Institute of Overseas Development Studies
- Foundation for Teaching Aids at Low Cost
- Hydroponic Advisory and Information Unit
- Intermediate Technology Development Group
- International Forest Science Consultancy
- National Centre for Alternative Technology
- Natural Energy Association
- Natural Energy Centre
- Overseas Department of the National Institute of Agricultural Engineering
- Overseas Unit - Transport and Road Research Laboratory
- Oxfam
- Simple Technology Development Unit
- The Soil Association
- Tropical Products Institute

UNITED STATES
- Accion International / AITEC
- Acorn Communications
- Agricultural Cooperative Development International
- Alternative Sources of Energy
- Appropriate Technology Group
- Appropriate Technology International
- Appropriate Technology Research
- California State Office of Appropriate Technology
- Center for Community Economic Development
- Center for Development Technology
- Center for the Integration of the Applied Sciences
- Center for Integrative Studies
- Consultative Group on International Agricultural Research
- Control Data Corporation

UNITED STAGES (cont'd.)
- Cornell University Energy Programs
- Department of Fisheries and Allied Aquacultures and International Center for Aquaculture
- Earth Metabolic Design Inc.
- Ecology Action of the Midpeninsula
- Ecotope Group
- Environmental Studies Section of the International Studies Association
- The Farallones Institute
- The Farm
- Florida Solar Energy Center
- The Friends of Appropriate Technology
- Garden Way Laboratories
- Genesis Housing and Community Development Corporation
- Institute for Local Self-Reliance
- Inter-American Development Bank - Committee for the Application of Intermediate Technology
- Intermediate Technology
- Intermediate Technology - Purdue
- International Bank for Reconstruction and Development
- Living Systems
- Meals for Millions Foundation
- META Publications
- National Academy of Sciences
- National Center for Appropriate Technology
- Navajo Community College Center on Useful Technology
- The New Alchemy Institute
- Office of International Programs - Engineering Experiment Station
- Ouroboros South Project
- Peace Corps
- RAIN - Journal of Appropriate Technology
- Rodale Press Inc.
- SANE
- Sunpower Inc.
- Suntek Research Associates
- Technical Assistance Information Clearing House
- Technology Application Center
- Technoserve
- Tranet
- United Nations Development Programme
- Volunteers in Asia
- Volunteers in Technical Assistance, Inc.
- World Education
- World Neighbors

UPPER VOLTA
- African Company for Development Studies
- Interafrican Committee for Hydraulic Studies

URUGUAY
- Inter-American Centre for Research and Documentation on Vocational Training

ZAIRE
- Centre of Studies for Social Action
- Integral Development Association
- Nkata Project

ZAMBIA
- Northern Technical College
- Technology Development and Advisory Unit

Appendix 3

QUESTIONNAIRE FOR OECD DIRECTORY OF APPROPRIATE TECHNOLOGY CENTRES

1. Name of Centre : _____

   (Include English translation if in foreign language and official abbreviation if you have one.)

2. Address : _____

   (And post box if any.)

3. Telephone number _____

4. Name of Director/Head of Centre _____

5. a. Date founded:

   b. Date of beginning of activities in AT: _____

6. Total number of people employed in 1976: _____ in 1977 (mid-year): _____

   6a. of which full time : _____ _____

   6b. of which part time : _____ _____

   6c. breakdown between professional and non-professional staff : _____ _____

   6d. Total man/months of work on AT in 1976: _____ in 1977:

7. Approximate budget in 1976 : *(if in local currency, give approximate equivalent in US$)*

1975	1976	1977 (estimate)
_____	_____	_____

8. Institutional affiliation of your centre: *(put x in relevant box or boxes)*

   a. Governmental centre ( )
   b. Linked with public agency ( )
   c. Part of the university ( )
   d. Affiliated with university ( )
   e. Affiliated with church or missionary organisation ( )
   f. Independent non-profit AT centre ( )
   g. Independent profit-oriented AT centre ( )
   h. Independent consulting firm ( )
   i. Affiliated with foreign aid agency ( )
   j. Linked with or part of industrial firm ( )
   k. Voluntary help organisation ( )

l. Foundation: operating ( )

m. Foundation: grant making ( )

n. International governmental organisation ( )

p. International non-governmental organisation ( )

q. Other (specify) ( ) *(Please give further details below if necessary)*

9. Name of institution with which you are affiliated *(if any)* _____

10. If your centre has set up branches or affiliates, either in home country or abroad, please indicate names, addresses and type of relationship. _____

_____ _____

_____ _____

_____ _____

_____ _____

11. If your centre is itself a branch or an affiliate of another centre, at home or abroad, give name and address of parent centre. _____

_____

_____

_____

12. Please give in 10-15 lines a brief historical sketch of the origins of your centre and of your plans for the future.

13. Which are the AT centres, foreign or local, with which you have the closest working relationships *(List by order of importance.)*

a. _____

b. _____

c. _____

d. _____

e. _____

f. If you have no direct contacts with other AT centres, please check this box. ( )

14. Sources of funding of your centre

(If relevant, put an X in the box and, in the right hand column, give approximate percentage of budget accounted for by this source of funds.)

			1976	1977
a.	government	( )	_____ %	_____ %
b.	foundations	( )	_____ %	_____ %
c.	donations	( )	_____ %	_____ %
d.	industry	( )	_____ %	_____ %
e.	university	( )	_____ %	_____ %
f.	foreign aid programme	( )	_____ %	_____ %
g.	consulting fees	( )	_____ %	_____ %
h.	church or missionary organisation	( )	_____ %	_____ %
i.	commercial or industrial activities	( )	_____ %	_____ %
j.	banks or other financial institutions	( )	_____ %	_____ %
k.	membership fees	( )	_____ %	_____ %
l.	subscriptions for publications	( )	_____ %	_____ %
m.	other (specify)	( )	_____ %	_____ %

Note If you wish this information to be kept confidential, please put an X in box ( )

15. Main type of activities in AT at your centre

(Put X in appropriate boxes and give approximate share of total budget and of total man hours of work per year devoted to each type of activity.)

			% of budget	% of man-hours	comments (if any)
a.	information and documentation	( )	_____ %	_____ %	_____
b.	occasional publications	( )	_____ %	_____ %	_____
c.	regular publications	( )	_____ %	_____ %	_____
d.	technology extension services	( )	_____ %	_____ %	_____
e.	promotion of local technical traditions	( )	_____ %	_____ %	_____
f.	research and development activities	( )	_____ %	_____ %	_____
g.	testing and evaluation of new equipment	( )	_____ %	_____ %	_____
h.	pilot production	( )	_____ %	_____ %	_____
i.	commercial production	( )	_____ %	_____ %	_____
j.	policy analysis and economic studies	( )	_____ %	_____ %	_____
k.	technical feasibility studies	( )	_____ %	_____ %	_____
l.	education and training of personnel	( )	_____ %	_____ %	_____
m.	technology diffusion	( )	_____ %	_____ %	_____
n.	influencing governmental or political decision-making	( )	_____ %	_____ %	_____
p.	financing AT activities of other institutions	( )	_____ %	_____ %	_____
q.	other (specify)	( )	_____ %	_____ %	_____

16. **Fields of concentration of your work in AT**
(Put an X in relevant box or boxes : Left box = important activity; right box = occasional activity)

1. Energy

a) energy savings	( )	( )
b) solar	( )	( )
c) wind	( )	( )
d) water	( )	( )
e) methane	( )	( )
f) muscular	( )	( )
g) other (specify)	( )	( )

2. Public Health

a) hygiene, disease prevention	( )	( )
b) birth control	( )	( )
c) training of medical personnel	( )	( )
d) health care equipment	( )	( )
e) local medical traditions	( )	( )
f) nutrition	( )	( )
g) other (specify)	( )	( )

3. Water

a) water resources	( )	( )
b) irrigation	( )	( )
c) waste waters	( )	( )
d) other (specify)	( )	( )

4. Primary sector: agriculture, forestry, fishing

a) crop processing and conservation	( )	( )
b) agricultural tools	( )	( )
c) agricultural machinery	( )	( )
d) cultivation techniques	( )	( )
e) new crops and plants	( )	( )
f) soil protection	( )	( )
g) hydroponics	( )	( )
h) aquaculture	( )	( )
i) husbandry	( )	( )
j) fishing	( )	( )
k) forestry	( )	( )
l) pest control	( )	( )
m) other (specify)	( )	( )

5. Industry

a) handicrafts	( )	( )
b) small industry promotion	( )	( )
c) reduction of scale of industrial processes	( )	( )
d) community goods	( )	( )
e) textile industry	( )	( )
f) small metal-working	( )	( )
g) other (specify)	( )	( )

6. Infrastructures and Services

a) means of transportation	( )	( )
b) roads	( )	( )
c) telecommunications	( )	( )
d) credit and lending systems	( )	( )
e) land reform	( )	( )
f) alternative institutions	( )	( )
g) other (specify)	( )	( )

7. Education

a) school system organisation	( )	( )
b) training of adults	( )	( )
c) pedagogy, school equipment	( )	( )
d) other (specify)	( )	( )

8. Housing

a) building materials	( )	( )
b) architecture	( )	( )
c) domestic waste disposal	( )	( )
d) urbanism	( )	( )
e) other (specify)	( )	( )

9. Environmental problems (specify) ( ) ( )

10. Other activities (specify) ( ) ( )

. . . . . .

. . . . . .

. . . . . .

17. What are the geographical regions in which your technologies are the most appropriate? *(Put X in relevant box or boxes.)*

a) tropical rain forests	( )	f) arctic or cold regions	( )
b) tropical savannas	( )	g) mountains	( )
c) arid and semi-arid regions	( )	h) no particular geographical distinction	( )
d) temperate regions	( )	i) other (specify)	( )
e) coastal regions	( )	_____	
		_____	

18. What is the diffusion of the appropriate technologies you have developed or studied? (*Put X in relevant box or boxes.*)

a) only within the centre	( )	e) international diffusion	( )
b) local diffusion	( )	f) other (specify)	( )
c) regional diffusion	( )	_____	
d) national diffusion	( )	_____	

19. What are the framework and means of diffusion of your technology? *(Put X in relevant box or boxes)*

	Major means of diffusion	Secondary means of diffusion	Comments (if any)
a) only by your own	( )	( )	. . . . .
b) advertisement, mass media	( )	( )	. . . . .
c) government agencies	( )	( )	. . . . .
d) international agencies	( )	( )	. . . . .
e) international aid programmes	( )	( )	. . . . .
f) banks, private credit agencies	( )	( )	. . . . .
g) schools, universities	( )	( )	. . . . .
h) big industrial firms	( )	( )	. . . . .
i) no diffusion until now	( )	( )	. . . . .
j) private voluntary foreign assistance agencies	( )	( )	. . . . .
k) other means of diffusion (specify)	( )	( )	. . . . .

. . . . . .

. . . . . .

20. What are the major obstacles you have met when diffusing your technology?

a) attitude of political leaders ( )
b) bureaucracy ( )
c) inadequate legislation ( )
d) cultural and social unacceptability ( )
e) reluctance to accept innovation ( )
f) lack of competitiveness relative to traditional technologies ( )
g) lack of competitiveness relative to modern technologies ( )
h) lack of funds ( )
i) lack of reliability ( )
j) lack of technical support ( )
k) maintenance difficulties ( )
l) other (specify) ( )

21. Some appropriate technologies have a very low cost and need no large spending from the user. Some others require preliminary investments which the average users (individuals or communities) cannot afford directly and for which they have to find sources of financing

1) What were these sources of financing for the diffusion of technologies you have developed?

a) own sources of funds ( )
b) local private credit system ( )
c) local public credit system ( )
d) government loans ( )
e) international banks ( )
f) international development agencies ( )
g) international development programmes ( )
h) self help technologies requiring no investment ( )
i) other (specify) ( )

ii) Did you help your customers (or your potential customers) in finding their sources of financing?

Yes ( ) No ( )

iii) What is the percentage of cases where your appropriate technologies could not be diffused because the potential customers did not manage to find a proper source of financing?

. . . . . %

22. Please give a brief description (maximum 5 lines per item) of the various appropriate technologies (hardware and software) you have developed and diffused or on which you are currently working. If relevant, give number of units built, number of units equipped and date of installation, and number of units presently working (*use extra sheets if necessary*).

a.

b.

c.

d.

e.

f.

g.

23. Please list all publications of your Centre (if any) and publications on AT by staff associated with your centre. (Please send these publications to OECD for inclusion in forthcoming annotated bibliography on AT.)

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