Information Technology, Development and Policy

Edited by
Edward Mozley Roche
Michael James Blaine

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For the emerging armies of 'information workers' in the developing world...

Information Technology, Development and Policy

Theoretical Perspectives and Practical Challenges

Edited by
EDWARD MOZLEY ROCHE
MICHAEL JAMES BLAINE

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Foreword

The International Federation for Information Processing (IFIP) is a multinational federation of organizations concerned with information processing. Currently it has 45 member societies representing 62 countries. One of its main objectives is to bring together computer professionals to stimulate research, development and the application of information processing in science and human activity. IFIP has eleven technical committees (TCs) covering a broad range of computing themes like information systems, education, and communication. Each TC has one or more working groups affiliated to it. The objective of a working group is to bring together a group of computing professionals interested in a specific area of work. Each WG is expected to act as a forum of exchange of ideas by organizing conferences and publishing monographs.

TC 9 which deals with the broad theme of Computers and Society initiated the move to create a working group to deal with all issues concerning the 'Social Implications of Computers in Developing Countries' in 1987. The starting point for WG 9.4 was a conference in New Delhi, India, in November 1988. The proceedings of the meeting were published by Elsevier Science Publishers in 1990 as: *Information Technology in Developing Countries*, S.C. Bhatnagar and N. Bjorn-Andersen (editors). The WG 9.4 was formalized in September 1989. The scope of the working group was to cover: National computerization policy issues; Culturally adapted computer technology and information systems; Role of transnational corporations, regional and international cooperation and self-sufficiency in informatics; Social awareness of computers and computer literacy.

The second event of the WG was a workshop on IT Manpower Needs In Developing Countries. The proceedings were edited by Subhash Bhatnagar and were published under the same title by Tata McGraw-Hill, New Delhi in 1990. The second conference of the WG titled 'Social Implications of Computers in Developing Countries', was held in Nairobi in March 1992. Twenty eight papers were presented by authors from 19 countries. Proceedings were published by Tata McGraw-Hill, New Delhi, and were edited by S.C. Bhatnagar and Mayuri Odedra. The third conference titled 'The Impact of Informatics on Society: Key Issues for Developing

Countries' was held in Havana, Cuba in February 1994. This volume carries selected papers presented at the conference. The fourth conference of the group focused on: Information Technology and Socio-economic Development. It was held in Cairo, Egypt in January 1995 and was attended by 150 delegates. Edited by Mayuri Odedra-Straub, the proceedings are being published by Ivy League Publishing company.

Besides the four International Conferences, the Working Group has co-sponsored several international meetings focusing on information technology and development. In 1993, WG 9.4 co-organized a conference on 'Intellectual Property Rights in Computer Software and Their Impact on Developing Countries', in Bangalore, India, and co-sponsored a conference on 'Health Informatics in Africa' in Ile-Ife, Nigeria. Other events supported by WG 9.4 include a conference on technology transfer to Developing countries in Zurich and a seminar on globalizaton held at the London School of Economics in 1994. The Group has also played a key role in the IFIP World Congress by organizing a few sessions within the last two Congresses.

Currently the Working Group has 200 members representing nearly 50 countries. The Working Group publishes a twenty page quarterly Newsletter titled, 'Information Technology in Developing Countries' which is distributed to nearly 1000 professionals in 50 countries in a hardcopy. It is also available electronically via email through a list server based in Finland which also services an unmoderated discussion list subscribed to by nearly 150 members. The publication of the Newsletter is accomplished in collaboration with Commonwealth Network of Information Technology, London and is supported by the International Development Research Centre, Canada.

The official aims and scope of the Working Group are:

1. To collect, exchange and disseminate experiences of developing countries;

2. To develop a consciousness amongst professionals, policy makers and public on social implications of computers in developing nations;

3. To develop criteria, methods, and guidelines for design and implementation of culturally adapted information systems;

4. To create a greater interest in professionals from industrialized countries to focus on issues of special relevance to developing countries through joint activities with other Technical Committees.

The Working Group is in the sixth year of its existence. It has been able to bring together more than 200 professionals to deliberate on issues relating to information technology and development. Although major research projects have not yet grown out of these associations, the Group has been able to produce sizable literature on this theme. Future plans of the Group include more focused international conferences, active contribution to the journal Information Technology and Development (the Chief Editor and two Associate Editors are the members of the Working Group) and a continued expansion of the Newsletter.

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Preface

We are confident that we speak for all of the authors when we express our hope this book, and the discussion it will generate, will be instrumental in providing a more balanced set of options to policy makers in developing countries as they attempt to formulate and implement national IT strategies or carry out specific institutional implementations in the public sector.

Similarly, we hope this book will provide managers in local and multinational companies a deeper understanding of their roles and responsibilities in introducing and using these new technologies in developing countries. Finally, we hope that this book will encourage both groups to think about IT and the issues that surround it in a broader socio-cultural context.

Introduction: information technology, development and policy

The Editors

By increasing both the speed and scope of communication and computation, modern information technologies (IT) have radically altered basic patterns of human interaction, communication and thought. This in turn has fostered economic growth and development and the greater dissemination of information and knowledge around the globe. However, the introduction of advanced computer and telecommunication technologies presents developing (and developed) countries with a number of unique challenges. For example, these technologies have been shown to break down traditional communication patterns which form the social and cultural fabric of many traditional societies. In addition, instantaneous access to events occurring in distant parts of the globe has prompted a fundamental reevaluation of many long-standing economic, social, and political institutions on both the national and international levels. The fall of the Berlin Wall in 1989 and the collapse of the Soviet Union are just two of the many examples of this process.

Simply stated, the purpose of this book is to assist developing countries in their ongoing efforts to implement modern IT in ways which maximize the potential benefits of these technologies while minimizing their economic costs and social disruptions. This introductory chapter has two objectives. First, to place the contributions of the individual authors in a broader conceptual context; and second, to identify the most important general lessons to emerge from this volume. The former task is addressed in the first half of the chapter, the latter is the subject of the second half.

The challenges of information technology for developing countries

While the long-term impact of IT on developing countries remains highly speculative, at least three issues deserve special consideration. The first involves the effect of IT on traditional social and economic institutions. Forty years ago, William Ogburn (1957) observed that the pace of technological change was usually much faster than the pace of social or cultural change. As a result, it is not surprising that many — even advanced — nations have had difficulties integrating new technologies into existing institutional structures. Unfortunately, not enough thought has been given to the unique problems developing nations face in this regard stemming from their often lower levels of educational attainment and the immutability of traditional social and religious values. Consequently, the introduction of sophisticated IT often has a destabilizing effect on the basic economic and socio-cultural structures of developing countries — particularly in the short-run.

One important reason for this is that fundamental assumptions underlying many information technologies — such as the importance of speed, efficiency and cost effectiveness or the supremacy of numerical and statistical analysis over more intuitive, holistic approaches — are antithetic to the intrinsic values of traditional societies. Over time, users of these technologies adopt a view of the world that is fundamentally at odds with the basic cultural and religious values of their non-user counterparts. This in turn creates a growing rift within the society which in extreme cases can incite a conservative or reactionary backlash. For example, the fall of the Shah of Iran was closely associated with the rapid introduction of advanced Western technology and institutions into a traditional Muslim society.

This tendency toward social and political unrest is exacerbated by three additional factors. First, IT enables local users to easily communicate with users in other parts of the world who are likely to share a similar set of values or 'cyber-culture'. Second, these technologies tend to segregate societies into user and non-user groups based on social and economic characteristics such as level of education, location (urban versus rural), and ability to pay for IT equipment and services. Finally, by encouraging the greater decentralization of decision making and expression of individuality, IT threats traditional social structures and political institutions. Thus, the introduction of IT into developing contexts may lead to greater inequality and increased economic and social polarization.

Of course, many writers argue that these same factors have a positive impact on economic and social welfare by bypassing often inefficient bureaucratic institutions and enabling local public and private organizations to perform more efficiently and at lower costs; but these benefits are by no means assured as many of the chapters in this volume clearly illustrate. Consequently, it is important to recognize that new information (and other) technologies are not substitutes for traditional economic and social institutions, but are merely a means for achieving larger economic and social goals.

The second major problem associated with advanced information technologies involves the impact on domestic employment. Unemployment in many industries has been directly linked to the introduction of computer-aided design (CAD) and manufacturing (CAM) into traditional mass-production processes. Similarly, the use of advanced telecommunication technologies have eliminated — in many cases forever — the need for extensive layers of hierarchy in organizations regardless of their function (Drucker, 1988). Thus, IT can radically reduce the number of persons involved in both the production and delivery of goods and services and the management of complex organizations and processes. While this is often seen as a great benefit, in developing countries it is a mixed blessing at best. Reducing the number of workers in the production process may decrease costs and increase quality and efficiency, but these benefits come at the cost of greater unemployment and increased competition for limited employment opportunities — particularly in the early stages of informatization. This in turn may lead to greater inequality in income distribution and living standards, further straining relations between local social and political groups and increasing the probability of instability and breakdown in critical local institutions.

Equally important, the employment opportunities associated with sophisticated IT tend to be inappropriate for the educational and skill levels of most workers in developing countries. Training workers to effectively use IT — in industry as well as government — has been difficult even in advanced nations, and it has generally proven extremely costly and time consuming in developing nations due to their lower initial levels of education. As a result, the introduction and use of IT in developing countries must be carefully analyzed in order to identify critical economic, social and political structures — such as basic education, worker training, and unemployment insurance — which can reduce the dislocations often associated with these technologies.

The third and perhaps most formidable challenge of IT involves the cost of building and maintaining the basic infrastructure needed to support advanced information technologies. Due to the enormous cost of creating national information infrastructures, certain parts of the world run the distinct risk of being left off the global information 'super-highway' and becoming even more backward and isolated than they already are. The reason is straightforward. Many developing countries currently face severe shortages of basic requirements such as food, education, and medical supplies and personnel, and have underdeveloped physical infrastructures including inadequate water and sewage systems, roads, rail lines, and airports. For these nations, investing capital in a modern information and telecommunication infrastructure necessarily means that fewer funds will be available to provide essential, basic goods and services. This problem is exacerbated by the large public sector deficits and debts of many developing countries, their low rates of domestic saving and investment, and their limited access to international capital markets.

These problems are clearly evident from Tables I.1 and I.2 which provide information on Internet usage and local infrastructure in a sample of developed and developing nations. By 1993, of the 48 countries classified as 'LDCs' using the World Bank's criteria, none had introduced ISDN and only 5 had packet-switched (X.25) networks. By 1994, a large developing country such as India or Brazil had almost no penetration of the Internet at a time when the number of hosts had reached more than a million. This stands in stark contrast to a country like Sweden or Canada where computer literacy and Internet usage were already substantial and growing rapidly (see Table I.1).

Table I.1
Estimated internet users per 1,000 inhabitants in 1994

Country	*Users*
Sweden	48.9
Canada	35.3
Japan	4.3
Poland	1.6
Brazil	0.03
India	0.002

Source: MPT Japan, Internet Society, International Telecommunications Union

Similar disparities are evident in the condition of basic infrastructure (see Table I.2). Although many developing nations have made great progress over the past several decades in improving access to safe water and sewage disposal, by 1992 over half of the inhabitants of many countries were still without these basic services. Similarly, the state of such basic infrastructural elements as paved road — not to mention railroad, ports, etc. — in many nations was far from adequate. In terms of the present discussion, the number of telephone lines and electrical generation and transmission are of paramount importance, since these services provide the backbone of a modern IT infrastructure. Not surprisingly, even larger disparities are evident between countries in these components. In 1992 China, India, Indonesia, Kenya and Nigeria had less than 10 telephone lines for every 1000 people. Brazil and Mexico — two countries noted for their recent advances in this area — had less than 100 lines per 1000 people. Conversely, the major industrial nations (G-7) had roughly 500 lines per 1000 people. Substantial differences are also apparent in electrical generation per person. Unfortunately, these disparities are likely to become even more pronounced in the future due to large differences in rates of economic growth and investment and population growth between nations.

Table I.2
Infrastructure development, various countries, 1992

	Paved Roads (km/million people)	*Safe Water (% with access)*	*Electrical Production (kwh per person)*	*Telephone Lines (per 1000 people)*
US	14,453	100	12,900	565
Japan	6,426	100	7,211	464
Germany	-	100	6,693	457
France	13,008	100	8,089	525
Italy	5,293	100	3,963	410
UK	6,224	100	5,660	473
China	-	71	647	10
Canada	11,451	100	18,309	592
Brazil	929	96	1,570	71
Mexico	1,019	78	1,381	80
Korea	1,090	78	2,996	357
India	893	75	373	8
Indonesia	160	42	233	8
Thailand	841	72	1,000	31
Turkey	5,514	91	1,154	160
Hong Kong	268	100	6,051	485
Singapore	993	100	6,353	415
Hungary	7,756	100	3,080	125
Egypt	633	41	849	39
Nigeria	376	42	137	3
Kenya	324	-	130	8

Source: World Development Report 1994; IMF; Table 32.

The state of existing infrastructure in the typical low or middle-income country suggests that many developing countries must make substantial investments in roads, water and sanitation, electrical production and telephony before they can hope to reap the full advantages of IT. Since these investments are likely to consume the bulk of these countries' funds for decades to come, a key determinate of the future status of individual developing countries will be their ability to encourage higher levels of domestic saving and/or foreign investment and to successfully direct those funds into areas which offer the highest rates of future economic growth.

The combination of higher rates of GDP growth coupled with higher rates of domestic investment will enable a few developing countries to experience marked improvement in economic performance and infrastructure development in the first quarter of the 21st century. These countries — which *inter alia* include the Asian NICs — will become *de facto* centers in the emerging global 'information highway' and the creators and implementors of new technologies. However, the same logic implies that the vast majority of developing nations will fall increasingly behind the current industrial nations and the fortunate handful of rapidly growing developing nations. Finally, some countries may attempt to reduce the cost of infrastructure development by concentrating investment in high-density urban areas at the expense of more dispersed rural areas. The likely result of such practices will be greater divisions between geographic regions and social groups *within* individual countries in addition to the aforementioned differences *between* nations.

Perhaps the most important conclusion to draw from this brief discussion is that the gap between the information 'haves' and 'have nots' shows little sign of narrowing in the next century, and may instead widen over time. In general, two opposing methods have emerged to address these disparities between countries: one relies on national planning and international organizations to promote economic development and build basic infrastructure in developing countries, the other depends on market forces to increase rates of domestic growth and improve the efficiency of local institutions. As we shall argue below, neither of these approaches has been particularly successful in assuring equal international access to sophisticated IT.

International organization and the diffusion of IT

International diffusion of information (and other) technologies is in great part a function of the international regime (King and Sethi 1992) which provides the general context within which innovation spreads from the technological center toward the global periphery. Just as the industrialization of Europe in the nineteenth century occurred under the regime established by the Congress of Vienna, so too has the global diffusion of information technology proceeded under the guidance of the interlocking system of organizations which comprises the United Nations. Intended to replace the failed League of Nations, these organizations have worked to adjust their respective programs to the challenges posed by the information revolution. Results, however, have been mixed, as evidenced by a continued global gap between information 'haves' and 'have nots'. Nonetheless, organizations such as the International Telecommunications Union (ITU), United Nations Educational, Scientific and Culture Organization (UNESCO), Intergovernmental Bureau for Informatics (IBI), and International Bank for Reconstruction and Development (World Bank) have a critical role to play in promoting the international diffusion of technology, particularly in cases where market forces are ineffective.

While it may be pre-mature to say that international organizations have failed in their mission of informatizing the world, it would be equally hasty to conclude that they have succeeded. One reason most organizations have achieved only modest success is they were not designed to cope with advanced IT. When the world's leaders met In San Francisco in 1945 to create the United Nations System, the only computers were on experimental drawing boards; senior diplomats could not possibly have foreseen the development of digital technology, telecommunications networking, or the micro-processor. As a result, the bulk of the present international regime is founded on technological assumptions of a bygone age, and the spread of the computer and information technologies has forced many international institutions to make substantial adjustments to their philosophies, ways of working, and basic assumptions. [For a review of the many different programs launched to respond to the rapid development of informatics, see Valentine & Arkin (1986).] A brief overview of the role several major institutions have played in the international diffusion of IT follows.

ITU Fortunately, the founders of the postwar system did not entirely neglect technology in setting up their international organizations. A great deal of attention was given to management of telegraphy, telephony and the radio spectrum through the International Telecommunications Union (ITU), which was to continue the work begun by its predecessor, Committee VII in the League of Nations. The League had worked on the first program to register and control the use of frequencies. It also engineered an improvement in the transparency of the international telegraph network through adoption of standard codes, and the gradual replacement of relay stations at national borders with direct pass-through arrangements. Finally, it had adjusted to the emergence of radio on the same frequencies used previously only by radio-telegraph operators. This early culture of adaptation to technological change has helped the ITU continually adopt to new technologies and practices as their worth was proven.

The development of computer communication systems, the study, clarification and adoption of many technical standards, and even more rigorous management of the radio spectrum required by the adoption of communication satellites have been some of the major successes of the ITU. Its complex system of advisory personnel operating in cooperation with organizations such as the IEEE and various national standards committees, has served it well in the management of a series of 'politically neutral' issues. However, it was the political dimension that presented the ITU with its most serious challenge as a series of struggles erupted between developed and developing countries.

In the 1960s, at approximately the same time IBM introduced the first coherent operating software for its mainframe computers, the world system experienced a major political transformation as the colonial possessions of the European Powers began to declare their independence (Stavrianos 1981). As a result of these actions, the composition of membership in the

UN General Assembly began to change radically, and a major rift emerged between the Security Council — which continued to represent the interests of the established Powers — and the General Assembly — which became more populist in nature. Because the ITU's charter called for majority decision-making, the inclusion of these newly independent nations soon began to dominate and politicize its 'technologically neutral' activities. For example, allocation of parking slots for satellites in geo-synchronous orbit and frequency bands for broadcasting became subjects of a heated debate on the global redistribution of resources. Some countries were demanding orbit slots even though they had no satellites or prospects of launching them.

By the early 1980s, there was a real chance the machinery of the ITU would become paralyzed as technical issues became even more politicized. Crisis was averted only in the end of the 1980s when the ITU bowed to the mounting political pressures and reoriented its work toward the development of telecommunications around the world. The ITU expanded its training and technical assistance programs to help poorer nations develop their telephone systems and moved forcefully towards becoming a conduit for international aid in the telecommunications sector (Pierce and Jequier 1983).

UNESCO The founding fathers also set up the United Nations Educational, Scientific and Culture Organization (UNESCO) to serve as a major force in promoting world development of education and research in a wide variety of fields. UNESCO was charged with an extraordinarily broad range of responsibilities involving almost every aspect of civilization not reserved by the other specialized agencies of the United Nations. One of its founding principles was the promotion of 'free flow of information', an ideal which would be applied to computer data moving across international borders more than a quarter of a century later.

UNESCO was among the first organizations to feel the mounting tension between developed countries and the growing number of newly independent developing nations. In the 1960s, UNESCO had begun to study international communications and mass media in response to the obvious need to eradicate illiteracy in the developing world. As part of that effort, measurements were taken of the number of newspapers, radio stations, telephone receivers, universities, and other communication elements in societies around the world (UNESCO 1964). The picture that emerged was one of extreme 'information poverty' throughout the developing world, as summarized later in the McBride Report (International Commission 1980). The next task for the international community was to explain this phenomenon.

Developing countries, which by this time had formed the Non-Aligned Movement, explained the disparity through dependency theory (Frank 1967; Prebisch 1950). Originally advanced to explain global differences in industrialization, this theory held that developing countries had suffered a permanent decline in their terms of trade because most value-added in global manufacturing occurred in developed countries. Similarly, in the information age developing countries were at risk of being locked into a permanent structural dependence because most data processing value-added occurred in mainframes located in the developed countries. Raw data was collected in developing countries and sent via telecommunications linkages to developed countries where it was processed into useful information and then returned to its point of origin, but at a price (Turn 1979). Further, until recently, most sophisticated hardware and software were developed and manufactured in developed nations. The implication of these circumstances was that the global spread of information technology would reinforce the unequal international division of labor which had been developed during the colonial era, making it impossible for developing countries to obtain economic sovereignty.

These concerns fostered the growth of a large movement within UNESCO and the United Nations to promote a 'New International Information Order' (NIIO) (Roche 1981). In terms of computerization, it was argued that these technologies should be harnessed in the task of bringing about a 'balance of information' between the 'North' and the 'South' (UNESCO 1980; Berwanger 1981). However, UNESCO found it impossible to reconcile its founding principle of 'free flow of information' with the desire by many of its members to actively intervene in the market to rectify this imbalance. Although critics of UNESCO have argued that its philosophy was anti-Western (Smith 1980), UNESCO under the leadership of M'Bow continued along this difficult path until the United States and Britain withdrew their support (Preston et al. 1989). By the early 1990s, UNESCO had removed M'Bow, softened the hostility from the United States and other Western countries, and re-formed a small working group (Busselmann et al. 1990) the Intergovernmental Informatics Programme (IIP) to consider informatics in developing countries (Intergovernmental Committee 1988; UNESCO 1989).

IBI Among all international efforts to promote IT, perhaps the IBI had the greatest potential and yet produced the deepest disappointment. From its beginnings, the Intergovernmental Bureau for Informatics (IBI) was an almost renegade organization which never managed to gain complete agreement and respect from major developed countries. Professor Fermin Bernasconi had broken away from the growing rigidity of UNESCO and formed the IBI in the 1970s as a new intergovernmental organization dedicated solely to helping developing countries exploit new IT. Bernasconi became the 'Secretary General' of the IBI. The IBI grew out of early proposals for the establishment of an International Computing Center to be operated by the United Nations, proposals which were never implemented (UNESCO 1949; Mahoney 1987). In contrast to the interventionist stance taken by UNESCO, the IBI initially appeared to promote a free market approach relying upon the good will of major vendors (IBM, Siemens, AT&T, etc.) to fund a variety of development projects. France and Spain were supporters of the IBI in its earlier years, but the United States continued to send only observers.

At a time when classical development theory was concentrating on projects such as bridges, roads, ports, and sanitation facilities, the IBI was one of the first voices which argued forcefully that information technology was a critical element of a nation's infrastructure and deserved the same priority as other projects (Pipe and Veenhuis 1976). As noted, UNESCO was in an increasingly difficult political situation as its key Western supporters began to withdraw their financial support. During its most vibrant period — the early and mid-1980s — the IBI organized a variety of conferences and research projects to raise the consciousness of the world community regarding the importance of information technology to general economic development (Bernasconi et al. 1986; Bernasconi 1985). Unfortunately, the IBI held one of its annual meetings in Havana, Cuba, much to the chagrin of its U.S. and Western supporters, including many of the large vendors who were potential donors to IBI projects. In fairly rapid succession the IBI lost its fragile financial and political support from Western nations and summarily collapsed (Mahoney 1987). It was an inglorious end to the longest-standing international organization created solely for the purpose of promoting development of information technology in the poor nations of the world.

The World Bank The International Bank for Reconstruction and Development (The World Bank), went through a similar conversion (Weiss and Jequier 1984). It never faced the same internal pressures as the United Nations General Assembly and the ITU, both of which worked with majority voting of members, a process which favored the rapidly-expanding number of newly independent nations. It observed the heightened sensitivity in the world community toward informatics, and gradually changed its priorities to include computerization and telecommunications in development funding. By the mid-1980s, the Bank was discussing these sectors along with its traditional staple of bridges, canals, roads, ports, steel mills, and other visible elements of 'development' characteristic of the industrial age model used in the first 25 years of its existence (Saunders 1982; Saunders et al. 1983; Hanna and Schware 1990).

Until the very end of the 1980s, the Bank had focused almost exclusively on aiding governments, bypassing the private sector. This meant, in effect, building government-run data processing centers to aid different sectors. There is little evidence to date, however, indicating a great amount of success in these efforts. They certainly have not brought about a new 'information society' in the developing world, although we must admit this was never a professed policy. Instead, informatics development has generally been advanced only within the context of other projects, and not as an agenda item in itself, as the specialized institutions supporting informatics never survived, and even today do not exist.

It is inevitable to ask whether the postwar machinery created in San Francisco has been successful in coping with new information technologies or whether developments in IT have out-paced the ability of these institutions to respond effectively. In general, international organization has been slow to respond to changes in IT. It took the better part of a decade for information technology to gain a prominent place on the agenda of those international organizations concerned with development, and ever then, IT never became the primary focus of any organization except the IBI. One reason for this failing was that their view of the development process did not include information technology as a critical element. Some 'late' but significant development programs in informatics have helped spread the technology and raise global awareness of its importance; yet even today IT is widely viewed as an ancillary factor in the development process, and the grossly unequal distribution of information technology around the world continues to reflect the disparities between rich and poor which we see in other areas such as education, health care, food, and security.

Even in those specialized UN agencies which have recognized the importance of information technology, little policy success is evident. For example, by the 1970s the United Nations Industrial Development Organization (UNIDO) had acknowledged the importance of technology transfer to developing countries (UNIDO 1979) and by the mid-1980s was studying developments in micro-electronics which UNIDO warned could cause developing countries to fall even further behind (UNIDO 1985). UNIDO experts conducted pioneering IT research in countries such as Bangladesh, Pakistan, The Republic of Korea, India and Venezuela (Lalor 1984), but its innovative plans to establish 'national, regional and interregional facilities and [network] existing [research] centers', or create a 'Western Asia Silicon foundry' and other such projects (UNIDO 1987a, 1987b) never materialized. By the end of 1995, the United States announced its decision to abandon UNIDO funding. Thus, the meager transfer of technology that has taken place has not been orchestrated under the auspices of the United Nations; but has instead occurred through more gradual and less systematic means.

Despite best intentions, attempts by national and international institutions to introduce advanced information technologies into developing countries have been widely criticized for their excessive cost and bureaucracy, and general inappropriateness. With the shift from large mainframe computers to more cost-effective micro and mini-computers, the 'mega project' aimed at building national data centers operated by developing country governments and sponsored by various international organizations has become obsolete. Nevertheless various specialized agencies continue to include limited funding for informatics in their major programs. For example, the World Health Organization (WHO) is concerned with uses of information technology in public health administration, the United Nations Environment Programme (UNEP) promotes use of information technology for analysis of the environment, and the Food and Agriculture Organization (FAO) for agricultural management. But in each of these efforts, information technology plays only a secondary role.

In short, the regime of international organization set up by the founding fathers in San Francisco has provided a rich environment for international development of information technology. It has not, however, solved the fundamental problem of information poverty in most of the world.

The role of foreign capital in financing infrastructure development

The perceived failure of national and international institutions to promote sufficient investment in infrastructure and the transfer of advanced technologies to developing countries ultimately encouraged a search for other methods of achieving these objectives. Particularly since the early 1980s, this search has centered on greater use of market-based mechanisms. *Inter alia*, these include: greater reliance on international (and domestic) capital markets and foreign investment (versus international aid) to finance investment in infrastructure, the privatization of state-owned enterprises — particularly when they provide essential services such as telephony, the use of market prices (versus administrative planning) to allocate investment and cut public sector deficits, and increased reliance on multinational firms to transfer advanced technology. Thus, since the early 1980s there has been a perceptible shift away from foreign aid and multilateral lending as the primary providers of infrastructural investment in developing countries toward the use of private foreign and domestic capital. Such market-based solutions, however, are not without problems. These problems fall into two broad categories: one involves the effect of foreign borrowing and investment on the recipient's balance of payments, the other involves important social issues such as access to and pricing of essential services.

There are basically three ways in which capital can flow internationally: (foreign) direct investment, portfolio and other short-term investment, and international lending and foreign aid. This distinction is important because each type of capital flow serves a different purpose for the investor and has a different impact on the recipient's economy. A foreign direct investment (FDI) is one in which the investor owns all or part of a productive asset located in a foreign (i.e. host) country and exercises managerial control over that asset. This latter element has often been a source of contention between foreign investors and host governments since each party has a legitimate claim to the right to control the investment's activities. In terms of the present discussion, direct investments have two important effects. First, they offer the host country a number of important economic benefits, particularly when they lead to the creation of a new plant or business (rather than a change in the ownership of an existing asset). These include: increased employment, production, exports and tax revenue; higher wages and living standards; and the transfer of skills and technology. But these benefits must be weighed against the second, more complex impact of FDI on the host country's balance of payments.

All inflows of foreign capital initially generate a credit in the host's capital (financial) account; however, they also create a future claim on the host economy. For example, a direct investment produces a debit in the current account when the local entity pays a dividend to its foreign "parent" or a royalty or licensing fee to a foreign party, and produces a debit in the capital account when the foreign investor repatriates capital. Equally important are flows of intermediate and final products associated with direct investments which may adversely affect the host country's trade balance. Thus, the ultimate effect of a specific direct investment on the host economy is a function of: 1)the real economic benefits (i.e. employment, production, technology transfer, tax revenue, etc.) it provides, 2)the exports and imports associated with the investment, 3)the investment's net payments of royalties, licensing fees, interest and dividends to foreigners, and 4)the portion of the entity's profits that are reinvested in the host country.

A foreign portfolio investment is a long-term investment (one year or more) in a foreign asset that does not entail managerial control. With the recent proliferation of capital markets in developing countries, portfolio investment increasingly consists of stocks and bonds issued by foreign private and public entities. Unlike direct investment, portfolio investment rarely generates additional employment or production in the host country, excepting the small amount of employment created in the local financial sector, and investments in 'new issues' or recently privatized, state-owned enterprises. New issues raise the initial funds for a new business, while privatization generates revenue which can be used to reduce the country's foreign debt or budget deficit. The vast majority of portfolio investment, however, comprises purchases of shares in existing companies, and bonds issued by local governments or public enterprises. Consequently, this form of capital inflow may offer fewer long-term benefits for the host economy than equivalent inflows of direct investment.

This conclusion is especially true of short-term capital flows, which refer to investments in foreign assets with maturities of less than one year. Examples include the purchase or sale of foreign exchange, commercial paper or government bills, and financing for import and export activities. Both long and short-term portfolio investment have two effects on the recipient's balance of payments. First, they generate a credit in the capital account when the initial investment is made (and a debit when capital is withdrawn); and second, they create a debit in the current account when dividends and interest are paid to the foreign investor. Due to the high volatility and speculative nature of short-term capital flows, they have often been associated with balance of payments and exchange rate crises in developing countries.

Finally, international lending involves loaning funds and granting credit to foreign individuals or businesses, governmental agencies, and public enterprises. These activities are generally associated with portfolio investment; however, international lending and international investing differ in a number of ways, the most important being that lending is the primary activity of commercial banks (and multilateral agencies), while investing is increasingly dominated by large institutional investors. Specifically, banks perform three unique functions: 1)they provide short-term financing and financial services to importers and exporters and thus facilitate international trade, 2)they offer services and infrastructure which enable large international firms to manage their global cash flows and working capitals, and 3)they provide an alternative source of short-term credit and long-term capital to groups that cannot access funds through international equity and bond markets. In addition, commercial banks have played a key role in intermediating international capital flows, the most notable example of this being the recycling the 'petro-dollars' through loans to sovereign governments and public enterprises in the latter half of the 1970s.

As these activities clearly illustrate, the long-term impact of international lending on the recipient is not always positive. Banks make loans based on the perceived creditworthiness of the borrower, *not* the potential economic benefits of the activity being financed. Consequently, certain groups — particularly in the public sector — may be induced to over-borrow while other more useful projects go without funds. As a result, many nations have accumulated large foreign debts without receiving equivalent economic benefits. The effect of foreign lending on the borrower's balance of payments is similar to that of portfolio investment; the initial capital inflow creates a credit in the capital account, and subsequent interest and debt service payments generate a debit in the current account. Thus, excessive foreign borrowing usually leads to large current account deficits and, as many nations have learned, frequently causes severe economic dislocations.

The use of foreign capital to finance domestic investment has several effects on the recipient's economy and balance of payments. Four outcomes are noteworthy. First, large capital inflows put upward pressure on the recipient's exchange rate. This in turn reduces foreign demand for local exports and increases local demand for foreign imports, pushing the country's current account toward deficit. In addition, particularly if the exchange rate becomes highly overvalued, it may encourage the 'flight' of domestic capital. Second, large inflows of foreign portfolio investment raise the price of local financial assets and in extreme cases may cause a speculative 'bubble' in local financial markets. Third, the payment of interest, dividends, royalties, and other fees to foreign investors and lenders, and the repatriation of capital and principal push the current and capital accounts toward deficit, and may cause balance of payments problems. Finally, as Mexico's 1994—5 experience clearly illustrates, countries that depend on capital inflows to increase domestic consumption or investment, finance a current account deficit, or support an overvalued exchange rate become extremely vulnerable to a sudden reduction or withdrawal of those funds. The resulting capital outflows put downward pressure on the exchange rate, drain foreign reserves from the central bank which in turn causes a contraction in economic activity and credit, and often precipitate a sharp decline in local financial markets.

The potential negative macroeconomic impact of large inflows of foreign capital has not stopped developing (and developed) countries from attempting to attract these funds through the indiscriminate sale of public enterprises, real estate and natural resources. 'Privatization' as it often is called has been particularly popular in the telecommunications sector (see World Bank 1994). During the 1980s, many countries — from the UK and Japan to Mexico and Argentina — sold all or part of their national telecommunication systems to the public. In many developing countries, large, multinational (telecom) corporations were the major purchasers of these assets. This occurred for several reasons. First, these firms had the enormous funds needed to both purchase these assets and make the investments necessary to modernize local telecommunication infrastructures. But more importantly, multinational corporations are heavy users of IT. A modern telecommunications infrastructure and reliable basic (and sophisticated) service is a necessary prerequisite for large foreign direct investment since it provides the means through which foreign headquarters communicate with their local operations. Further, in many industries — particularly services such as finance, banking and tourism — IT is an essential component in the firm's 'production' process. Several chapters below examine the role of advanced information technologies in promoting critical competitive advantages for both the firm and the nation. Thus, MNCs have both the means and the incentive to purchase local telecom and other IT firms in developing nations.

The sale of essential national services — from telecommunications to water and gas — to foreign corporations raises the important question of who will gain access to the service and at what price. The fundamental premise of market-based mechanisms is that investments are only made when the expected profit is adequate, and goods and services are only provided when their price more than covers cost. Consequently, foreign investors have no incentive to invest in local infrastructure unless those investments yield a suitable return. Since few developing countries can generate such returns, and few individuals within those countries have the ability to pay for service, one would expect to see foreign investment concentrate in certain industries and specific countries, as has in fact occurred. Further, those able to pay — such as large local and foreign businesses, government agencies, foreign tourists and wealthy nationals — are usually concentrated in a few large urban centers. As a result, the private provision of IT (and other basic) services — particularly when those providers have a large percentage of foreign-ownership — has the potential to further polarize and stratify the populations of developing nations.

In fact, judging from past trends, the market price of basic telecommunications services will remain out of reach for perhaps the bulk of the world's population. The same is also likely for even basic computer access. Certainly the kind of access most readers of this book currently take for granted will remain a distant dream for the majority of the world's people for the foreseeable future. In the final analysis, the privatization of essential services such as telecommunications in developing countries may benefit foreign multinationals far more than local constituents. All of this suggests, contrary to prevailing opinion, that foreign investment and international capital will not provide an acceptable long-term solution to the developing world's need for investment in basic infrastructure and essential services.

Conclusions

Despite the foreboding tone of the preceding discussion one should not conclude that IT offers no positive benefits to developing countries. On the contrary, the fundamental premise of this volume is these technologies have become so pervasive that no country can hope to achieve gains in economic growth and social welfare without them. However, it would be extremely naive to assume that only positive outcomes are associated with the introduction and use of information (and other) technologies. In and of itself, however, technology is not the problem. The problem lies in its uses and applications. Even industrialized nations have experienced economic, social and political dislocations from the application of IT to government and industry. Therefore, one major conclusion to emerge from this analysis is that developing countries must carefully analyze the potential economic, social and political costs of introducing IT and develop specific policies to adapt these technologies to their local contexts and needs.

Elsewhere (Roche and Blaine 1995), we have advanced the concept of 'socially-conscious' telecommunications as an alternative to standard delivery systems. This approach uses dedicated lines to transmit a continuous, open audio and visual signal between key locations in a developing country, providing, in essence, an open tele-conference between two or more sites. By constructing several, separate, large open rooms, an inexpensive means of communication could be established between a capital city and say ten of the country's largest regional centers. Similarly, regional centers could establish separate links between other cities or even smaller villages. People wishing to communicate with another site would simply walk into the appropriate room, step up to an open microphone and converse with someone at the other end. A simple admission fee could be charged for the use of the facility, or the service could be made freely available and subsidized by standard individual lines used by businesses or wealthy individuals. Such groupware technologies are now becoming a common application on the Internet.

The communal approach may offer developing countries a number of unique advantages over traditional, individual pay for service arrangements. First, its low cost makes modern communication services available to a large portion of the population that would otherwise not have such services. Second, the concept of communal, open lines may fit well with the social and cultural attitudes toward communication in many traditional societies. Third, the facilities themselves might become a novel social institution much like the party line in rural America in the 1930—40s. This could serve as a vehicle for creating a national identity within ethnically diverse geographical boundaries. Finally, it would make citizens aware of the power of new technologies to improve their living standards, which in turn might make them more willing to learn about and contribute to the creation of more sophisticated local infrastructures.

Such concepts, however, are unlikely to be developed by a multinational telecommunications service provider that purchases a substantial portion of a national telephone system. In fact, exactly the opposite is likely; service will be made available only on a pay-per-use basis. This means that foreign multinationals and tourists, local businesses and government agencies, and wealthy nationals will be the major users. The establishment of reliable service to distant rural locations or poor urban areas could take many years, and even then service is likely to remain substandard in many cases. Similar disparities are associated with the sale and use of advanced computer technologies due the high cost of hardware and software relative to income for the majority of the inhabitants of developing nations. Thus, the challenge of adapting IT to local needs and situations is a critical element in the ultimate ability of these technologies to benefit local constituencies. It is also a problem that the contributors to this volume take very seriously.

The advent of the 'information century' poses serious challenges to all nations, regardless of their current level of economic and social development. History clearly warns that the rapid pace of technological innovation can radically alter the relative stature of individual countries and precipitate fundamental shifts in the global balance of power and the structure of national and international institutions, although these changes are often difficult to detect in the short-run. One thing we may be sure of, however, is that local governments, businesses and institutions in developing countries must accept the responsibility for devising new, more appropriate ways of using the advanced and emerging technologies of the 20th and 21st centuries. This is not an easy challenge, but it will be crucial for the preservation of unique local cultural and social institutions and the maintenance of order and stability in the often difficult transition from developing to developed status.

The Chapters

In general, all of the authors share two fundamental beliefs. The first is that information technologies are a critical element in contemporary socio-economic systems, and therefore, there is a strong conviction that all nations and all peoples should benefit from the wider application and use of these technologies. The second similarity is that, to varying degrees, all of the authors *reject* the currently popular notion that the introduction of information technologies — from the production of IT equipment or software to the creation and maintenance of a modern IT infrastructure — is best handled by the private sector alone. The chapters contained herein underscore the importance of the *public sector* in all aspects of IT development and provision. Clearly, public institutions in many developing nations can be improved in order to provide basic IT products and services more efficiently or at a lower cost. However, as the over-riding concern of these contributors is *widening* the access to IT, there are many reasons to believe market-based IT policies will restrict access instead. Intervention by the state or other institutional actors is necessary and yet even then the outcome is fragile and precarious.

The chapters in this volume divide into two groups. The first group addresses the theoretical issues associated with the introduction and use of IT in developing countries. These chapters cover a wide range of specific issues, but in general explore two fundamental questions: 1)What are the likely social and economic impacts, costs, and benefits of introducing IT into developing countries?, and 2)How can developing countries maximize the benefits and minimize the costs of these technologies? Using theoretical and empirical analyses, these chapters attempt to develop models capable of answering these complex questions. The second group of chapters addresses the social and cultural impacts of IT on developing countries. Through a combination of empirical and case studies, this section explores the unique effects of specific environmental and cultural factors on the adoption and use of IT. A brief summary of each chapter follows.

Section 1: Theoretical issues

The first two chapters of the book examine the impact of IT on the relationship between developed and developing countries. Through an in-depth review of research on the multinational corporation, globalization, the sociology of modernity, and economic development, Alvarez and Calás attempt to develop a framework capable of understanding the cost and benefits of pursuing 'globalization' through information technologies. They note that most contemporary research fails to assess the complexity of information and communication technology in the global context since it is restricted by the epistemological and political boundaries of individual disciplines. As a result, it is unable to present a realistic description of emerging global realities. The authors use their inter-disciplinary framework to analyze to role of IT in determining Mexico's position in the North American Free Trade Agreement. They do not believe the hype of the information superhighway, but instead argue that it is going to become a 'toll road' for most persons in developing countries.

The policy implications of this work is that those international institutions charged with creating programs for developing countries should continue to question the 'inevitable logic' of privitization and seek to alleviate as much as possible the destructive effects of private enterprise and market forces.

David Mundy focuses on the role of the international donor community in introducing IT into developing settings as elements in many international aid projects. He raises the important question of whether the specific kinds of information technology 'inserted' are appropriate given the unique challenges facing many developing nations and whether they represent the best uses of the limited resources these nations can muster for economic development. Behind this discussion lies the more basic question of whether IT increases the independence of developing countries by providing them with more efficient tools for planning and development or whether these technologies in fact *increase* the dependence of developing nations due to their limited educational, financial and technological resources.

The conclusion that emerges is that while IT can play a critical role in increasing the efficiency of local institutions, its adoption must be carefully considered, and special attention should be given to the use of 'appropriate' technologies. In short, the cost of a system is only marginally related to its potential benefit. Although there are many promises of the benefits, the nature of computers as a complex technological system of necessity introduces a great degree of dependence on supplier countries.

Since current research has determined support costs can be 4—6 times technology costs, unless compensating policy measures are taken, even a free gift of the technology could produce a negative cash flow for the receipient nation. It is painfully obvious this aspect of IT is not widely known by policy makers in the developing world.

Enrique Lopez and Maby Gonzalez Vilaseca examine the 'balanced' use of information technology as a tool for economic development. Their chapter provides a detailed analysis of the social, economic and political issues developing countries must consider when devising and implementing an information technology strategy, and the possible alternatives available to these countries. One important issue facing developing countries is the choice between 'mature' and 'emerging' technologies. Although the former is often less expensive in the short run, maintanence costs and obsolescence may make it more expensive in the long run. On the other hand, advanced technologies may be inappropriate for the country's specific context. Another important issue is privatization. Again, while the privatization of domestic IT firms and infrastructure may generate much needed capital and encourage technology transfer and investments, it may ultimately create levels of foreign participation and ownership that are unacceptable in some developing countries. Finally, and perhaps most importantly, the chapter provides a step by step procedure that policy makers can use to develop and evaluate their technology strategy. The Lopez-Gonzalez chapter is unique in the level of practical advice it provides to policy makers.

The chapter by Richard Heeks focuses on strategies developing countries employ to promote domestic software production for export. He observes that the software industry is of vital importance to economic development and argues that successful software industries require government intervention. The form of intervention is changing, however, shifting from regulation to promotion. Appropriate governmental actions include: stimulating the supply of working and venture capital, providing education and training, investing in basic software research and development, providing marketing assistance to local software enterprises, creating a supportive institutional structure, and investing in the domestic telecommunications infrastructure. In order to accomplish these tasks, governments must be able to respond quickly to industrial needs and changing markets and technology. This will require close cooperation between government and industry; however, the state must strive to fulfill its role without becoming merely the servant of industry or the market.

Renata Lebre La Rovere examines the role of the Brazilian government in promoting the diffusion of information technology in the banking sector. Brazilian banking has some unique aspects which make it a fruitful area of study. In Brazil, unlike the United States where interstate banking is prohibited, state regulation allows banks to conduct business throughout the entire country. Given the size of Brazil, its banks are some of the largest in the world, as measured by number of branches. This provides clear challenges for the introduction and utilization of information technology. La Rovere's analysis underscores the important role of governments in creating and expanding the business opportunities of local firms and industries. Through investments in infrastructure, technology diffusion, education, training, and targeted regulations, governments play a critical role in improving the competitiveness of local banks and financial institutions. During the 1970s, the Brazilian government placed high tariffs and other restrictions on imported IT equipment in an effort to promote a domestic computer industry. In addition, telecommunications services were provided through a nationally owned firm. By the 1990s, however, many of these restrictions had been lifted. La Rovere examines the impact of these changing policies on the domestic banking industry and concludes that the lack of coordination between Brazil's IT and telecommunications policies reduced the rate of IT diffusion in the domestic banking sector, thus reducing the industry's competitiveness.

La Rovere's analysis should serve as a sobering reminder to government policy makers in developing countries — many well-intentioned policies in one economic sector can produce untoward consequences in another. This once again illustrates the importance of integrating IT into the country's broader development strategy, and working closely with domestic firms and institutions to coordinate efforts and monitor their impact.

The next two chapters — by Elliot and France — examine the impact of information technolgy on the firm. Elliot notes information systems are becoming more important elements in the strategies of firms in developing countries. Unfortunately, little is known about the decision-making process used in these organizations since the vast majority of research has focused on firms in industrial nations. Elliot conducted an empirical study of Hong Kong firms in the manufacturing and banking industries in an attempt to determine the process they used to evaluate investments in information technology. His framework for analysis is based on the 'traditional' systems acquisition process developed in the literature. The results of this study revealed that all of the firms used a similar decision-making process, and that the process was broadly similar to models developed in industrial nations. Elliot synthesizes these results into an 'inter-sector IS/IT investment decision-making model' which can be employed by firms in other developing countries, particularly in Asia, to assess IT investments.

Using the St. Vincent's electric power supply company as a case study, R. B. France describes the Goal-Concerns-Points (GCP) technique for evaluating and selecting an information system. The GCP technique begins by identifying a set of specific goals for the prospective information system. A set of system concerns is then derived and used to analyze the proposed system solutions. The result is the selection and implementation of a solution better aligned to the needs of the organization. Further, the explicit connection between evaluation criteria and the organization's stated system goals enables management to easily determine the degree to which proposed solutions achieve their stated objectives. The interesting aspect of France's approach is its 'home grown' nature. Although in comparison to the method discussed by Elliot, GCP does not mimic traditional thinking about the systems development process, nevertheless, as evidenced by the case, it is capable of being used quite effectively in a developing country setting.

France's study should encourage policy makers in developing countries and international institutions to continue to seek out and develop unique and specialized approaches to the introduction of IT, although as can be seen from Elliot's analysis, 'traditional' systems development methods can also be used with a great deal of effectiveness.

Section 2: Practical challenges (Cases)

In her chapter on computer use in Kenya, Dominique Van Ryckeghem provides a thoughful introduction to the second major theme of the book, namely the impact of cultural factors on the adoption and use of modern — Western — technologies. She observes that although the number of computers and users in Sub-Saharan Africa is increasing, they remain well below levels in other developing countries such as Brazil, South Korea or India. Further, unlike the latter nations, which are also producers of information technology, African countries are mainly technology importers. This is important because, as Van Ryckeghem notes, computer technology is *not* culturally neutral, but instead assumes a particular view of the world based on efficiency, rapidity and functional rationality. As a result, the values 'embedded' in modern IT may be at odds with traditional cultural values of many African nations. This may provide a powerful explanation for many problems developing countries encounter when they attempt to implement modern IT. Van Ryckeghem also presents an analytical model which attempts to explain the relationship between cultural elements and computer usage. This model is then used to examine this relationship in the unique context of Kenyan culture. It is fascinating to read her analysis and sharp observations detailing how the cultural and social characteristics of Kenyans provide a context in which all of the Western assumptions regarding the efficiency-productivity effects of information technology are submerged into a human network with completely different behavior.

This chapter more than any we have seen should serve as a guidepost to those charged with introducing information technology to developing countries. The context there really *is* different and the way to get those productivity effects so well-reported in the West is still not known in many contexts.

Braa and Monteiro present a detailed analysis of the existing health management information system in Mongolia. Their analysis shows how critical pieces of information can be lost to policy makers because the computer system put in place might be designed with a great deal of detailed data collection at the local levels, but engage in aggregation of data at the central or national level in such a way that the data becomes useless. In the Mongolian case, the aggregation of local data was done so that important information which would have allowed public health officials to pinpoint the geographical locations exhibiting abnormally high levels of infant mortality was completely lost as the data was centralized.

This chapter is followed by a similarly detailed analysis by Clement, Robinson and Wagner of a decentralized, urban health care network in Nicaragua. Drawing on this case study and on recent research in computer supported cooperative work (CSCW), the authors propose a 'hierarchical spider's web' model for adapting computing technologies to local conditions and social practices in developing countries. They argue that this approach provides an alternative to the more conventional, centralized, top-down model. Through a blend of theoretical analysis and practical application the authors examine both the advantages and challenges of this new model. In the case of Nicaragua, the challenge was to somehow link together public health administration at the local, regional, and national levels. At the local level, *brigidistas* (mid-wives) provide a significant portion of health care. The computer system supporting this health network must be able to transfer information regarding different patients as they are referred for treatment through different levels of the system. Clement, Robinson and Wagner discuss how new technology such as groupware can operate on the type of relatively inexpensive infrastructure found in the developing world.

One of the key implications for policy makers is that although the computing and telecommunications infrastructure in a developing country may not be state-of-the-art, there are some types of advanced software available which can enable the infrastructure to 'emulate' a considerably more expensive system. Policy makers need to pay more attention to software selection rather than fixating only on the next generation of microprocessor operating at higher speeds, etc.

Remaining in Nicaragua, Irene Horejs examines the role of information technology in rural development planning. She argues that regional development planning must be seen as a decentralized, participatory, decision-making process which implies that organizational and procedural aspects are crucial for its effectiveness. The main benefit of information technologies is their potential to 'enable' better informed decision-making, and also organizational change and improved working procedures. The chapter presents a description and analysis of the author's experience in establishing a computer supported information system as part of a rural development program in Northern Nicaragua in the late 1980s. Horejs describes the process of establishing the system and critically analyzes its successes and failures, paying particular attention to the general lessons to be gained from this experience for other developing countries.

Using the case of a computerized system in a Ugandan university, Chrisanthi Avgerou and Nora Mulira explore the role of IT in 'enabling' institutional change and supporting new forms of organization, work procedures, services and products. They point out that such changes are not always positive. The authors note that most information system projects in developing countries concentrate on creating 'efficient' systems rather than implementing broader organizational improvements, and argue that the full developmental potential of IT can only be achieved by adopting a broader, 'information systems' perspective. Examining the admissions system at Makerere University, Avgerou and Mulira conclude that ongoing efforts to build a computer-based bureaucracy have addressed efficiency goals but have failed to address broader goals of attracting and selecting appropriate candidates for higher education.[1]

This underscores the critical point that the design and evaluation of an information system must focus on the larger context of the organization and the culture within which it operates. If indeed the type of outcome reported by Avegerou and Mulira is prevalent in many developing countries as new systems are implemented, then it is clear a great deal of re-thinking must be done by policy makers.

In the final chapter, Eileen Trauth examines the social impact of foreign inward IT investment on Ireland, classified as a 'newly industrializing country'. She notes that many countries — both newly industrialized and developing — view foreign investment in IT as a way to solve their economic problems and increase local employment, investment and exports. However, economic development based on inward investment has cultural and policy implications that must be considered. Based on an ethnographic study of the information sector in Ireland, Trauth identifies four general lessons for other developing countries. The first is that inward investment is not a panacea and the costs and benefits of this approach must be carefully weighed. The second lesson is that these investments must be appropriate for the specific context in which they occur. In particular, the infrastructure — education, telecommunications, utilities, transportation and housing — must be taken into account. Third, the development of human resources through education and training must be coordinated with employment policies so that jobs exist for newly skilled workers.

Clearly, the circumstances for all late entrants into the information age are different from those which existed for early entrants such as the United States. As a result, although competition may be appropriate for large and well-established information societies, greater government intervention may be necessary for late entrants to compete in a global information sector. The Trauth chapter shows these lessons are important for all developing countries as they seek to maximize the potential gains of computerization.

Perhaps the single most important conclusion to emerge from these case studies is that information systems do not have to be expensive or complex to increase the performance of organizations or the efficiency of service delivery or data analysis and planning at either the local or national level. In many cases, PC-based systems, when properly designed to take local needs and skills into account, may greatly increase efficiency and performance. A second point from these studies is the critical importance of incorporating local users into the design and implementation process. Participation increases the likelihood local skills will be used and systems will more closely satisfy needs; it also increases the probability systems will be used and users will be motivated to acquire those additional skills necessary to maximize gains from these systems. Involving users in the early stages of systems design is increasingly recognized as a major determinant of success. This can be a particularly challenging task given the proclivity of international organizations and other aid bodies to rely heavily on external consultants. Thus, a final implication of these studies is that in many developing settings, the appropriate allocation of funds for the design and creation of information systems may favor training and other devices to increase local participation rather than purchases of sophisticated equipment and applications. As many of the authors note, a high proportion of the IT equipment installed in developing countries over the past decade lies idle for lack of proper training and maintenance.

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Notes

1 A note from N. Mulira: Uganda makes for an interesting case study. It differs from other African countries in East and Central Africa because it was at one time an educational power in higher learning. Makerere University used to be the University of East Africa. After the serial civil wars of the 1970s and 1980s, the University no longer enjoys the same level of prestiege as before. Currently Uganda is trying to recover from the ravages of these wars and there is a need to regulate the demand for social services and to promote programs geared towards overall national socio-economic development. In Kenya, the majority of the population (80 per cent) lives in rural areas where they engage in agriculture, which forms the backbone of the country's economy. This agriculture is not intensively mechanized and the government's efforts to alleviate poverty have not yet succeeded.

Part I

THEORETICAL PERSPECTIVES

1 The global data highway: For whom a freeway? For whom a toll road?

Rosío Álvarez and Marta B.Calás

Introduction

On 2 October, 1990, at the United Nations General Assembly in New York, George Bush announced that, 'a new era of peace and competition and freedom...a world of open borders, open trade, and, most importantly, open minds' had begun (Bush 1990). Images of borderless nation-states, peacefully co-existing as one world moves toward a global advanced civilization, flood the horizon. With the aid of information and communication technology (ICT), this global society is portrayed as transcending time and space, making information available to everyone. Communication networks reduce the world to timeless and distanceless dimensions. People, organizations, and nations come together for common purposes on the network (Williams 1983). As this rhetoric goes, time, distance, and inequalities are electronically overcome by participating in the global information society, moving us from local, to national, to global in a historic, linear, and progressive trajectory.

Unfortunately, the optimistic image of the harmonious 'global' world portrayed here ignores other more critical images: the unleashed powers of multinational corporations (MNC) where managers sit at their computer monitors transmitting and receiving information around the globe, as they construct a 'Transnational World Order'. This new world order is based on the creation of a single 'transnational' system of production, distribution, trade and consumption. National sovereignty will become secondary to MNC interests as world capital, reduces developing countries to colonies (Raghavan 1993).

While these literatures on globalization and information and communication technology attempt to capture the complexity of the emerging 'new world order' (Tehranian 1990), they often overlook the transformations taking place. As Appadurai (1990) indicates, between opposing depictions of the 'global' world there exists a complex and disjunctive globalization process. Thus, these discourses on globalization and information and communication technology provide only partial representations of this complex new world order. Representations which suggest emergence of one economy, one culture, or one world invite the use of terms such as homogenization, hegemony, or imperialism. Yet even these terms obscure and simplify the complexity of the globalization processes occurring today.

This chapter argues that contemporary literatures on globalization and ICT fail to represent the complexity of information technology in the context of globalization. Further, it is argued that each of these literatures has been capable of depicting some specific images made to fit the political agendas of their disciplines, but none has been able to present a sufficiently complex picture of newly emerging global organizational realities. These realities cannot be understood through conventional, disciplinary lenses. ICT and globalization are qualitatively newer phenomena with unexpected input. Understanding their organizational consequences requires both abandoning prior assumptions and developing different theoretical formulations for representing emerging organizational forms.

This chapter suggests some possibilities in this direction. First, different contributions of several disciplines regarding ICT and globalization are reviewed with articulation of the limitations in their assumptive bases. Second, the contradictions of these contributions are revealed and a multi-disciplinary view is offered for better understanding the complexities of global organization via information technologies. Finally, the proposed view is illustrated through an analysis of Mexico and the North American Free Trade Agreement. For this purpose, it is necessary to step inside this *disorganized* global sphere and look at some forms of emerging organization, recognizing that global configurations of ICT, 'are driven not by any obvious economies of scale, of political control, or of market rationality, but by increasingly complex relationships between money flows, political possibilities and the availability of both low and highly-skilled labor' (Appadurai 1990, pg. 298).

An analysis of the literatures on these issues is presented in Table 1. Their contributions and contradictions are examined in a dynamic conceptual space that more adequately represents the complexity of the contemporary disjunctive global world — the so called 'global data highway', and its organizational consequences. More specifically, a review of literatures is presented that encompasses three themes: global organization, modernization, and fragmentation. Each of these themes have appeared in several disciplinary arguments which articulate changes in contemporary organization due to information technology (Bell, 1976; Castells, 1989; Frederick, 1993; Scott Morton, 1991). Further, the argument follows, these assumptions sustain paradigmatic world views (Burrell and Morgan, 1979) which dominate in the literature 'disciplinary domains'.[1] By bringing these assumptions into a common conceptual space, the aim is to contribute in creating other theorizations beyond the paradigmatic limits of these disciplines.

ICT and the global organization

The study of international organizations has produced a substantial body of research on the multinational corporation (Bartlett & Goshal 1988, Egelhoff 1988), and MNC economics (Buckley 1988, Dunning 1988). More recently research on multinationals has focused on 'globalization' and 'transnationalization'. The 'global' or 'transnational' corporation differs from its multinational predecessor in that the latter sees foreign operations as adjuncts to existing operations, while the former operates as a single economic unit. Consistent with this new identity, the transnational/global organization: 1) achieves efficiency and economy through global operations, 2) responds to local and national differences, and 3) is innovative through worldwide information and knowledge transfer (Bartlet & Goshal 1989).

In attaining these goals, the transnational/global organization relies on an information system which includes technologies such as parallel processing, fiber optic links, satellites, and object oriented programming. This merger of information technology and telecommunications provides the global organization with a powerful information network (Kane & Ricks 1988, W. Marx 1993), the 'global data highway' necessary for transmitting information quickly across national boundaries. These technologies are no longer considered inputs into the organization but represent permanent vital components of the global corporation which enable them to coordinate, control and manage global resources (Bradley, Hausman & Nolan 1993).

The global organization literature portrays the business organization as existing in a borderless world (Ohmae 1990); a world economically integrated and fully interdependent where national boundaries are broken down and universalistic assumptions of economic efficiency and market logic prevail. The global corporation is portrayed as a 'countryless' organization which has little national identity. This image is consistent with the prevailing ideological assumption of a global consumer civilization; one world, one nation, one people, and more importantly, one great market. This ideology is best expressed by Theodore Levitt (1983). He argues that, 'A powerful force now drives the world toward a single converging commonality, and that force is technology...Almost everybody everywhere wants all things they have heard about, seen, or experienced via the new technological facilitators that drive their wants and wishes...increasingly into global commonality, thus homogenizing markets everywhere.' (1983, pg. 92).

As the globe becomes one world united by common tastes and the propensity to consume, the nation-state is an obstacle to the globalization process, its narrow and confining borders are viewed as outdated and limit-ing by the global corporation. What becomes more relevant now are socio- and psycho-graphic groups which define specific consumer desires. The life of middle class consumer is available to all and attainable through peaceful and democratic means. In a world of fratricidal wars and economic decline, this representation of 'globalization' then becomes a very appealing ideology (Barnett & Muller 1974).

Global neo-liberalism and the market

The global world as defined by these theorists is a very specific creation; it is a neutral homogeneous one which relies on a certain political climate. According to W. Marx (1993), 'The liberalization of trade and of regulation and the formulation of policies that bolster market-based economies will hasten the expansion and modernization of global networks and at the same time deliver to individuals, companies, and governments the full benefits of information technology.' (1993, pg. 370). W. Marx argues that in order to truly benefit from the globalization process the market must be free to work unimpeded by any protectionist measures.

The global organization, therefore, becomes the vehicle by which all can participate in the information society. The creation of the global data highway allows these organizations to accomplish their task, enabling all persons to benefit equally from the creation of global networks through an electronic 'trickle down' effect. That is, the introduction of ICT simultaneously brings about price reductions of consumer goods, including information itself. According to Madnick (1991), 'This moves us toward the point where anyone, anywhere can connect to anyone else...there will be no serious barriers to low-cost communication vertically and horizontally within an organization and between it and its principal working partners (suppliers, collaborators, customers, etc.)' (1991 pg. 28). It is an image of a highway with no stops signs, no traffic lights, and no other deterrents — it is a *freeway*. Thus, this literature relies on the free flow of information to allow actual markets to approximate the assumptions of neo-liberal market theory. Markets become frictionless and operate under conditions of perfect information (Melody 1991).

Enhanced efficiency and competition — this seductive rhetoric stresses — allows for efficient allocation of resources which in the long run will benefit the consumer. For example, Berthoud (1992) observes, 'The market itself is increasingly viewed as the only means to promote development. Within this neo-liberal framework, economic growth as such — without any redistribution at all — should allow us to solve the dramatic problem of poverty throughout the world.' (1992, pg. 73). There is no recognition of complex or conflicting needs of the various consumers. They exist in an 'a-historical' context in a fully economically integrated world where national boundaries are meaningless and universalistic assumptions of economic efficiency and market logic prevail.

This view of a homogeneous global world attempts to obscure the competitive and destructive nature it assigns to the ability to store, transmit and analyze information. Behind the banner of globalization hide some very conventional images of organizations as weapons. Not surprisingly, some argue that the strategic nature of information technology for contemporary organizations is comparable to its importance in actual wars (Davidow & Malone 1992).

From this literature, then, a schizophrenic image of the global organization begins to emerge. It is an organization which exists in a homogeneous, neutral and almost placid world. A world where all governments and individuals can benefit alike. At the same time, it operates in a warlike manner pitting nation against nation, using bytes as bullets, and information as even more destructive weapons. The nation-state is now replaced by a corporate state composed of inaccessible outsiders who control access to information. But is this really true? Is the existence of the nation-state in conflict with the global organization? As Calas (1993) notes, 'Despite its more recent imagery of a world without boundaries, 'international management theory' as a discourse for and about the contemporary world supports — implicitly and explicitly — the traditional view of the nation-states in competitive warfare as the necessary condition for globalization and transnationalization.' (1993, pg. 8).

The reality is much more complex than a simple bipolar reality. Although the globalization rhetoric seems to be moving us toward a homogeneous integrated world where the nation-state would seem to be a reality of the past, the global corporation benefits directly from the existence of strong but obedient nation-states. By supporting strong nation-states, global organizations prevent the creation of strong supranational regulatory bodies that would control their transactions. Further, it is important to note the supplementary relationships that 'national interests' have with 'global interests.' How else will local uprisings be calmed, will IMF austerity programs be implemented, will free trade agreements be enforced, if not by the nation-state apparatus?

The nation-state also serves to maintain safe investment environments. As Van Dinh and Porter (1986) point out, international capital can operate at its most efficient level when it removes itself from providing social welfare services (health, education, etc.) and assigns their provision to the nation-state and its citizens. Thus, the nation-state serves to maintain stable *asymmetrical* relationships which support a global division of capital and labor.

ICT and modernization

The promise

A common theme that runs through the global organization, global market, and global world literatures is also shared by theories of the information society as the road toward modernization (Naisbitt 1982, Toffler 1980). While the voices within this perspective are far from harmonious, they all embrace the fundamental ideology that ICT represents modernization. This ideology, when applied on a global level, sees the adoption of ICT as the way for many developing countries to leap out of underdevelopment. It becomes the 'Marshall Plan' of computing (Mattelart & Schmucler 1985).

Some of the ideas advanced under this logic relate to geographical dispersal of production and economic activity (Toffler 1980). Individuals in this 'Third Wave Society' are able to transcend geographical boundaries and redefine the social unit as the 'electronic cottage'. From this perspective, ICT offers the prospect of democratization (Naisbitt 1982, Toffler 1980) focusing on the transition from an industrial society to an information society (Bell 1973, Porat 1977).

These scholars share a fundamental assumption — the linear and progressive development from industrial (or pre-industrial in the case of developing countries) to post-industrial societies. This represents a technological determinist view. The theoretical heritage of this perspective is linked to the modernization school which assumes that social change is unidirectional, progressive and moves societies from primitive to advanced. Societies converge as they move along the path of evolution (Rostow 1960). Consistent with the literature on ICT and globalization, there is an unmistakable reference to advancement in a progressive linear fashion. That is, the global world moves from industrial to post-industrial with modern ICT as the engine.

The peril

In contrast to those who view ICT as a desirable path toward modernization and globalization, other scholars offer a more critical analysis. These theorists focus on issues such as power, control, centralization and surveillance, associated with ICT (Bloomfield 1989, Bloomfield & Coombs 1992, Gandy 1989, Markus & Bjorn-Andersen 1987). For example, Gandy (1989) discusses how the term 'information society' is actually a misnomer that obscures the extent to which it has become a 'surveillance society'. Extending the impact of ICT to a global level, some view the role of MNC's as promoting the privatization and commodification of information, creating a more marked separation between 'center' and 'periphery.'

Although the theoretical frameworks used by these critics vary, the most prevalent frameworks are 'world systems' (Wallerstein 1974) and 'associated dependent development' (Cardoso & Faletto 1979). These approaches share the fundamental assumption that ICT is not a neutral tool for development. They define forms of social relations that influence not only ideas or profits, '...but the very rhythms, patterns, pace, texture, and disciplines of everyday life...[which] in contemporary capitalist societies express the characteristic and prevailing relations of power' (Robins & Webster 1988, pg. 46). There is an attempt to demystify ICT and place it within its social, political and economic context, and to define its problematic role in the globalization process.

Information access becomes an issue of class and income. Schiller (1984), Golding & Murdock (1986) and Hepworth & Robins (1988) all contest the context of information access for all people at all times in all places. Schiller's work focuses on the disparities between the information rich and the information poor, while Golding and Murdock focus on access to information as a function of the ability to pay. Hepworth & Robins analyze information inequalities within societies themselves and examine the uneven development of the information economy, questioning the inherent logic of capitalism in an information society that produces such inequitable distribution of wealth and employment.

Mosco (1988) presents the concept of the 'Pay-per Society,' where electronic communication and activities are monitored, measured, repackaged and sold as a commodity. As global organizations recognize the enormous profits available in the pay-per society, the massive mergers of telephone, computer, telecommunication and broadcasting companies — such as Microsoft Network/NBC, Murdoch/MCI, Disney/ABC and Time/Turner — come as no surprise. The basic ICT issue changes from access to information for all through the 'global data freeway', to using the global data highway to extend the pay-per society. From this perspective, MNC's that are able to secure the 'free' flow of information are the ones that have the need for and can take advantage of the new opportunities afforded by ICT. They are the truly global organizations.

Meanwhile, the information society must rely on massive consumption of 'info-modities,' increasingly expanding the gap between the have and the have nots. What about those that cannot pay to travel on the global data highway? Are they to become mere spectators as the information age passes them by? For whom is this a freeway? For whom is this a toll road? In general, these authors contest the idea that the current transformations introduced by the expansion of ICT is simply an economic or technological process. The use of ICT and the expansion of the data highway by global organizations is not '...simply a struggle to establish new products and markets in the face of recession...the upheaval we are undergoing is very much a social and political matter.' (Robins & Webster 1988, pg. 46).

ICT and fragmentation

The promise of becoming part of the global village has not pacified those living in poverty, unemployed, or in the global 'periphery'. Expansion of a global data highway which excludes many is not a stable process. As Mosco

(1988) argues, the turbulent environment that is witnessed throughout the world includes responses by those resisting their exclusion from the information society (Third world people, women, etc.), creating a more fragmented high-tech world. The globalization process becomes as much a disintegrating process as it is an integrating process. As indicated by Paz' (1959) prophetic words, 'Today the center, the nucleus of world society has come apart and we have all become peripheral beings... We are all on the margin because there is no longer any center' (1959, pg. 152).

It would be easy to infer that if these discourses were taken seriously the 'information society' might produce less passive 'inhabitants'. The informational possibilities unleashed by these technologies would influence social relations toward real conditions of post-modernism. However, the fragmentary accesses we see from peripheral locations — the uncontainable 'ramps' of the 'data freeway' — not only redefine contemporary articulations of time and space (Harvey 1989, Smart 1992), but also redefine the limits of many common conceptualizations of modernity — such as 'organization,' 'market,' 'ownership,' 'education,' 'government,' 'nation,' 'wealth,' 'poverty,' and even 'personhood' (DeLoughry 1993a, 1993b & 1993c, Frederick 1993, Haraway 1985, Ruth 1992, Wilson 1993).

The 'unintended' consequences of ICT

Access to ICT in recent years has helped to advance efforts to organize via NGOs (non-governmental organizations). As Frederick (1993) indicates, '[I]n the last decade there has emerged a new kind of global community that has increasingly become a force in international relations...global civil society is best represented in the global `NGO Movement,' non-governmental organizations and citizens advocacy groups uniting to fight planetary problems whose scale confound local or even national solutions.' (1993, pp. 2—3). Perhaps the most immediate issue is the NGOs' ability to control information, contesting and circumventing the power of private global media activities.

Non-controllable access to information by the the NGOs suggests it is possible for these organizations to offer lower cost services to communities otherwise serviced by market-oriented multinational activities. The issue of access versus ownership will become the point of contention between multinationals and NGOs. Focusing only on intellectual property issues is not sufficient. The activities of NGOs might also create barriers for those who benefit from maintaining less-informed (gullible) actual or potential consumers. Further, they might also hinder governmental efforts to maintain control over their populations by keeping them within their 'informational boundaries'. Informational activities promoted by NGOs create problems of control for both 'markets' and 'governments.'

Several international organizations have appeared which provide information to developing countries on how to participate in low cost networks — such as FidoNet, based on inexpensive hardware, software and direct dial telephone lines. FidoNet allows people to communicate on a global scale with networks like the Internet, UUCP/Usenet, and Bitnet, as well as PeaceNet — part of the Institute for Global Communications focusing on human rights, and economic development. Other organizations — such as the Association for Progressive Communications (APC) — share expertise and computer networking capacity from various global sources and place their nodes under the full responsibility and management of local users. Consequently, computer networks have emerged which are dedicated to facilitating the exchange of progressive social information through local and global cooperation. These include Nicarao in Nicaragua, AlterNex in Brazil, and Pegasus in Australia (O'Brien 1991).

These efforts contribute to the creation of sustainable indigenous information and communication systems which allow local innovation and re-inventions. For example, an 'Africanized' approach to global electronic communications trains local people to use low-cost electronic networking techniques for message and file transfer capability using: 1) digital radio terrestrial environments, 2) low earth orbiting satellites, and 3) telephone-based analog modems (Garriott, 1993).

Observing these cases of ICT uses from 'the margins,' it is fair to say global access to ICT turns on their head many assumptions about the 'good guys' and 'bad guys' since it changes the context in which 'good' and 'bad' are defined. For example, what is one to make of NASA's refusal to allow Relcom — a Russian network which provided access of information to citizens during the 1991 coup — to use one of its channels for alternative access? (Press 1992). How should one interpret Cuba's strong push for computer literacy from school children onward, or its support for international access so that children and adults in rural and urban areas can communicate worldwide? (Press, n.d.).

These examples illustrate not only the reconfigurations of *subjects* fostered by information networking activities, but also the *subjective* reconfigurations which constitute the networks themselves. The values of sharing, interconnecting, cooperating, and other forms of 'joining,' no matter how briefly or from what remote location, create a kind of human endeavor far apart from the atomized, egotistical individual, fully present in time and space, which is the subject of all the discourses on modernism — be they of 'the market' or of 'dependencia,' etc.

More recently the idea of 'hybridization', in relation to globalization, has emerged to describe these reconfigurations. Rowe and Schelling (1991) define hybridization as '...the ways in which forms become separated from existing practices and recombine with new forms in new practices.' (1991, pg. 231). The notion of the hybrid as a transitory construct is also fitting to describe the social fragmentation that exists within globalization (Pieterse 1994). Hybridization becomes a tool to understand the multi-temporal heterogeneity of contemporary society (Garcia Canclini, 1990) in which notions of development and underdevelopment coexist and redefine each other into what some have called *tiempos mixtos* (Calderon 1988). Who are these 'peoples' whose races, colors, genders, intermix with communication infrastructures, hardwares, and softwares, in a virtual global space? They are probably closer to Haraway's (1985) cyborgs (and their emancipatory potential) than they are to any 'organizational man.'

A multi-disciplinary framework

This brief review of literatures on global organizations, the sociology of modernity and post-modernity, economic development, and communication represents a limited exploration of what seems to be occurring in several disciplines, where ICT is creating a locus of common interest. Table 1 summarizes some of the assumptions behind these literatures, and more clearly contrasts some of the intersections and contradictions discussed above.The 'dazzle' brought about by technological capabilities and their accompanying connectivity to 'the world' should not blind us to the different political agendas embedded within these disciplinary orientations. While the significance of ICT for multinational organizations and for developmentalists may be clearly at odds, the more commonly expressed dichotomy between the 'have' and the 'have nots' may obscure other facts. For example, some apparent opposition between multinational organizations and developmentalist might act to support each other; but more importantly, the 'have nots' might be empowered through the newer organizational forms fostered by ICT.

In the next section the conceptual arguments developed above are applied to the actual circumstances surrounding Mexico and the North American Free Trade Agreement. This example furthers the argument for using more complex and perhaps transient theories when attempting to understand ICT and globalization.

Mexico: An example

ICT and NAFTA

Mexico has invested more in its telecommunications infrastructure than any other Latin American country, surpassing Brazil, Argentina and Chile. Its investment has been focused in three areas: 1) the Morelos Satellite System, 2) conversion from analog to digital telephone switches, and 3) the development of value added services (Barrera Herrera, n.d.). The majority of this investment in telecommunications came during President Salinas de Gortari's administration.

The main objective of the Salinas administration was the 'modernization' of Mexico under the National Development Plan of 1989—1994. Better telecommunications were deemed indispensable in order to provide the infrastructure for the new foreign investment desperately being sought. Accordingly, the telecommunications industry was deregulated and Telmex — the Mexican telephone company — was sold to a group of Mexican investors, Southwestern Bell and France Telecom. Realizing that foreign cor-

Table 1.1
The global data 'freeway'?

	Globalization	*Modernization*	*Fragmentation*
Model Organization	MNC/TNC Virtual Organization	Electronic 'Cottage'	NGO
Dominant Images	Borderless world Countryless organization	Global village/ Electronic Periphery	Global 'communities' Indigenous ICT
Dominant Ideology	Consumer civilization	Modernity	Hybridization
Desirable Outcomes	Economic integration through efficient allocation of global resources determined by the market	Equitable access and distribution facilitated by technology	Reconfiguration toward new forms of civil society determined by networking
View of Nation State	Instrumental—necessary for corporate expansionist activities	Developmental—linear progress toward First World standards of living	Problematized—there is no 'wholeness' within fragmentation
Emerging Subjectivity	Virtual Organizational Man	Emancipated Individuals	Cyber Communities

porations require a reliable telecommunications infrastrucccture, the Mexican government began to pave the road for the global data highway in order to attract foreign direct investment.

Telmex recently completed an overlay digital network *Red Digital Integrada* for business users. This lays the foundation for voice data integration and a blurring of the distinction between basic and enhanced services. Providing these digital services has required an investment of over US$250 million

(Lerner 1989). The basic objective of the overlay network is to supply large subscribers such as financial institutions, maquiladoras, the government and tourism (UNCTC 1991). The border cities were the first to be interconnected since they are the home of the highest concentration of (mainly) U.S.-owned maquiladoras (off-shore assembly plants) (INEGI 1991). Many of these plant are even considered 'post-maquilas' because of their complex, high technology production processes (Kopinak 1993).

Although industry is one of the largest users of Mexico's telecommunication networks (Barrera Herrera n.d.), the pressure to satisfy demand for enhanced services for large subscribers has ecplised the commitment to improve basic telephone service for average Mexicans. Mexico's telephone system faces a serious crisis with over 1.5 million unfilled requests for basic service (Pérez Escamilla 1989).

By incorporating services (including telecommunications), The North American Free Trade Agreement (NAFTA) has the potential for providing expansion of cost-effective networks that, in the past, might have been obstructed by state and public opposition. The U.S. and other countries had sought to include services in the GATT talks, but opposition from developing and developed countries thwarted these efforts (Jussawalla & Cheah 1987). Nevertheless, at the conclusion of the Uruguay Round of GATT, the World Trade Organisation (WTO) was charged with putting in place and enforcing agreements on trade in services that were quite similar to those contained in NAFTA (Pitroda, 1995). In fact, the General Agreement on Trade in Services (GATS) was one of the major accomplishments of the Uruguay Round (China Business Review, 1995). GATS provided a strong framework for the effective liberalization of nearly all types of services. Some see NAFTA and GATS as the economic constitution for multinational or transnational corporations (Grinspun & Cameron 1993, Mosco 1990).

Under 'Scope and Coverage' of Article 13, NAFTA extends telecommunication trade terms to any party that provides 'enhanced or value-added services... in the territory, or across the borders' (NAFTA 1993). This essentially grants national treatment to firms whose only link with Mexico is electronic (Mosco 1990). Further, according to Article 1302 of NAFTA — 'Access to and Use of Public Telecommunications Transport Networks and Services':

> Each Party shall ensure that persons of another Party may use public telecommunications transport networks or services for the movement of information in its territory or across its borders, including for intra-corporate communications, and for access to information contained in data bases or otherwise stored in machine-readable form in the territory of any Party.' (NAFTA text 1993).

It is no surprise that global organizations favor the unimpeded flow of data. It is estimated that 90 per cent of current TDF (trans-border data flows) is intra-corporate in nature (Jussawalla & Cheah 1987). Current debates on TDF focus on, '...issues of national sovereignty, cultural integrity, economic and military security, free flow of information, information disparity/imbalance, data protection and ownership.' (Konoshima 1986, pg. 145). NAFTA ignores this debate and supersedes all previous attempts to regulate international transborder data flows.

Maquiladoras: The 'showcase' of global organization

The maquiladora program, created in the 1960s as an emergency measure to create jobs, has become the centerpiece of Mexico's development strategy. Maquiladoras have often been considered the showcase of the benefits NAFTA brings to Mexico and the U.S.. Currently there are approximately 2,000 of these enterprises employing 470,000 Mexicans, and growing at an annual rate of 23 per cent (INEGI, 1991). In order to keep up with the rapid growth of the maquiladora industry, Mexican telecommunication providers have made substantial investments in infrastructure. By the late 1980s, 289 private microwave networks, 60 private telephone network links to the public network, and 34 private cross-border lines had been established (UNCTC 1991). Investment is underway to interconnect the cities that house the majority of the maquiladoras. With the liberalization of trade in services, foreign service providers are now able to invest heavily in an industry that previously has been government controlled.

The consequences of ICT and NAFTA

From the perspectives of global organization and modernization, Mexico's current situation is ironic. For example, in 1985 Mexico purchased the domestic satellite, Morelos, from Hughes Aircraft Corporation and launched it on NASA's space shuttle (Mody & Borrego 1991). According to the Mexican government's official statement, the Morelos Satellite System was being created to modernize the country's information infrastructure and to expand telecommunication services throughout the nation (Esteinou Madrid, 1988). To date, the satellite operates at less than half capacity, yet unmet demand for basic telephone services still exist (Mody & Borrego 1991). One of the major users of Morelos is Televisa, Mexico's television conglomerate. Thus, Mexicans can watch sophisticated heart transplants via satellite transmission, but their main cause of sickness is still gastro-intestinal illness (Esteinou Madrid 1988).

Another example is the sale of Telmex. The announcement of the Telmex sale was promoted as the best way to acquire needed capital for modernization and extending basic telephone services to local users and data services to local businesses. On average, Mexico still has less than ten telephones per every 100 persons and most of its digital lines are concentrated around the border area, in the cities of Tijuana and Ciudad Juarez. Ensenada and San Luis Rio Colorado were the first fully digitized cities in Latin America (Barrera Herrera, n.d.).

While advances in ICT have made it easier for global corporations to relocate production processes to less-developed nations, chasing the lowest wages has become the growing trend. Proponents of this strategy stress the positive impact of locating advanced ICT in developing countries. They argue that transferring advanced technology will benefit host governments and local workers. One of the main promises of ICT is that it will lead to an information society that relies less on manual labor and more on advanced electronic processes. However, as Fernandez Kelly (1987) notes, 'Contrary to some optimistic forecasts in advanced industrial countries, "high-tech" is not eliminating manual labor; rather is reorganizing it on the basis of geographical and national considerations' (1987, p.153). ICT allows global corporations to decentralize manufacturing operations, while maintaining centralized production control.

By using ICT, U.S.-based multintionals can closely monitor and control subsidiaries in Mexico. This same technology allows them to subdivide the manufacturing processes into minute repetitive tasks and geographically disperse them throughout the world. Further, since ICT allows maquiladoras to rely less on labor intensive assembly and more on flexible specialized processes which employ more complex technology, the new wave of maquilas — the 'post' maquilas — employ a 'post-Fordist' framework. The post maquila restructures labor processes through job rotation, multi-skilling, and other employee development concepts (Wilson 1990). The use of ICT has allowed maquiladoras owners to increase their control over production and increase the gap between design and assembly. It has also allowed management to increase hiring flexibility through the oversimplification of tasks (Fernandez Kelly 1987). Since maquiladoras employ a high concentration of women, this could potentially benefit them; but Wilson (1990) concludes that the maquilas which employ complex technology are actually caricatures of post-Fordist plants. That is, these plants have combined flexible and advanced technology with low wages, short job ladders, and no research and development. This suggests that the benefits of ICT in the maquiladoras have come at the expense of the predominantly female labor force.

While millions of dollars are invested in creating telecommunication infrastructures, these post maquilas are creating a 'global periphery'. They have become more like 'islands' of high tech surrounded by footloose manufacturers that relocate immediately when changes in wages, political stability, labor organization, or any other 'undesirable activity' occurs. With the aid of ICT, the periphery becomes any location that can provide political or technical concessions which enable maquiladoras or any global corporation to exploit local conditions. The concepts of transcending geographical borders or the unity of a 'global' world now appear in a different light — a global world of peripheral humanity.

From these examples, Mexico is experiencing what Hepworth and Robins (1988) call an information economy that is '..unevenly developed in terms of its geographical expression...'; this is one of the realities of '...information capitalism' (1988, pg. 333). In the absence of a clear, rational, and most importantly, inclusive development policy the consequences of allowing foreign ICT providers to expand into Mexico tends to exacerbate existing disparities. Thus, the post-industrial society is providing fewer people with better information and communication potential, while the vast majority are excluded and nation-states remain unable or unwilling to alter the process. Current Mexican economic policies and NAFTA provide a road map for paving the data 'freeway' across Mexico, but the majority of Mexicans are forced to walk the backroads.

What implications will NAFTA have for Mexican citizens? For those who subscribe to the economic law of comparative advantage, Mexico — with its current economic crisis and the extreme devaluation of the peso — has an inexpensive source of labor (Business Week 1995, Ramirez 1995). But, with its oversupply of labor, how will Mexico benefit by investing in a data 'freeway' for global organizations when modern automation technologies employ very few workers? Would we believe that the mere presence of ICT promotes social and economic development for Mexico and its people?

ICT and fragmentation

Constructing what Dawkins (1993) calls a 'community based world order', citizens of the three NAFTA signatories — Canada, Mexico and U.S. — are in fact coming together to hold trilateral meetings (Aguilar Zinser 1993). They are no longer dependent on the right government policy or the right political party to create more socially equitable living conditions. Instead, they are appropriating information technology at the local level, and developing new ideas about trade and international agreements that go beyond trade to address a wide range of other issues (labor mobility, compensatory financing for developing regions, social justice) in a comprehensive way. A prime example is the dissemination of information concerning the Chiapas revolt by the Zapatista Liberation Army (EZLN) that began on 1 January, 1994 (the first day of NAFTA). It is not the focus of this chapter to cover the events leading up to the insurrection but rather to briefly discuss how ICT was used in this revolution.

As the fighting began in January, various computer networks and lists were full of information regarding the events. One need only do a search of the Internet to find an overwhelming amount of information with day by day coverage of arrests, human rights abuses, rebels demands, and the Mexican government response. During February 1995, the Mexican government 'cracked-down' on the rebels at the request of U.S. financial and corporate leaders (Cockburn and Silverstein 1995). The EZLN began using fax transmissions to notify international audiences about the human rights abuses (Newsweek 1995). Instantly news traveled throughout the Internet and a massive and immediate response came from all over the globe. To date, over one and half years later, the information is still traveling and being actively read as indicated by the amount of activity on discussion lists and gopher servers.[2]

Thus, the excluded are using — or what some might consider misusing — the traditional tools of domination and re-appropriating ICT to advance their social and economic development. Working within the sphere of 'disorganized capitalism' (Lash and Urry 1987) they are staging their own information revolution.

Conclusion

This chapter has called attention not only to the contradictions between and within many disciplinary interests, but also to the very different organizational world that is being produced through ICT 'outside' disciplinary boundaries. It is no longer possible to observe the consequences of ICT on global organizations by focusing solely on one form of argument or one type of organization. Technologies that enable MNCs to operate on a global scale and scope or behave like 'virtual' organizations (Davidow and Malone 1992) are the same technologies that permit indigenous communities to self-organize and redefine their lifestyles. But it is important to realize that analyzing the complex and dynamic nature of these changes from within one discipline is wishful thinking. Rather, it is necessary to observe that organizational forms are constantly emerging, and therefore need a multi-disciplinary, dynamic framework, using as its basic set of assumptions the enabling forces of ICT.

Each of the disciplinary representations assumes a particular form of subjectivity. But, in the global space enabled by ICT, these subjectivities may be clearly at odds with each other. The passive Third World poor, managed by the 'virtual organization man' of the MNCs might be contrasted with the 'emancipated individual' expected to emerge from modernization. And both these subject positions may be negated by the 'informational communities' appearing in multiple sites throughout the world (Preston 1994). For all these reasons, it is necessary to conceptualize contemporary *organization* in the context of ICT as an ever changing global organizational space. It is necessary then, to articulate multi-disciplinary and dynamic models capable of considering concurrently the multiple organizational realities, subjectivities, and political agendas enabled by information technologies.

It is essential to abandon the notion of *organization* as an entity with identifiable, internal and external boundaries. Several steps are offered for this purpose: 1) If it is assumed that organization is a hybrid phenomena occurring at different nodal points or in the interstices of a global system, then it is possible to abandon the notion of levels of analysis for organizational research with all the limitations that implies. 2) If it is assumed that what is common to organization is the constantly changing flow of information (Castells 1989), then it is possible to develop newer research approaches. These approaches should recognize the context in which these new realities are appearing, and should also be dynamic and proceed beyond simplistic dichotomies. 3) If it is assumed that the conditions just described are newer phenomena not yet in our experience, then it is possible to develop different vocabularies, metaphors and representations for articulating these emerging concepts.

It also is possible to consider the arguments raised in this chapter as a more general metaphor evoking the need to abandon traditional disciplinary theorizations and their limitations regarding ICT and globalization. This represents a call toward *neo-disciplinarity* (Burrell et al. 1994), and is also an argument for re-describing, enacting, and visualizing old and emergent power relations which exist not only in the global cyberculture, but in the most immediate material space of our daily lives and practices.

Finally, this chapter has only begun to probe beneath the rhetoric of 'globalization' by analyzing the informational forces that are driving these multiple organizational systems. Highlighting the pragmatic value for organizational and managerial practices was not the aim of this chapter. Rather, its value lies in the recognition that traditional concepts of, for example, organization and management — including all the limits in our thoughts imposed by these very terms — may be of little use to organizational participants in the contemporary 'informated' (Zuboff 1988) organization.

Notes

1 This chapter is intended to go beyond the problems identified by Markus and Robey (1988) regarding the theoreotical difficulties in representing organizational change brought about by information and communication technology. The chapter does not claim any solution to the situation they describe but rather calls attention to a higher level of complexity that ensues when intersections between organization and information technology are conceptualized at a global level.

2 Doing a Veronica search in August 1995, yielded several hunderd sites that where actively dedicated to posting and dissemenating information on Chiapas and the EZLN. The host sites where located throughout Europe, the U.S. and Mexico.

2 IT in developing countries: a loss of independence?

David Mundy

Introduction

Information technology (IT) is increasingly used by administrators and managers in both the public and private sectors of industrialized countries (ICs) to assist in decision making and resource control. In some cases the use of IT has lead to revolutionary improvements in the quantity and the quality of information available to administrators and managers. Access to information has also been improved and costs have been reduced; both factors are important in consumer-driven, market-based economies. Information itself is now viewed as an important commodity in the economies of ICs.

Many developing countries (DCs) suffer from a severe shortage of resources. For example, those nations classified as least developed countries (LDCs) by the United Nations Development Programme (UNDP) contain whole communities without access to basic services such as education and health care. For example, the enrollment ratio in DCs for all levels of education in 1990 — measured as a percentage of the population between the age of 6 and 23 — was 46 per cent, while the percentage of the population in DCs with access to health services during the 1985—1991 period was 81 per cent (UNDP 1994). Consequently, the governments of such countries are often heavily dependent on the international donor community to support the provision of basic services through bilateral and multilateral assistance, often in the form of aid projects. In 1992, the average bilateral official development assistance received by the governments of LDCs amounted to 13.6 per cent of Gross National Product (UNDP 1994). The problem of providing these basic services is often exacerbated by the lack of information of sufficient quality to support those government officials responsible for the management and administration of the country's scarce resources and the planning of its future development. The manual procedures inherited from former colonial administrations for managing resources often cannot cope with the new priorities identified at independence or with the increasing volumes of work due to an increasing population.

Examples abound of government departments in DCs which are under severe strain. Revenue cannot be collected in a timely fashion; current demand for resources cannot be determined, and prediction of future demand is impossible. Statistical analyses of survey data are published several years after the collection of the original data, and no longer give an accurate picture of the state of the DC. Personnel records also maybe inaccurate. It is not unknown for an employee to remain on the pay-roll for several months after his or her resignation or retirement, making it difficult to compile accurate employee profiles or identify employees with particular skills. Above all, much information in DCs is only available in a form which makes access and analysis difficult, for example as paper-based records in filing cabinets or distributed between locations. These problems may be further compounded by the replication of the same information in forms which are inconsistent. This leads to a lack of information or the availability of poor quality information for administrators and managers who are then unable to make appropriate decisions for future development (Wilson 1988).

One of the attendant benefits of the introduction of IT is the transformation of inefficient procedures into efficient procedures. According to Bogod (1979), 'the analysis and systematisation that occurs when computerisation takesplace can be recognised in itself as a most significant contribution to improving management decision-making and resource allocation'. There is, then, a strong argument for using IT in the public sector of DCs to improve the quality and timeliness of information available to decision makers. This should enable better management of the nation's scarce resources and more effective planning for future development (Bell 1992).

IT in the public sector of developing countries

The introduction of IT into the public sector of DCs has largely been driven by the international donor community. For example Odedra (Odedra et al. 1993) estimates that approximately half of the IT equipment in Africa in the early 1980s was acquired as a result of the activities of the international donor community. The number of projects in DCs financed by the international donor community which include IT equipment has steadily increased during the last decade. In their survey of World Bank financed projects, Hanna and Schware (1990) report that the volume of lending by the World Bank for IT equipment in projects grew an average annual rate of nearly 30 per cent in the 1980s. In some projects, the purpose of the IT equipment is to improve the access to, and the analysis and dissemination of, information. It is not uncommon for projects to include the provision of a small number of personal computers (PCs), together with standard applications software — such as spreadsheets, databases and statistics packages — for the analysis of data collected during the project in order to measure its success.

The total cost of the IT equipment in such projects is a relatively small proportion of these total budget for the projects, amounting to no more than 5 per cent (Hanna and Schware 1990). In other projects the purpose of IT equipment is to facilitate the transformation of socio-political structures in decision making (Lucking and Franks 1990, Madon 1994). In these projects the cost of the IT equipment may be considerably greater, sometimes amounting to 60 per cent or more of the total budget (Hanna and Schware 1990). Management information systems, finance and accounting systems, and information management systems accounted for approximately two-thirds of the applications of IT in the World Bank financed projects surveyed by Hanna and Schware. Furthermore, the second largest use of IT in these projects, at 12 per cent, is to support structural adjustment programs.

Measuring the success of an aid project is, at best, a contentious issue. However, for those projects which include IT equipment, two metrics may be applied: the degree to which there is a transfer of technology to the DC; and the degree to which the use of the technology in the DC is sustainable. Unfortunately, for many aid projects which include IT equipment the measure of success is quite low. In part this may be due to the failure of the international donor community to recognize the development of IT in DCs as an important area in its own right (Schware and Choudhury 1988). This in turn results in the lack of the infrastructure necessary to support the introduction and use of IT in the public sector (Wilson 1990). Ironically, therefore, through the introduction of IT into DCs, it could be argued that developing countries are becoming *more* —not less — dependent on industrialized countries.

Another reason for the increased use of IT in the public sector is the need for DCs to become members of the global information society. Over two decades ago, the United Nations (UN 1971) predicted, 'Computers will play an increasingly important role in developing countries which intend to participate in the world economy in ways other than the supply of raw materials. Developing countries will find computers a necessary ticket of admission. The next decade should see developing countries even more active in closing the computer gap'.

The amount of information that is directly available in electronic form is growing rapidly. While some of this information has traditionally been available in printed form, it is increasingly available only in electronic form due to the prohibitively high costs of printing. From a PC with a connection to a computer network, access is available to a wide variety of remote on-line data bases around the world. For example, Bennett (Odedra et al. 1993) cites a study in which it is estimated that 90 per cent of the data on Africa resides in databases outside Africa. Attaching a CD-ROM reader to a PC gives local access to large amounts of information. Using the capabilities of standard applications software, this information may be processed in new ways which, without IT, would have been unthinkable. Without the appropriate IT facilities researchers in DCs will find it difficult to keep abreast of new developments in their areas of specialization, such as health care and agriculture (Holderness 1993). In addition, without access to computer networks, professionals in DCs will be unable to communicate effectively with their counterparts in ICs through electronic mail and will thereby be excluded from the global professional community (Sadowsky 1993).

Dependence and Independence

Web models (Kling 1987) provide a theoretical framework in which to analyze the dependence relationship between the governments of DCs and the international donor community. From the perspective of a web model, the context, infrastructure, and history of an organization may constrain the different activities undertaken to analyze, design, and manage an IT-based system during the IT innovation process — the process by which IT is introduced and used in an organization (Kling and Scacchi 1982). The dependence of governments of DCs on the international donor community for the provision of resources to support the IT innovation process is a direct consequence of attempts to reduce the effects of these constraints on the innovation process which would otherwise arise from the specific context, infrastructure and history of organizations in DCs.

The innovation process is commonly described in the literature using a model with a number of distinct stages, each of which has a specific objective. For the purpose of this analysis, the model of the innovation process has been derived from a synthesis of two models — one developed by Sauer (1993) another by Walsham (1993)— and has three stages: initiation, development, and operation. In the following paragraphs the three stages and the corresponding objectives of the innovation process are briefly described. Those aspects of the context, infrastructure and history of organizations in DCs which may constrain the innovation process, and hence lead to dependence on the international donor community, are considered in subsequent sections.

Stage 1 - Initiation: After the detection of a performance gap in an organization, and the development of a proposal for an IT-based system to fill that gap, the objective of the initiation stage is to reach a strategic decision to proceed with the subsequent stages of the innovation process. Following Earl's classification of information management domains (Earl 1989), the human resources required during the initiation stage are those of the 'hybrid' and the 'leader'. The hybrid has the business confidence to recognize an opportunity to introduce and use an IT-based system, the technological competence to draft a proposal to develop that system, and the organizational skills to move the proposal to a strategic decision. Technological competence in the hybrid is essential; Earl suggests a minimum of two to three years training and experience in an IT department. Strategic decision making in organizations to develop IT-based systems requires leaders who have both a technical understanding of IT and practical experience with the use of IT in organizations. A technical understanding of IT enables managers to align the IT investment to organizational needs, to give direction to IT activities and to champion those activities. Experience with the use of IT in organizations enables managers to construct appropriate IT visions for the organization.

Stage 2 - Development: Having elicited the user requirements, and analyzed and synthesized them into an abstract design, the objective of the development stage is to transform this design into an executable system and make it fully operational in the organizational context. In the development stage there is a need for skilled human resources which Earl classifies as 'professionals'. The professional has the technological expertise to deliver IT-based systems, the business awareness to use appropriate technology, and the organizational skills to interact with hybrids, leaders and end-users. Additionally the development of IT-based systems requires the procurement of IT equipment — hardware and software.

Stage 3 — Operation: The objective of the operation stage is to provide the service for which the system was designed. This may necessitate the repair of design flaws, and requires on-going efforts to maintain the system's continued integration into the organization. It may also require coping with variations in requirements and changes in organizational contexts over time.

Developing human resources for IT

One of the key factors which determines the success or failure of an aid project with an IT component is the availability of appropriately trained personnel who are involved in different aspects of using IT equipment. Unfortunately, this area of human resources is often overlooked or not given the necessary consideration, and as a result, the projects are less than successful. Leaders with the desired characteristics are unlikely to be found in the public sector of most developing countries. The IT culture which is now widespread in ICs is much less evident in most DCs. Since relatively little use has been made of IT in the public sector of most DCs, many potential leaders have no direct experience and are therefore less able than their counterparts in industrial nations to exploit the use of IT. There is a wide disparity in backgrounds of the consultants recruited from ICs by the international donor community to work on aid projects, and their local counterparts from DCs. The consultants are likely to have prior experience in the use of IT, while their local counterparts may have little or no experience. At the very least, consultants are aware of the capabilities of IT and know how IT can be used to assist them professionally in solving a range of problems. Typically such staff has had considerable exposure to the use of IT, both in their formal education and in their professional careers.

There is also a computer-literate generation of middle-rank managers and administrators in ICs due to the widespread use of IT equipment beyond secondary education. Indeed, there are initiatives within the institutions of higher education in ICs to ensure that all graduates are not only familiar with the use of IT, but can also apply that knowledge to their own professional interests (CTISS 1992, McCartan 1990 & 1992). This exposure to IT and its application is not limited to the professionals of ICs. An increasing number of students in ICs have had some experience with IT and are familiar with basic IT concepts such as the use of PCs and standard applications software to store, retrieve and analyze a variety of information. Finally, many households in ICs can now afford a PC.

In contrast, the situation in many DCs is very different. The majority of local counterparts in DCs have had little or no prior experience with the use of IT, particularly during their formal education. Since the majority of graduates in DCs have never used IT equipment, they have little awareness of the capabilities of IT or realize how IT can assist them as managers or administrators. Unlike their counterparts in ICs they are unlikely to be able to afford a PC for their use at home. The cost of IT equipment in DCs is beyond the reach of most employees in the public sector, representing at least a considerable proportion of their annual salaries. For example, the average per capita GNP of developing countries in 1991 was US$880 compared to US$14,920 in industrialized countries (UNDP 1994). Furthermore, access to the hard currency needed to pay for the IT equipment is difficult or impossible for most citizens in DCs.

Under these circumstances, any proposal to exploit IT in the public sector of DCs is likely to come from the consultants recruited by the international donor community. Two forms of dependence may arise from this use of consultants. First, without the proper involvement of potential leaders during the development of proposals by these consultants, it is unlikely that the capacity to develop proposals will be built into the public sector of DCs. Second, the ability to recognize opportunities to exploit IT may be dependent upon the cultural and organizational norms of the international donor community, which may be less than appropriate in DCs. Kumar and Bjorn-Andersen (1990) report that the designers of IT-based systems from different cultural backgrounds are influenced by different cultural values which may in turn determine the effectiveness of those systems in organizations. Similarly, Markus and Bjorn-Andersen (1987) suggest that IT-based systems embody the ideals and values of those responsible for their design. The perceived benefits of IT-based systems to the international donor community — for example, improved access to information and the consequent increase in the accountability of decision makers — may be seen as threats to the cultural norms of some DCs (Goodman and Green 1992).

Given the ready availability of standard applications software, 'leaders' with inadequate technical understanding of IT may assume that a knowledge of the use of applications software is sufficient to allow an IT-literate end-user to undertake the analysis, design and management of IT-based systems. While this may be true for relatively small IT-based systems — such as those based on a word processor, it is certainly *not* true for more complex IT-based systems using databases. Indeed, there have been a number of instances where insufficiently skilled staff have been responsible for the analysis, design and management of IT-based systems which have later proved ineffective, and contained a number of design or implementation errors which were difficult to correct.

The preceding assumption under-estimates the complexity of the activities involved in the introduction and use of large IT-based systems, particularly the specialized skills in information systems engineering required (Sommerville 1993). There are often few experienced professionals in the public sector of DCs. Hence there is again a dependence on personnel recruited by the international donor community; in this case, information systems engineers. In the absence of adequately skilled professionals in DCs, it may be difficult for proposals made by leaders for the introduction and use of IT to be accepted without recourse to the international donor community.

Training the end-users of IT-based systems is an important aspect of the innovation process. Without appropriate training, end-users will be unable to benefit from the introduction and use of IT, and are less likely to envision new ways to exploit IT. The professionals responsible for the analysis and design of IT-based systems must write suitable user documentation and provide appropriate training. Consultants recruited by the international donor community may be unaware of important social, political and cultural differences which make the transfer of skills to local counterparts more difficult. Additionally, given the disparity in experience between consultants and their local counterparts, consultants may assume a higher level of technological awareness than is warranted. These problems may be compounded by the need to communicate in a language which is neither the consultant's nor the local counterpart's.

Maintenance is a frequently forgotten aspect of the innovation process. Typically an IT-based system supports the functioning of some part of an organization. For the IT system to remain useful to the organization its operation must be changed as the behavior of the organization changes. An IT-based system which remains static in a dynamic organization will become less and less useful, until it is eventually no longer used (Lehman 1980). To effect the changes necessary for an IT-based system to retain its relevance, further work on the part of 'professionals' is typically required. If consultants have been responsible for the production of the original system, and if there has not been an effective transfer of skills to local counterparts, then it is unlikely that maintenance can be undertaken without further recourse to consultants. The need for education and training initiatives to equip local counterparts as leaders and professionals is, therefore, an important requirement for the successful utilization of IT introduced into the public sector of DCs by the international donor community. However, certain cautions must be noted.

Local counterparts in developing countries are often sent to industrialized countries for education and training in some aspect of IT. However, the education and training provided can often be irrelevant to the specific conditions encountered in DCs due to their lack of resources. For example, the orientation of many specialist courses in software engineering in universities in ICs is toward theoretical research. This has little immediate relevance in DCs where information systems professionals often have to take responsibility for all stages of the innovation process, as well as advise end-users (Douglas 1989).

There is, however, much material on the practical aspects of the analysis, design and management of IT-based systems using currently available and emerging technologies (Mundy 1995). Educators and trainers in ICs are often unaware of the limited resources in DCs and make assumptions about the previous experience of the trainees. Further, much of the IT literature is dominated by research conducted in ICs, particularly in North America, Western Europe and Japan. The concepts portrayed in this literature may be inappropriate in the different situations found in DCs (Goodman 1991a &1991b). Finally, but not least, training for technical support personnel is often overlooked. Without such personnel the successful installation and maintenance of IT equipment cannot occur and IT-based systems may lie idle for lack of maintenance.

The financial costs of IT

During the lifetime of the IT-based system, it is inevitable that some form of maintenance will be required. Meeting the recurrent costs of the day-to-day operation of IT-based systems in the public sector of DCs is often the responsibility of local governments and not the international donor community. Consumables — items such as floppy disks, paper and ribbons — often must be imported. This is a drain on the usually scarce hard currency reserves. This is particularly true in DCs where the operating environment for IT equipment is relatively hostile —'dirty' or unreliable power supplies, and high levels of humidity and dust. The technical expertise required to undertake maintenance may not be available in DCs and the equipment has to be sent abroad for repair. Even where the expertise is available, the necessary spare parts must be imported, which is a further drain on hard currency reserves (Akinlade 1989). There are many urgent needs within most DCs, and expenditures on IT mean that less can be spent on other areas, such as education and healthcare. Ironically IT-based systems may generate a flow of funds back from DCs to ICs.

The dependence on the international donor community for the provision of IT equipment may also lead to compatibility problems between equipment sourced from different manufacturers, or even between equipment from the same manufacturer. This is true despite the widespread belief that much IT equipment is now compatible. Different printers require different ribbons and print heads; different capacity floppy disks can be used with some, but not all, floppy disk drives; different versions of the same software applications require different configurations of the IT equipment and may even behave differently. The same software application from different manufacturers can be radically different. These problems are, at best, an irritation. However, at worst, these problems can result in the IT equipment in the public sector of DCs being under-utilized or not used at all because the expertise needed to resolve these problems is not readily available. As a consequence, IT equipment acquired at some expense to the DC may lie idle, and the capacity of local leaders to use IT may be severely restricted.

Depending on the frequency of use and the operating environment, IT equipment may become unusable after a period of between five and eight years because the spare parts needed to maintain the equipment are no longer available or the cost of maintenance has become prohibitively expensive. At this point the cost of acquiring replacement equipment must be borne by the recipient government and is yet another drain on the hard currency reserves of DCs.

Short cuts to avoid expenditure of foreign exchange reserves can lead to illegal activities. Software piracy is widespread in many DCs where there may be little respect for intellectual property rights for a variety of cultural and political reasons (Goodman 1991c). While there is no physical way to ensure that copies of software applications are not made, and there is little or no risk of punishment, the probability that viruses will be transferred between different IT-based systems is increased, thereby threatening the integrity of the information in these systems.

Making a case for the introduction and use of IT in the public sector of DCs on the basis of reduced costs is likely to be problematic. The introduction and use of IT often requires the expenditure of scarce hard currency reserves which, unlike the local currencies of DCs, are beyond the control of governments. Unlike the situation in ICs, the automation of clerical procedures and the consequent retrenchment of clerical staff may not lead to savings in the public sector of DCs. As Bennett (Odedra et al. 1993) indicates, despite the significant reductions in the cost of IT equipment within the last few years, the cost may still be several multiples of the annual salary of a clerical officer employed in a DC. In any case, the introduction and use of IT does not necessarily result in staff retrenchment.

Again, Bennett notes that clerical staff, such as data entry clerks, are still required to service the needs of the IT equipment. Automation in the public sector of DCs may also be politically unacceptable where there are no welfare benefits for the unemployed, and where the number of skilled and semiskilled personnel seeking employment is rapidly increasing due to continued population growth in DCs and wider access to education. Consequently, the recruitment of additional clerical officers may be more cost effective and socially acceptable than investment in IT. However, as has been indicated earlier, one of the associated benefits of the use of IT is the opportunity to improve the quality of information which is available to administrators and managers. It is unlikely that such benefits would result from the employment of an increased number of clerical officers even with improvements in operating procedures.

Steps toward independence

As noted, supporting the use of IT in DCs requires expenditure of typically scarce foreign exchange reserves. Further, the use of IT in the public sector of DCs is unlikely to generate hard currency earnings directly, although it may save expenditures of both local and hard currencies. The governments of some DCs have attempted to tackle one or both of these issues through the establishment of indigenous IT industries. However, the relatively small size of the domestic market in most DCs may make it difficult to sustain these industries. Thus, it is essential that export markets, particularly in ICs, can be penetrated. This is not as straightforward as it first appears since a marketing infrastructure in the ICs is required through appropriate representation of the indigenous IT industry. In addition, there is often considerable prejudice on the part of consumers in ICs against products developed or manufactured in DCs (Fialkowski 1990). Mesher et al. (1992) note that the absence of a demanding domestic market in most DCs for IT equipment, particularly software, makes it unlikely that world class IT equipment will be produced in DCs. Similarly, Nichimolu and Goodman (1993) suggest that the small size of the domestic IT markets of many DCs may mean that there are few experienced IT professionals to oversee the development of world class products.

The initiatives taken by the governments of DCs to promote domestic IT industries vary widely. In some DCs the governments offer substantial financial incentives for multinational IT companies to locate part of their operations in the DC. In such countries there are usually large supplies of cheap unskilled labor. For example, in the DCs of Southeast Asia, a number of multinational IT companies have established plants to assemble IT hardware from components designed and fabricated in ICs. Nonetheless, the resulting investment in IT in these DCs remains minimal. Under the agreement with the government, the multinational company is not permitted to sell the IT equipment in the domestic market. Further, since the design and fabrication of the components occur outside the DC, the skills and infrastructure required for these activities are not transferred to the DC. In the worst case the multinational company has no reason to stay in a particular DC and is likely to relocate should better financial incentives be offered or a supply of cheaper labor be available in another country.

For a developing country to become self sufficient in IT hardware requires considerable investment in both human resources and manufacturing capacity. With the relatively small size of the domestic market, and the ready availability of hardware on the international market, it is unlikely that hardware designed and assembled in most DCs can ever achieve sufficient sales to make the venture profitable. Indeed, the profit margins on much IT equipment are now so low that even the representatives of multinational IT companies have difficulty covering their overheads.

Notwithstanding these considerable disadvantages, there have been one or two successful ventures in DCs to assemble a range of own-label PCs using commercially available components. The resultant PCs are typically destined for the domestic market. Such ventures cut out the costs of assembly and shipping PCs from foreign IT companies. Since the variety of possible configurations of a PC — memory capacity, hard disc capacity, monitor — is quite considerable, keeping all the necessary components in stock is a considerable expense and locks up a significant amount of capital. Further, since the rate of technological change is so rapid that a PC may be obsolete in two or three years (or less), there is often pressure from customers to keep up with industry standards so that the range of IT equipment which can be supported is maximized. As a result, the IT industry in most DCs faces the likelihood of a stock of components which cannot be sold. Finally, providing maintenance service to users requires representatives and an adequate supply of spare parts both of which are a further drain on capital.

An alternative to an indigenous computer hardware industry is an indigenous computer software industry. The major cost of any software system is usually the cost of the human resources required to develop it. Using the comparatively cheap work force available in most DCs to develop software systems can reduce their cost. This is attractive not only for software developed for the domestic market, but also gives a competitive advantage to software for export markets. Indeed, Jones (1994) predicts that, as the capital cost of the IT equipment necessary to support software development falls in real terms and software development becomes increasingly dominated by the cost of skilled labor, it will become increasingly attractive to transfer software development from ICs to DCs. Of course, the major drawback of an indigenous computer software industry is that the work force must be highly skilled in IT, and most DCs are unable to provide this training. Again the domestic market is usually too small to sustain an indigenous computer software industry.

The governments of some DCs, for example Cuba (Mesher et al. 1992) and India (Heeks 1992), are actively pursuing a policy to develop software systems for the export market. Government funded initiatives have led to the creation of higher education institutions which provide the training in IT necessary to produce a highly skilled work force. To adequately equip such facilities is not without problems, requiring at least PCs and standard applications software, as well as a suitably qualified academic staff. Since government departments in ICs increasingly require their IT-based systems to be designed and implemented using an approved methodology, for example SSADM, it is also necessary for the academic staff to have access to relevant journals and to be able to attend appropriate conferences to ensure their familiarity with these methodologies.

Companies have also been established to develop a range of software systems for the export market. In some instances these companies are sub-contractors for multinational IT companies that develop specific software systems which are then taken over by the multinational company. While this avoids many of the risks for the indigenous software company it can also result in the local company receiving less than its fair share of the profits from the sale of the software system. Other companies work in joint ventures with multinational IT companies, receiving not only a share of the profits realized from the sale of the software systems but other benefits such as further training for the local work force.

Conclusions

The increased use of IT in the public sector of developing countries seems inevitable to better control scarce resources and to make more accurate information available to administrators and managers in local government. However, it also appears the use of IT in the public sector of DCs only serves to make them more dependent on industrialized countries (Lewis 1993). The use of IT equipment in DCs requires access to resources that are scarce in most DCs — hard currency and suitably skilled human resources. It is not surprising, therefore, that throughout many DCs significant quantities of IT equipment are lying idle for want of maintenance, supplies or competent staff to maintain or use it. It is ironic that much of the IT equipment has been introduced by the international donor community in an attempt to improve resource allocation and planning in the public sector. Without adequate resources, DCs are dependent on the ICs for all major areas of IT —software, hardware, training, and personnel. It is difficult to believe that most DCs can ever become totally self sufficient in any of these areas.

The most obvious way to encourage the reduction in the dependence of DCs on ICs to support the introduction and use of IT in the public sector of DCs is through the adoption of appropriate policy measures. A number of DCs already have IT policies which serve, to some extent, to maximize the effectiveness of IT investments. For example, many policies require that IT equipment used in the public sector be broadly compatible. However, these policies should include additional measures to deal with the aspects of human and financial resources specifically. Examples of such policies are the regional and national guidelines for policies for the introduction and use of IT in the Southern African Development Community (SADC 1995). Notable among these guidelines are measures to encourage the sharing of expertise in information technology throughout the region; to accredit IT-related education and training provided in the region; to encourage the local design, development, and manufacture of IT equipment; and to assess the impact of the introduction and use of IT on member states. Furthermore, member states are encouraged to assess the use of IT at the proposal stage and to adhere to regional guidelines. Finally, to reduce the dependence of DCs on ICs, the governments of DCs should be more wary about accepting projects which involve the use of IT. Greater emphasis on the development of *human resources* for administration and management might be more appropriate than the introduction of *technology* for administration and management.

3 IT as a global economic development tool

Enrique J. Lopez and Maby Gonzalez Vilaseca

Information Technology as an Economic Development Tool

Knowledge and information are key and critical factors in determining a country's international competitive position. The ability to gather and analyze information about international markets, trends, consumer needs, production costs and competitors allows a country to become a 'knowledge hub', from which it can determine how to best adapt to changes in international economic and technological conditions. A systemic approach through information mechanisms and links is necessary for each country to evaluate its international competitiveness and determine the path through which it will attain desired results. Developing countries face severe external debts, information poverty, obsolete infrastructures, trade barriers, and poor commercial development, all of which hinder efforts to develop their information technology base and tests their abilities to cope with global technological changes and trends. Their level of economic development reflects the magnitude of their application of information technology.

Reports by the United Nations Development Program and the World Bank indicate a trend away from traditional economic measures such as Gross National Product (GNP) and per capita incomes toward indicators which place greater weight on social and human gains. A country's level of exposure to technology can impact its economic position by enhancing its competitiveness or inhibiting it from acquiring new technology. In a social context, the country's educational system can be an impediment or a facilitator for its people to become receptive to technology and the challenges it offers. Some countries' political systems have served as an impediment to exposing a population to technology and its commercial uses.

The telecommunications component of information technology (IT) serves as a foundation for infrastructure development and a key factor in generating exports and attracting foreign investments. According to several studies, exports of products characterized by seasonal demands such as apparel, or requiring close contact with customers such as auto parts, are particularly dependent on reliable and abundant telecommunications. Developing countries, however, face a shortfall in telecommunications. Conservative estimates will require an investment of approximately $60 billion (US dollars), an extremely high funding level for economies with limited possibilities (Bishop and Mody 1995).

IT has broad applications for management in the industrial, services and public sectors. Specific areas within developing countries where information technology can have an impact include: agricultural and rural development, poverty alleviation, environmental management, infrastructure and population and human resources development. In the industrial sector, the creation of new industries in the form of micro-electronics and software-based products or the integration of information technology with other technologies has generated new dynamics and high profitability. In addition, the use of information technology has revolutionized industrial organization techniques, enhanced productivity and competitiveness, and reduced costs in all phases of the production processes. It serves as a tool that allows developing countries to modernize traditionally 'low-tech' industries while taking significant steps toward closing the technology gap.

Changes in service sector technologies also have major implications for developing countries due to their impact on fundamental process and organizational change in all sectors, including distribution, financial services, engineering, insurance, marketing and transport, to name a few. The impact is not only economic, but also on education, consumer behavior and quality of life. Finally, technology has a far reaching impact on the public sector, a sector that by its very nature is highly information dependent. The applications of IT are increasing, accelerating the processes used by governments, including policy making, planning and budgeting, debt management, macroeconomic analysis, popular participation, global political, social and economic information gathering, monitoring the quality of services provided, implementing new services and overall financial accountability and control.

In order to incorporate IT into a country's economic development plan, developing countries must increase their internal capacity not only to assess and diffuse new technologies, but also to mobilize their political and social will. In this context, they must face the problem of disparity between the growth in human capacity to generate knowledge and technology versus their incapacity to mobilize technology in support of economic development. They must also be able to measure the tangible results of their economic development efforts.

Developing countries find themselves at a great disadvantage in today's global economic environment. Their most abundant and salient resource is labor, however, for the most part, they exhibit low levels of literacy and health. How developing countries effectively compete and improve their competitiveness is a critical question. They can no longer just rely on making the best product, having the best labor force or providing the lowest price for products and services. In order to gain and maintain competitive advantage, countries must be able to design, produce, market, distribute and service products and/or services and provide these at attractive prices. This entails understanding how to establish and sustain a cost advantage, identifying what determines value for the consumer, determining what differentiates a country's products and services and developing a successful differentiation strategy.

A country must develop a technology strategy that reflects its current use of technologies and which incorporates its labor force into the process. This strategy improves competitive position by identifying appropriate market segments and competitors at the same time managing diversification in response to market and customer direction and needs. This should be done within a context that will establish strategic regional and global inter-relationships among distinct entities in specific industries: To promote its abundance of labor, a country must establish policies that offer incentives, and use social and political organizations, national infrastructure and technology to improve internal efficiency. A salient component in the attainment of the above is the timely and accurate access to information in support of commercial processes. Informatics is the catalyst which not only supports a country's industrial base, but also maximizes its use of technology.

An increased rate of innovation, broader applications of new technologies, the reduction of labor and production costs, shorter process and product lifecycles, and organizational paradigm changes are just some of the trends industrialized countries have had to cope with. They now are among the challenges facing all developing countries (Dahlman 1994). Advances in science and engineering and intense competition for global markets have produced a technological rivalry among countries. This has forced nations to accelerate their rate of innovation. This is particularly evident in the telecommunications industry, where the technology lifecycle of communications products such as a facsimile or cordless telephone is under two years, after which they become 'obsolete'. If developing countries are to compete, they must choose their role as either technology developers, assimilators of foreign technology, or directly support technology developers in the production cycle.

The Impact of Emerging Technologies

Technology's evolution has rapidly out-paced society's ability to fully exploit its applications. The continued global thirst for automation and information is the driving force behind this evolution. That a country's acceptance and implementation of new technology may engender widespread economic and social change and resistance is clearly evident. Countries that implement new technology face a very real challenge: implementing emerging technologies and re-tooling their industries to adapt to these technologies.

In order to minimize the undesired impact of technology, a country should first and foremost, establish technology as a component of its economic development plan. Leaders of a country must recognize the importance of technology if they are to 'sell' it to their countrymen. They should be cognizant that technology will trigger other changes within the country's social, political and economic infrastructures. This determines the acceptance of technology as a development tool as well as the receptivity to the changes technology causes. This may sound basic, but it should not be taken lightly. How do a country's leaders 'sell' technology within the country? The answer lies in their ability to present the social, political and economic benefits technology facilitates. The projected benefits must be quantifiable and realistic and strategies must be developed that include a quality of life encompassing health, education, and financial security.

Shortened product life cycles (the period from development to technological obsolescence) increase developing countries' technological risk. Rapid technological change require a significant resource commitment to research, development, manufacturing and support of technology. However, technological obsolescence does not imply operational obsolescence. The rapid rate of change does not always have to be an obstacle to developing countries. It allows so-called 'obsolete' technology to be acquired and utilized by these countries as a springboard to newer - though not necessarily state-of-the-art - technology. This technology can be used in government and educational institutions or it can be utilized to develop applications or manufacture products that do not need the latest technology. It is important to note that every process warrants 'leading edge'. - or as it is sometimes also referred to, 'bleeding edge' - technology. New technologies also demand managerial and organizational changes in order to receive maximum benefit from their application. This exerts additional pressures on industries in less developed countries, requiring them to define and incorporate productivity norms and competitiveness levels similar to those of industrialized countries. This demands even further flexibility and adaptability.

All of this suggests some steps a developing country should take to ensure the maximum benefits from technology implementation, however, they are of limited use without also considering and incorporating all components of the country's economy. For example, in India and Brazil, where there has been advanced and effective use of computing and communications technologies in industries, the benefits have been limited to only a small number of large firms which have little downstream linkages with local suppliers and the rest of the industrial sector (Hanna 1994).

When technology is implemented, many overlook its real basic and useful applications as well as its organizational ramifications. Sometimes countries commit to a technology even though its direct benefits do not warrant its acquisition and acceptance. Economic and political factors often serve as catalysts for acquiring new technologies, responding to special interests, not the interests of the country. In most instances, the ramifications of a new technology are overlooked since the primary focus is on technological innovation, not commercial applications or long term economic development. These issues directly impact the selection of new technology. Selection criteria for new technology must include the technology's application, projected life cycle, its costs and payback in terms of useful life, and its social, political and economic impact. All technologies have an evolution platform which is the basis within which a specific emerging technology will evolve during its life cycle independent of where the technology is applied.

Evaluation of a technology's life cycle is one of the steps that countries must undertake as part of their IT platform selection. This includes specifically identifying the technology and evaluating its current stage in its lifecycle is. A technology's lifecycle can be best described in the following three phases:

1 Emerging — recently developed technology at the beginning of its life cycle and which has been selectively accepted and implemented.

2 Maturity — technology that has been widely accepted and implemented by industry and consumers alike. Evaluation of planned obsolescence of the technology during this phase is warranted.

3 Post-maturity — technology past its mature phase being displaced by emerging technology or evolving and enhanced. This phase does not imply operational obsolescence.

Not all developing countries are in the same phases of technology development and differences are great, depending on the country. Factors such as geography, industrial development, internal policies on education, government ideologies and systems and trade policies are just a few of the factors that impact a country's technology stage.

Developing countries are cautioned when considering the acquisition of a lower priced technology which may be financially attractive, but, depending on its life cycle stage, can prove to be more expensive in the long run. As technolgies reach obsolescence, support is often diminished, forcing a 'fork-lift' upgrade into newer technology and creating internal problems. The phase in the technology life cycle can be utilized as a measure to determine whether a technology should be accepted or rejected for implementation. The primary points to be included in an evaluation of technologies at different stages are:

1 Application to cross-industry needs: Identify the country's technology needs and how a particular technology can meet these.

2 Projected life cycle: How long will a technology serve the country's needs, including its capability to be upgraded within the same platform in the future?

3 Required capital investment: What funding is necessary to implement a technology, including tangible and intangible implementation, operational and maintenance costs?

4 Payback: What are costs recovered over a technology's useful life? This should be measured in terms of the tangible and billable services it can provide for the country's business community as well as intangible services which support governmental functions.

5 Migration path from present technology: Identify the necessary resources to conduct migration from present technology. Evaluation of how a change of technology platform will be implemented, the process and impact on the communities it serves.

6 Technology platform modularity: Ensure the platform that is selected allows for growth in modular form, rather than requiring full replacement.

Some developing countries do not have the luxury of being able to select the most appropriate platform due to financial constraints. These countries should evaluate a 'phased-in' implementation approach by installing needed technology in the areas of highest need and priority. They should also consider accepting less of the needed technology than more of an obsolete one. Those that do not take this into account will be taxed with the strongest of penalties - falling further behind in a fast paced technological world. The selection decision can commit a country to a technology that can enhance its global competitiveness or one that can expose it to risk of stagnation or failure. A final factor to be considered when evaluating technology is a developing countries' vulnerability to unscrupulous industrialists seeking to 'dump' obsolete equipment. Unfortunately, there are numerous and visible examples of this world-wide practice.

A Standards Alliance

A country's alliance with accepted standards can facilitate its migration path into new and emerging technologies. This is of extreme importance and warrants special attention when evaluating and implementing new technology. There are two types of standards; 1) standards that have been accepted and approved by respective industry governing bodies, and 2) de-facto standards - vendor(s) provided standards accepted by an industry as the model to be followed in the absence of more formal standards.

It is no secret that standards governing bodies have not kept up with the rapid pace of technology. The telecommunications industry is a prime example of an industry where new technologies have had to adhere to quasi-standards in the absence of accepted and approved standards. For example, in the United States, following the divestiture of American Telephone and Telegraph, the telecommunications industry witnessed a strong surge in new technologies within numerous products and services. Standards governing bodies, many of them surprised, were slow to react to this avalanche of new industry participants, and end-users invested in products whose value would significantly decline over time. The presence of large and significant corporations in the telecommunications industry was a positive factor since many of the smaller industry participants looked to them for 'standards guidance' or 'de facto standards'. Similar scenarios have occurred in the information systems arena.

This has also occurred in the field of cellular telephones, where the signal transmission technology has not been standardized. Presently, two types of technology are being utilized with the respective parties strongly lobbying for 'their' technology with standards organizations in the hopes of having it selected. The stakes are high as cellular service has been well received and enjoys a favorable user base. The cost will be high for developers and manufacturers of the technology that is not selected, (if one is in fact) chosen since they will have to re-tool their technology base. This does not mean they will be put out of business. That will depend on the companies' financial strength, although clearly it will set them back in the technology race. Thus, implementing technology that supports industry standards can positively impact its internal usage cycle and potential for future evolution or enhancement, in addition to offering direct protection of the technology investment.

A salient factor that warrants in-depth evaluation in determining a standards alliance is trade blocs. The thrust of technology today is toward 'open systems/network'. This is true for a technology manufacturer's product, however, it is not necessarily true when comparing one manufacturer's product and its ability to work with another manufacturer's product. Compatibility, connectivity and operational transparency are the key. For example, European and American communications and computing standards are different, and even though there are numerous value-added products that compensate for this incongruence, the core products in these continents are different. Therefore, a developing country should select the standards which will facilitate the implementation of selected technology and the exchange of information and communications with its primary trade partners. This should not, however, inhibit the country from being able to acquire and retain new trade relations with countries outside its 'standards bloc'.

A Technology Plan

Developing countries have to develop proactive short term and long term strategies that specifically focus on IT as part of their overall national science and technology policies. Science and technology policies in support of economic development can not be reduced to pure technology issues whose primary objective is to increase the efficiencies and productivity of certain manufacturing sectors. This focus is too limited and narrow. The growth of science and technology for development fundamentally requires a broad base of infrastructure and support in education, training, technical services of all kinds, research and development, technology transfer, linkage with the manufacturing sector, marketing and management. This policy must be developed without prejudice and should be based on prudent actions that will complement overall economic development independent of special interests groups. Specifically, it must support the country's economic position, encourage the participation of both public and private sectors, and address issues such as funding, standardization of information technology, international informatics policy issues, foreign ownership, intellectual property rights, work force training and mobility, infrastructure, education and technology diffusion. It should also include support for research institutions, promote closer industry/higher education research collaboration and enroll the private sector's funding and research efforts. This should be done within the overall context of maintenance of macroeconomics stability and within an economic development plan that promotes the productive use of labor, provides basic social services, education and protection of the environment and natural resources, especially water and land. Development of such policies commits governments to follow through with execution. This commitment must exist very early in the process since political interests can obstruct implementation.

Following the successful internal 'selling' of technology, a country's leaders must identify and weigh the impact a technology has on the country's industrial base. Four impact areas warrant attention: 1) technology, 2) social, 3) political, and 4) financial. A detailed discussion of each follows.

Technology Impact

Implementation of a selected technology is the real test. Obstacles such as delays, conversion problems and cost overruns are encountered when new technology is put in place. The goal is to implement new technology with minimal disruption, ensure acceptance from end-users, and deliver the tangible benefits on time and within projected costs. It is necessary to understand implementation issues prior to selecting a technology platform in order to quantify required resources and identify their availability. Issues that warrant attention during implementation include the change-over from the old technology, acceptance testing, end-user training, site preparation and post-implementation 'debugging'. A country's ability to support a technology platform implementation can mean the difference between success or failure.

The belief that implementation of new technology places a country on 'auto pilot' is unrealistic. Active participation at different levels of government and society is a must if the new technology is to gain acceptance. Decisions to pilot the technology, phase it in, or fully implement it should be based on the magnitude of the technology and its potential impact during implementation. Conversions to a new technology requires a sound support structure. Converting to a new technology requires that the present technology be displaced and that end-users be cognizant of changes that will occur and trained to ensure that business operations are minimally impacted. End-user awareness of the new technology and its enhancements is a requirement if conversion objectives are to be met.

An example of these issues occurred when an international transportation carrier selected new computers for its operations. The decision was primarily based on the computer's increased speed and lower costs, and did not take into consideration the resources and costs necessary to convert the current software applications to run within the new computing platform. When the new and faster computers were tested, limited improvements were measured by end-users in response time. This was attributed to the fact that their software was not capable of exploiting the new computers' increased speed without some costly modifications. The new computers ran in 'emulation mode' for over two years until the management team that had made the error was replaced. During this time, the company did not benefit in any form from the extensive capital outlay. This type of problem is common when technological prowess is given higher value then a technology's application.

But new technology must be accepted both internally and externally. To only focus on its internal acceptance without analyzing its external acceptance may negate the projected benefits of the new technology's implementation. Automated teller machines (ATMs) in the banking industry and their implementation are a prime example of internally developed technology and applications software that was beyond their external customers capacity to understand and accept. In this case, it was the industry's IT leaders who spearheaded the development efforts at a time when automation in most industries was uncommon. The banks' personnel and their customers were apprehensive to utilize an automation process for transactions involving something as important as money. Even though this industry-wide development effort was seen by the larger banks primarily as a competitive move, it took some time for large banks to implement this technology, not to mention smaller ones. Years passed before ATMs became true banking transaction locations where customers felt at ease and smaller financial institutions came onboard.

Finally, the acceptance of technology has a 'generation gap' component. The younger the generation, the more exposure they have had to technology - even in developing countries. This early exposure to technology does not guarantee its acceptance but serves as a buffer to increase the interest and receptivity of these generations.

Social Impact

The goals of development are to improve quality of life; thus, there is a need to measure development progress in human terms. Technology can have positive effects on the economic development of a country, but it can also fail to fulfill the high expectations placed on it if the process is not adequately managed from its inception. Examples of where social growth has not kept pace with economic growth have been presented in studies by the World Bank and the United Nations Development Program. For example, in countries such as Brazil and Pakistan, growth has increased the incomes of the poor, but social services have fallen short of expectations. As a result, mortality among children remains unusually high and primary school enrollment unusually low, not preparing the poor to take advantage of economic opportunities.

Proposed strategies for rapid and politically sustainable development improvements include:

1 Promote the productive use of labor, developing countries' most abundant asset.

2 Provide basic social services, including health care, family planning, nutrition and primary education.

3 Develop programs to protect the environment and natural resources, especially water and land.

IT's impact on the labor force is a component that merits maximum attention within a social context due to its ability to provide maximum benefit to a country, with potential positive ramifications in the political segment. Automation has decreased the direct labor share of production costs but requires a highly skilled labor force, one which often is not abundant in less developed countries. At the same time, it provides developing countries with automated alternatives that lessen the need for highly skilled personnel in professional applications (computer-aided design in engineering and architecture, etc.), thus relieving these countries of handicapping constraints (Hanna 1994). Technology offers employment opportunities for a country's people, however, educational and training requirements can inhibit disadvantaged segments of the population from participating. This can create a form of 'technology apartheid'. It is up to the country's leaders to provide an educational system that prepares its labor force to actively participate in fulfilling employment expectations.

Resistance to change is a human trait, especially when it pertains to technology. Fear of the unknown and unfamiliarity with new approaches and concepts are a given in the IT sector. Questions that government policies must address and answer are: Who will manage the new technology? What specific skills are needed to manage this technology? What disciplines and skills must the labor force possess to adequately re-tool the country's industries? The answers lie within the education and training component of the national technology development plan, if the country's leadership has taken the time to set one up.

A country's ability to educate and train the new generation of technical managers is key in its IT development plan. These managers of technology must relate to and understand technologies, serving as a bridge between technicians and economists. They must possess the business acumen to be effective in incorporating technology in a country's planning table and must be sensitive to their peers' lack of in-depth understanding and fear of technology. Technology managers are the champions of applications that will serve as critical components in a country's plan to utilize IT in reaching its goals and objectives for economic development. The need for skilled technology managers has become a matter of national survival. The technology manager concept is in its 'emerging' phase within the technology arena, about to enter the 'mature' phase, creating an imbalance in the supply and demand of this type of human resource. A country's willingness to prepare its work force to embrace new technologies will allow it to reap numerous benefits.

Political Impact

Since the implementation of technology will trigger change, political considerations warrant attention early in the planning process. It is this planning process in support of technology implementation that may raise challenges for the government. Political constraints many times have obstructed implementation of technology, thus directly impacting economic policies for a country. Most governments have embraced technology as a resource for applications within the military and public sector domains, which in many cases has created discrete stand-alone technology bubbles. With the Cold-War era over, developing countries have begun to reassess the priorities given to the government and military in utilizing limited technology resources. Global trends in military downsizing, competitiveness and inter-regional economic dependencies have fueled this effort.

Issues such as the 'foreign' ownership of a country's enterprises and infrastructure as well as the impact on employment are very real. Technology, for the most part, requires a higher level of education and less labor intensive human involvement. This requirement can be a point of contention since most developing countries possess excess labor with limited education. Technology can restrict a government's jurisdiction when formerly state-owned and controlled industries are changed over to majority ownership and control by non-government entities. This can create perceptions by a country's citizens that the better educated and wealthy are the only beneficiaries of technology. Governments must ensure that as technology is being implemented, unrealistically high expectations are not developed and that, over the long term, the education and training needed to allow participation in the country's IT platform is made available to all. Educational systems in developing countries usually must re-tool if they are to serve as a facilitator of education and training in support of new technology.

Governments may also have to establish governing bodies such as public utility commissions, standards organizations, professional organizations, etc.

to manage and maximize the implementation of new technologies. Countries must take this into account when evaluating technology feasibility and effectiveness. For example, technology today allows the identification of a calling party in the telephone network, however, opposition by law enforcement agencies (because it could reveal undercover operations), and civil rights groups (because it violates citizens' privacy) could produce a ban on its use. A reversal on this by a governing body can result in costly consequences for those providing and utilizing the technologies involved. It is not always possible to forecast decisions by these bodies, but identification of contingent plans based on industry trends and issues can prove beneficial.

Technology applications can limit a government's ability to fully control information and decision making processes, primarily in countries where the movement of information has been restricted over a period of time. This challenge is most evident in countries that have a high degree of centralization. This form of political impact has been witnessed in the former Soviet Union as it wrestled with various models in an attempt to transform its highly centralized economy into a more decentralized one. In this case, the Soviet government had centralized and absolute control over the type and quantity of information its people were exposed to, whether in the form of radio, television, news media, or government institutions of the educational system. As the government allowed openings for people to communicate and interact through technology, they were exposed to international networks, foreign news and writings. This contributed to a hastening of the social and political changes that followed.

Financial Impact

Trends show a reduction in the costs of technology in recent years. This is the driving force behind IT's increased popularity and use. Unfortunately, lower costs reflect only the cost of 'true' technology, not necessarily peripheral costs such as applications, programming, training, installation, etc. It is these additional costs that tend to increase and reflect a *higher* overall investment.

A developing country should avoid the temptation to buy older technology in order to compensate for rising peripheral costs without ensuring that the selected technology can evolve within its planned technology platform. Countries must identify an information technology platform which will protect it from pre-mature obsolescence. In determining which platform to select, countries must evaluate the benefits of new technology versus costs over its projected life cycle. These costs include maintaining and upgrading the respective technology as it approaches maturity. Upgrading technology in developing countries does not imply leap-frogging from obsolescence to a state-of-the-art technology platform. Two approaches can be considered, one which utilizes the existing technology to continue technological development by integrating new technologies, and a second which consists of totally replacing the present technology.

The costs that warrant identification in each approach are those that comprise all aspects of supporting the technological, social and political components of the technology plan, identified earlier in the chapter. In both cases, however, the following evaluation process should be used when determining which approach to select and quantifying the financial requirements. The process consists of ten steps:

1 Conduct an inventory of present technology components and identify its specific product-cycle stages. This is done to quantify the country's technology components.

2 Identify utilization of and functionalities in the existing technology: Evaluate how these functions can address the immediate technology needs, in whole or in part, of the country. Can this technology be a part of the long term needs of the country? If so, how and for how long?

3 Determine how cost effective the present technology is: Identify tangible and intangible costs of the present technology and its effectiveness in meeting the country's needs. What are the related costs and what are the benefits? Do costs surpass benefits? This step should be conducted for both the private and public sectors.

4 Evaluate present technology and how it can meet future needs, in whole or in part: Identify the life-cycle stage of the present technology and determine the timeframe in which it can support the country's needs in a complementary role before requiring replacement.

5 Identify the present technology's financial, operational, and personnel liabilities: Quantify the liabilities that will be incurred in should the country convert from its present technology base. Any conversion, no matter how smooth, will take its toll on the country. Quantifying potential shortcomings will prove beneficial during the implementation phase.

6 Evaluate internal costs and rate structures: Quantify the services offered to the country's business community and the rates charged to assist in the payment of technology needs over the short and long term. This evaluation will allow the country to quantify technology costs and identify sources - both commercial and governmental - that can contribute to its payback and maintenance.

7 Evaluate whether the present technology can evolve into a newer compatible technology platform. Depending on the stage of the present technology, the potential alternatives will be determined.

8 Identify the costs of a platform evolution or a technology 'fork-lift'. These should include tangible and intangible costs, be they social, political or financial.

9 Identify training costs and required skills level for personnel to be trained.

10 Identify necessary internal on-going technology management requirements and how these will be met.

By employing such an evaluation process, the costs of new technology can be minimized while the benefits can be maximized.

Privatization - technology's mortgagor

Funding a country's information technology infrastructure is the biggest challenge facing developing countries. Their inability to commit already limited financial resources for this purpose places them at a disadvantage and is a hurdle in its acquisition. Technology can be acquired via foreign direct investment (FDI), technology licensing agreements, imports of capital goods, foreign education and training, or through informal means such as attending foreign conferences and trade fairs, reading technical manuals, systematic copying, reverse engineering etc. Funding the selected implementation approach becomes the primary objective once technological decisions have been made. In addition to traditional international funding sources, developing countries have in recent years identified privatization as an alternative funding channel.

Developing countries have looked to privatization as the means for bringing significant hard currency into their weak economies while at the same time establishing a technological platform on which to build a telecommunications infrastructure which will support economic development efforts. Privatization has been particularly significant and visible in the telecommunications industry. Many countries have begun to privatize selected segments or even all of their telecommunications infrastructure. In most cases this requires major capital investments in addition to those payments made by investors for a stake in the operating companies. Investors are attracted to telecommunications due to its prominent role in our global information society. Privatization of telecommunications worldwide has established the foundation upon which an information technology plan can be implemented in support of extensive information exchange. This approach has been a radical change for governments or natural monopolies which are witnessing loss of full control within this industry sector. The telecommunications model can also be utilized when privatization is desired of other technology-intensive sectors of a country's economy.

Privatizations in telecommunications have occurred in many emerging markets, with investors banking on future consumers as well as the strategic geographic deployment of technology. Industrialized countries have opted to pursue deregulation in their telecommunications industries, opening them to competition in varying degrees for both domestic and international services. Investing in a country's telecommunications industry has multiple risks. These are not only technological in nature, but also include regulatory, operational and financial risks. Investors interested in telecommunications acknowledge these risks and utilize generic criteria for identification and selection of privatization candidates. This criteria includes:

1 High population density: This is used as a barometer in identifying the initial and future potential consumer base.

2 High Gross National Product: This is used to identify the potential industrial consumer base and existing sectors which have a need for a more advanced telecommunications infrastructure, possibly translating into consumer buying power.

3 A growing infrastructure: This increases the potential to maximize technological innovations.

4 Foreign investment receptiveness: The laws and regulations regarding FDI indicate the commitment of respective governments to protect foreign investments, thus reducing associated risks.

5 Education: This facilitates necessary support issues such as training, etc. when implementing technologies.

Most developing countries that have privatized telecommunications, and those in the process of doing so would not, for the most part, qualify in all criteria; however, this is part of the high risk/high reward scenario inherent in privatizations. Some early privatization efforts have targeted lesser, but more focused areas within a country's telecommunications sector such as cellular telephone service. Here the capital investment is much less and installation is simpler than developing and installing a complete network infrastructure for the country based on installation of cables. Unfortunately, this approach only addresses a short term need of a country's overall telecommunications infrastructure.

The telecommunications model requires that the following, at a minimum, be evaluated by governments when considering and evaluating privatization.

1 Projected capital investment — domestic and foreign.

2 State of present information technology platform.

3 Desired information technology platform.

4 Desired level of government regulation in:

a) pricing of services, including consumer protection,
b) competition allowed and fairness,
c) evolution of technology and allowed enhancements.

5 Desired utilization of national labor force and training.

6 Projected real revenues.

7 Projected demand for services, including future enhancements and offerings.

8 Targeted geographic areas, both high density and rural.

9 Allowed percentage of foreign investment stake and incentives.

10 Allowed re-investment of investor profits, including expatriation percentages.

11 Required operational management needs, including training and utilization of internal professional workforce.

At this time, Eastern Europe and Latin America offer the primary opportunities for privatization since these countries have a need for developing their IT infrastructures. Germany's Deutsche Bundepost Telekom has begun investing approximately \$32.5 billion over a five-year period to bring the former East Germany network up to West Germany standards. We estimate that privatization ventures in telecommunications range from approximately \$10 million for a small cellular system to upwards of \$14 billion for Mexico's infrastructure upgrade and replacement.

Results of telecommunications privatization efforts in developing countries have been mixed, with no clear blueprint for success. Studies conducted by the International Monetary Fund (Bishop and Mody 1995) argue for a case-by-case approach to privatization rather than attempting to establish a simplified model. Privatization brings numerous possibilities and limitations as a means of economic reform by stimulating the private enterprise sector. Conclusions from the above study include:

1 Instruments of privatization must be various and flexible, and are dependent on the objectives of the government.

2 The state enterprises' financial condition and performance and the ability to mobilize private (national/foreign) resources are of importance.

3 Privatization must occur in a macro-economic and sectoral environment in which competitive forces are allowed to lead efficient production.

4 The politics of privatization center on the relative strength of proponents and opponents and ultimately determine the benefits (IMF, 1990, p.43) of the effort.

The extent of industry privatization efforts ranges from Chile, which has privatized nearly every sector, to Sri Lanka's which accomplished very little despite numerous creative initiatives. Chile's efforts have been broadly judged as successful, but the history of their efforts has been characterized by government re-acquisitions of previously privatized enterprises and policy reversals. In Sri Lanka's case, the economic and socio-political constraints made it difficult for such initiatives to succeed.

The arguments in favor of privatization are almost always couched in financial terms - reducing the deficit, mobilizing financial and managerial resources and improving the management and efficiency of public enterprises. These arguments should also include social gains. Supporters of a country's privatization efforts often include planning and finance ministers, international development agencies and investors. The challenges for governments include resolving issues resulting from the foreign ownership of previously state-owned enterprises and management, the possible restructuring of labor laws and regulations, the need to establish regulatory bodies, and the acceptance of international professional organizations including standards setting organizations.

Privatization is not always the answer to developing countries' information technology woes, neither does inclusion of information technology in a country's overall economic development plan guarantee its implementation. Governments must recognize and understand the importance of technology in order to champion its cause and must work to ease the impact of the changes IT will bring about.

Conclusions

Developing countries realize the need to develop an information technology plan which allows them to enter and participate in today's highly competitive global economy. As they commence their journey into the Information Era, they face numerous challenges which force their leaders to define paths through which they will introduce, maintain and expand technology's benefits with minimal disruption of social, political and economic formations.

In preparing an information technology plan, a developing country might take the following steps:

1 Include information technology as part of its overall economic development plan.

2 Identify and analyze its global competition. Within this context, identify areas where an information technology plan can provide support the country's economic development.

3 Identify and analyze emerging technologies. Conduct a thorough evaluation of alternative technologies and their respective costs. Utilize this information as part of the evaluation whether to adopt the complementary or replacement approach for the country's technology.

4 Ensure that the selected technology platform adheres to a standards alliance.

5 The technology plan must consider social, political and financial as well as technological impacts.

Implementation of this plan places developing countries on a catch-up path that will allow them to introduce and maintain a sound technology platform, thus enhancing their national potential and promoting an attractive environment for foreign investments.

Funding the costs of an information technology plan is a difficult, but high priority task. Developing countries have limited alternatives, with privatization being the front runner as a funding source. There is not one model for success since many factors impact the process, most of these factors are country specific.

Developing countries will continue to take significant and tangible steps towards closing the technology gap; however, they will not be able to leapfrog from developing to first tier status. Political, economic and social realities will not allow this to occur. Even in a case where the political, economic and social factors are not impediments, the rapid rate of technology's evolution presents a real challenge, one within which even industrialized countries have difficulty. Technological leap-frogging implies an evolution from lesser to substantially newer technology. This may be possible within a specific industry sector, not on a countrywide basis.

Even though the situation does not look bright for technology in developing countries, this must not dampen efforts to pursue its acquisition and utilization. Leaders of these nations must continue to make the necessary political, economic and social changes that will enable them to take advantage of technological change. Economic alliances, improved education and training, and government commitment are necessary in order to overcome the structural inabilities attributed to underdevelopment. There is a window of opportunity as regional trade blocs define their international economic inter-dependencies. This is the time for those countries to implement technologies that will facilitate their incorporation into present global trends. If they cannot or do not, the journey will be longer, rougher, and with considerably less results.

4 Promoting software production and export in developing countries

Richard B. Heeks

The software industry in developing countries[1]

Information technology (IT) is diffusing rapidly into all industrial and service sectors and is now seen as one of the most crucial technologies affecting economic growth in developing countries (Kaplinsky 1987, Bhatnagar 1992, World Bank 1992). Developing countries which fail to introduce new information technologies will be left with obsolete, uncompetitive production methods and with an increasingly inefficient system of administration.

Within the overall set of technologies that make up IT, software is vital since other technologies cannot function without it. Software has also been forming a greater component of overall value within information technologies and 'is increasingly becoming a pervasive technology embodied in a vast and highly diversified range of products and services' (Gaio 1989). The World Bank (1993) notes that 'Computer software has become the "lifeblood" of business, industry, and government'. As a result of its crucial role in all areas of the economy, the global market for software and related services has grown rapidly. Typical growth rates have been 15-20 per cent per year and market size is predicted to reach US$300-400 billion by 1996 (Schware 1992). The software industry[2] has been dominated by the United States, but other countries are now becoming important players, including the developing countries.[3]

The development of a local software industry can lead to many positive externalities, and it is a necessity that developing countries are able to adapt software technology to suit their particular local needs. Software production is also the best entry point for developing countries into the IT production complex. For example, compared to hardware production, software production has much lower entry barriers since it is less capital-intensive, more labor-intensive, has a lower rate of obsolescence, and (at least for certain types of software) far fewer economies of scale. All of these factors assist developing countries, and software's labor-intensity of production offers these nations a clear opportunity compared to many other production processes.

Hence, it is not surprising that 'in developing countries interest in both the production and the use of software is becoming more intense' (Schware 1990), and that actual production is also increasing. India, China, Brazil, Mexico, Singapore, Hong Kong, Taiwan, South Korea, and the Philippines all have notable software industries, with annual growth rates of 30 and 40 per cent being common. Not only have these countries been producing large amounts of software for local consumption, but exports have also grown rapidly to more than US$1 billion annually by the mid-1990s.

Software and government policy

Because of the importance of software for local use and for exports, 'Software production is nowadays an industry, essential for the growth of the economies of the developing countries; and the launching of programs to promote strong and indigenous software industries is a priority task.' (Fialkowski 1990). Many other commentators (UNIDO 1983, Kopetz 1984, Narasimhan 1984, Schware 1987, Gaio 1989, Mody 1989) agree that the creation and implementation of a government software policy program is an essential element in software industry development.

According to Borrego (1992), 'The point of departure if a country regards software as an area of growth is the government's commitment to nurture and create the necessary conditions'. These comments are borne out by the experiences of individual countries. Where government policy has been absent - as, for example, in most Arab countries, Paraguay, or Turkey - piracy and imports dominate, there are few software firms, and development of the industry is severely constrained (Mandurah, 1990; Rigg and Mejias, 1992). The conclusion drawn by the World Bank (1993) is that 'Specific measures within a coherent policy framework will be required to accelerate the development of the software industry'.

On the other hand, where governments introduce the right kind of policy, successful development has ensued. The software industry in Ireland is largely the creation of the Irish government's Industrial Development Authority. In China, '...the Chinese software industry has achieved a substantial expansion under a period of increasing official support in the 1980s'. (Baark 1990). In Taiwan, '...government efforts to promote an indigenous hardware and software industry resulted in 100 software houses...' (Fialkowski 1990).[4] So, government policy for the software industry is essential, but what constitutes 'the right kind of policy'?

In the 1970s and early 1980s, very few countries had a software industry policy. One of the few that did was India, which has the Third World's longest-standing software industry policy and largest export industry. Policy at that time was framed largely in structuralist terms - with regulations, licenses and other physical bureaucratic mechanisms providing the main policy instruments.[5] In those countries with structuralist software policies, initial protection and regulation often played a vital role in nurturing early development of companies and capabilities. Unfortunately, regulation was also associated with tolerance of inefficiency and encouragement of corrupt behavior. These negative aspects have been the focus of attention much more often than the beneficial effects of regulation, and have prompted a reaction against regulation in software industry development.

Such a reaction mirrors wider changes; there has been a pronounced crisis of faith in the structuralist policy model for the past fifteen or more years. This model - which dominated much political thinking on economic affairs since the 1930s - came under intense pressure on a number of fronts. These include:

1 pressure from multinationals and international institutions, all of which favored market-led rather than state-led solutions to economic problems;

2 pressure of self interest within local political economies from those who now saw more to be gained from the market than from the state;

3 pressure from supposed failures of state regulation such as recession in Western nations, declining growth rates in some developing countries, and the political demise of state socialism in Eastern Europe;

4 pressure from supposed successes of the market in countries where the state had been 'rolled back';

5 pressure from technological changes which placed an increasing part of economic activity outside the control of state regulatory measures.

As a result, the ideological pendulum has swung away from prescriptions based on state regulation and toward prescriptions based on market mechanisms. Swings in software policy from state to market have therefore been visible in many developing countries, such as China, India, Brazil and Singapore. The new market model is said to provide the much-desired 'answer' to development but its glitter has blinded many to the evidence of the problems thrown up by market forces. Such problems are painfully evident in software industry development with even the World Bank (1993) - normally a staunch supporter of market-oriented, neo-liberal policy - declaring, 'Free-rider problems, externalities and market imperfections are rampant in the software industry....[Some] market-based responses only provide partial solutions to the underlying economic problems, and may even be counter-productive with respect to generation of externalities for the economy as a whole.' Others go further. Correa (1990a) states that market barriers hamper the software industry, while Fialkowski (1990) identifies market imperfections as the main constraint to software industry growth in developing countries. Both authors conclude that state intervention is required in order to overcome these problems.

However, in many developing countries, external neo-liberal pressures remain strong and political time lags mean that evidence about the shortcomings of market-oriented strategies has yet to be widely recognized. Developing countries, then, are still in danger of 'throwing the baby out with the bath water' and abandoning almost all forms of state intervention in their bid to emulate the neo-liberal model. This is ironic given signs in the past few years that the ideological pendulum has slowed, possibly stopped, and may even be swinging back very slightly in some places. In the US, for example, the Clinton administration - despite the reversals of the mid-term elections - has been trying to create a more active government role in industrial development, and even in the UK the Minister for Trade and Industry promised without blushing in his inaugural speech to intervene in British industrial development. At the moment, such pronouncements indicate more a change of mood and attitude rather than action, but they mean that it is time to re-evaluate the state's role.

Evidence on policy directions for software industry development remains confused, with trends in different directions and evidence both for and against particular standpoints. Adding to the confusion is the fact that many of the countries which seem to be moving from state to market in general terms are simultaneously increasing the extent of state intervention. This trend is widely seen in Asia and to a lesser degree in Latin America. State interventions are addressing an increasing number of areas, including finance, education, marketing and improving the nature of the software production process. In an effort to sort through these confusions and contradictions, and to answer the question 'What is the right kind of policy?', the next section reviews why and how states have intervened in a number of areas to assist the development of local software industries.

State intervention in software industry development

Finance and investment

In some ways, software firms are not like other industrial enterprises. Their main product is intangible and of highly variable value depending on context. Partly because of the hit-and-miss nature of package sales, all software development has come to be viewed as risky and, given the conservatism of financial markets in developing countries, there has been a significant shortage of both investment and working capital.[6]

States have reacted to this problem in different ways. Some have focused on attracting funds from multinational corporations rather than mobilizing local capital. This is particularly true for smaller countries, which lack the large domestic markets that naturally attract foreign companies. IBM investment was attracted to Taiwan through a government-supported local institution; the Irish government has worked hard to attract foreign investment which has created more than 7000 software jobs; and Hungary provides tax holidays for software joint ventures.

Concerned that such investment may create little long term benefits for the local economy, other states have focused more on local capital markets. In Brazil, the nationalized banks pushed ahead with substantial investments in software, despite its intangibility, and this has reaped rewards in terms of skills and products created. Similarly, India has used nationalized financial institutions to channel millions of dollars provided through lines of credit from overseas. The money has been used to provide venture and working capital funding to smaller companies that would otherwise have to rely on self-financing. Ireland has also provided working and venture capital grants and loans. Other countries, such as Israel and Taiwan, have used tax breaks on software company investment. These and other states have acted successfully to stimulate the flow of foreign investment and local capital into the software industry, overcoming the reluctance of chief executives and financiers alike. Where governments have not acted, as in Turkey, lack of access to capital remains a major developmental barrier.

Education and training

There has been widespread agreement that the single most important input to the software production process is skilled labor; conversely, that the relative lack of such skilled labor is the most serious constraint to software industry development in many countries (Kopetz 1984, Schware 1990, Platz 1992). As in the case of financing and investment, the state often finds itself working alongside private provision which has many shortcomings. While the private sector may appear to be very active in training, 'there is little control over the quality standards of these institutions, and a good proportion of the students receive little hands-on experience in the use of computers'. (Schware 1987). In India and Singapore, governments have tried to correct this problem with a program to establish skills standards through examination and certification. Singapore's government has gone further by creating three training institutes in collaboration with multinationals from different countries. Thanks to these institutes and other government measures, Singapore's software skills base grew more than ten-fold during the 1980s (Gurbaxani et al. 1990).

Governments also need to stimulate in-house, on-the-job training which offers an important route for skills formation. Many software companies have taken short term views and shied away from investment in training, partly because of the dangers of staff turnover. Because they can take a more macroeconomic perspective, governments can more readily justify this type of investment. In Japan and Ireland, the state has provided grants or tax reductions for in-house training, and in Singapore 70 per cent of the cost of continuing education for software developers has been met with public funds. Although it needs to work alongside other providers that may focus on specific skills, the state remains the prime source of core informatics skills relevant to software industry development. Thus, state education in computer science and related subjects has long been recognized as an essential prerequisite for software industry growth (UNIDO 1983).

In Latin America, universities have played a major role in the development of software industry capabilities, while in Ireland an integral part of the government's software development plan was strengthening university computer science programs. In addition, states can also seek - as did Singapore - to introduce new ideas and skills by funding training and education overseas.

Two final successful measures come from Singapore. As in many countries, the state has realized the importance of general computer literacy and has pushed this into as many school and college courses as possible. Like India, Singapore has also funded a number of information technology projects that have raised IT awareness. Finally, governments can efficiently monitor labor market trends in the software industry (such as the trend away from programmers towards analyst-designers) and disseminate this information to universities, private training institutes and software firms.

Research and development (R&D)

Direct public investment in software R&D can be justified in two main areas. First, in basic software research where there are considerable economies of scale. Second, in software development to meet local needs, where the market has failed to produce the required products. In either case, government funding of R&D becomes more rather than less critical during periods of liberalization - particularly in order to combat the growing impact of multinational corporations and the increasing concentration of innovation within their hands. Only a few of the richer developing countries - Brazil, India, South Korea, Taiwan - have the resources to fund basic software research.[7] The Brazilian government has been particularly active, helping to focus R&D activities on areas, such as Unix and software development methodology, with rich potential spin-offs for the software industry. Many more countries invest to meet local needs. In China, for example, the government has invested heavily in the development of Chinese language software, which has the added advantage that it can be used for export as well as to meet domestic market needs.

Naturally, R&D work alone is not sufficient for industrial development - government must ensure that there are adequate channels for the dissemination and commercialization of the innovations produced. Governments sometimes pay for the work done in existing private sector firms. However, where these firms lack the requisite skills or where the returns on investment need to be more widely distributed, the work can be done by public sector bodies. Overall, then, R&D programs will need to follow the South Korean model, with the government directing research and development work in a mix of government, industrial and academic institutions.

The work of successful software producers is highly R&D-intensive. Without a sufficient level of R&D, software firms will miss opportunities to develop local technological capabilities or new software products, and will be consigned to services work of low skill-intensity. Yet, just as they have tended to skimp on training, software firms in developing countries have also tended to cut corners on research and development. For example, Indian software firms spend an average of only 3 per cent of sales on R&D, compared to 15 per cent in the US. Apart from directly funding software company R&D, the state can also mitigate this situation by providing tax relief on R&D spending.

Marketing and provision of market information

Even the largest of developing country software producers - firms like Tata Consultancy Services in India, and the Stone Corporation in China - are small in comparison to players in the West. For these firms (and even more for the smaller producers), market-related costs, especially in relation to foreign markets, represent a considerable barrier to growth. The costs of marketing packages and services are high, sometimes forming the major part of total costs for a package. So too are the costs of obtaining market information on potential partners, sales channels, regulations, customer needs and competitors. States can reap the benefits of scale economies in both these areas, being of particular assistance to small and medium-sized software enterprises, which are seen by some as the driving force of software industries in developing countries.

Regarding marketing, since governments cannot directly create buyer-seller relationships, their role is to raise general awareness and create the environment in which such relationships may begin. The Indian government has done this by organizing subsidized trade exhibitions and workshops overseas, and by coordinating visits of foreign buyers or government bodies to India. Market information can be provided on a continuous basis from government offices overseas. The Irish government has specifically opened offices around the world with information gathering as part of their activities. More in-depth information may also come from government-commissioned market research reports which are then disseminated to software producers.

Some governments - such as those in Brazil and China - have felt it useful to set up a register of software in an effort to disseminate information which then fosters collaboration and avoids duplication of effort. However, the evidence is that many producers avoid registration because they see no benefit, and so the registers have had little impact.

Intellectual property rights (IPRs)

Software piracy has more to recommend it as a strategy for developing countries than is often admitted. It has been an important, probably essential, part of the initial development of informatics in most developing countries. Piracy greatly increases the accessibility of up-to-date software and so speeds the diffusion of a hardware base. It also saves huge amounts of foreign exchange, which developing countries can ill afford to waste. These countries feel few moral pressures to attack local piracy when the large multinational software producers are seen as already making large profits.

Weak laws on intellectual property rights allow local producers to increase growth and skills by creating versions of popular packages for the local market through 'reverse functional engineering' (Heeks 1995). This is the process by which they carefully study the functions of word processing packages, databases, spreadsheets, etc., and then replicate these functions through their own programmed code. Yet, almost all commentators and all large software package producers claim that a mature local software industry requires a legal framework which only the state can provide. The framework must not only criminalize common distributional piracy, but also protect producers against the theft of their original ideas by competitors. It is said that without such legislation local producers will not invest in software package production and that the growth of the software industry will be stunted (Borrego 1992, Gwynne 1993).

Even those who posit an initial role for piracy feel that during the development of a software industry, a crossover point will be reached when the costs to a few large local producers of lax legislation start to outweigh the benefits to local consumers and smaller producers. Yet, there has been little attempt to critically question these claims and to explain, for example, why many software firms *have* invested in and produced packages in situations of little legislation and high piracy. In the case of India, local package producers were most active during the late 1980s, when piracy levels were at fever pitch. By the mid-1990s, with government action helping to bring piracy levels down from nearly 100 to roughly 80 per cent, local package production was fading and most local firms preferred to act as agents for imported products. Of course, many factors are at play here, but these trends throw into question the efficacy of anti-piracy action and the reality of a crossover point.

However, such questioning may be of only theoretical interest since the US government has pressured developing countries to act on piracy long before this hypothetical crossover point is reached. Countries threatened with retaliation - usually under the punitive section 301 of the US Trade and Tariff Act - and pushed into enacting new or tougher anti-piracy legislation during the 1980s and 1990s include South Korea, China, Taiwan, Mexico, India and Brazil. In accordance with US government pressure, most countries have extended copyright law to software rather than treating software as a special case. The laws enacted are by no means the optimum legislative route, and they are more likely to benefit foreign firms than local ones (Correa 1990b).[8]

The orthodox view of IPRs has therefore been too readily accepted and too little investigated in developing countries. There may well be only a marginal link between software industry growth and IPR legislation. Having said this, even in a marginal situation and especially under US pressure, the government retains a promotional role that cannot otherwise be fulfilled.

Infrastructure

Software producers rely on many basic items of infrastructure in order to conduct their business such as electricity, water and roads. Although these are provided by the private sector in a few Western nations, it is still generally accepted that they are provided by the state in developing countries.

There is more debate over the provision of telecommunications infrastructure. This forms a fundamental part of any strategy to move software exports away from on-site 'body shopping' (with its political, financial and 'brain drain' costs) since overseas clients demand good phone, fax and e-mail links before they will contract work to be done offshore (Heeks 1991). Western companies and governments are pushing for more private sector provision of telecommunications, but autonomous state organizations in several countries have proven themselves adept at meeting software industry needs. The Irish government's telecommunications agency has invested US$2.5 billion to help build the software industry; South Korea's Korean Telecommunications Authority has kept revenue above expenditure while massively expanding international links; and in Singapore, the state has laid the foundations for it to become the 'intelligent island'. Even India's notorious telecommunications system now boasts good international access, used by all the top exporters and provided mainly by semi-autonomous public sector enterprises such as Videsh Sanchar Nigam Ltd.

Still to be proven is the investment by some governments, such as India and Taiwan, in 'software parks'. These are specially-designated locations - created and sometimes administered by the state - in which several software firms are brought together. The initial aim is to reap the benefits of scale economies in infrastructural provision and of operational gains from clustering similar small firms. More ambitiously, some hope to add in government-funded training, consultancy, quality validation, and market research facilities. There is little clear evidence of gains from software parks. Given the problems of software technology parks in India; the absence of clear benefits for software firms working in export processing zones; and the possibly misguided nature of the spatial concept behind industrial parks, such promotional measures should be approached with great caution (Heeks 1995, Wahi 1993).

Finally, some governments have attempted to alleviate the problem of low technology-intensity of software production found in many developing countries. One method has been for the state to invest in an infrastructure of hardware (especially large IBM-compatible machines) to which small software firms are given access. In both India and China such investment has failed to meet other than narrow academic software production needs. Such an infrastructure is also becoming outdated given falling price/power ratios, increasing portability of software development environments across hardware platforms, and increasing access to overseas computers through wide area networks. The alternative method - used in India, Hungary, Mexico and the Philippines - has been to provide import tariff reductions on hardware used by software developers. While this has undoubtedly helped software firms, there has been a lot of 'spillover' with computing power imported for software firms finding its way to other users.

Infrastructure provision has therefore been like the curate's egg: 'good in parts', especially in telecommunications, but less successful in other measures.

Procurement

There is general agreement that a healthy domestic market is a precursor to long term success in exports, and that the small size of domestic software markets in most developing countries is a severe constraint to industrial growth (Schware 1987, Fialkowski 1990, Press 1991, Platz 1992, Heeks 1992b). Because of its large purchasing power, the state is the most important domestic consumer for emerging software industries and is therefore in a strong position to influence the local software industry's development through its procurement policies.[9]

The first stages in this process are to ensure that, throughout the public sector, software specifications are sufficiently detailed and sufficiently unbundled from hardware to give local software firms a chance of tendering. Governments can also act to ensure that staff are sufficiently well trained to consider factors such as support and reliability as well as price in choosing software (World Bank 1993). Without these changes, contracts will often go to foreign hardware and software package suppliers. Once these changes are in place, though, governments can act - as in Brazil and Singapore - by prioritizing local firms in their procurement procedures. Such actions have been an important contributor to software industry growth in developing countries, and have also expanded the base of software project skills (Heeks 1992c, Schware 1992). The main benefit has come where this process includes large scale informatics projects. The main danger is that these actions lead to US trade pressures like those which forced Brazil to open its procurement.

Spread of best practice

The nature of software production in developing countries is epitomized by Mandurah's (1990) description of it in the Arab world - 'very basic'. While there are pockets of excellence, most software production cannot genuinely be described as a production process and bears no resemblance to the much-touted idea of the 'software factory'. Instead, it resembles a school art room - full of creative individuals using basic, outdated tools to their full capacity but involved in a 'seat-of-the-pants' exercise which is barely managed at all.[10] As a result, overseas buyers are less willing to accept the products or services of developing country producers, so exports remain limited. Entry barriers remain low, allowing small, cheap, bad firms to enter and survive in the market. This makes software production overly competitive and reduces returns (and, hence, capital for reinvestment) for all software firms.

The practice of software development therefore needs strengthening by the state in three key areas:

1 More use of new technology, such as CASE (computer-aided software engineering) tools which automate aspects of the software development process. Because they replace labor with capital, these tools pose a significant danger to software exports from developing countries since they are substantially reliant on low labor costs. However, the greater danger will be in *failing* to adopt this new technology and lagging further behind other producers who take advantage of the productivity and quality gains that the new technology can bring (Heeks 1990).

2 More use of new techniques. At its most basic, this involves the use of simple project management techniques to gain greater control over the development process and help to bring more work in on time and on budget. Beyond this, techniques such as formal methods can be adopted. These will be required for software producers to remain locally and globally competitive.

3 Adoption of international quality standards. These form a subset of the new techniques to be adopted, but are of such significance that they deserve separate mention. There are many flaws in the conception of quality as a management issue, and it has been viewed far too uncritically as a panacea for improving organizational performance. However, while it remains 'flavor of the month' it will become increasingly desirable and soon increasingly necessary for software firms - particularly exporters - to adopt quality standards. More and more Western clients will demand that their software suppliers have undergone certification procedures under, normally, the ISO 9000 quality standard (Dataquest 1993a).

Through procurement, the state can act in all three areas though few in developing countries have yet followed the lead of governments in the West. Government contracts stipulate, for example, that tenders can only be accepted from ISO-certified firms and that certain tools or methods (e.g. Structured Systems Analysis and Design Methodology) be used. There is also considerable indirect pressure to adopt other management techniques in order to meet time and cost deadlines.

The state can also act, as in Singapore, through the creation of best practice centers. These can have several functions:

1 *to evaluate* the condition of software development in the country and target areas of greatest need.

2 *to inform* by translating textbooks and international standards; by holding seminars at which those who have adopted best practice techniques talk to others; and by setting up demonstrator centers and projects where the various tools and techniques can be assessed. These centers can also inform local software purchasers of the need to demand certain minimum standards from local suppliers.

3 *to certify* by acting as international standards certification centers, or by helping other organizations to become certifiers.

4 *to transfer* by providing packs with 'try-out' versions of new tools; by training university students and existing developers in new tools and techniques; and by subsidizing training and acquisition of new tools.

5 *to establish* a set of local standards. By demanding certification in such local standards for all government procurement, supposedly open tenders can favor local firms.[11]

Finally, the state may provide finance. In Singapore and Ireland, for example, the state will provide a proportion (70 and 50 per cent respectively) of a quality consultant's fee.

Other intervention areas

State-owned enterprises (SOEs) As Evans (1992) points out, the state can have three roles - as well as being a regulator and promoter, it can also be a producer. The fashion for privatization has cast a shadow over public sector software firms in many countries, but this is not entirely justified. Although software industries mainly grow through private ownership, experience shows that publicly-owned firms can be profitable and play a lead role, especially in early industrial development. Thus, both Brazil's Cobra and India's CMC have built up a formidable base of innovation skills. In the case of CMC, this has been successfully commercialized and even turned into export earnings.

However, the record of SOEs in other countries has been more mixed. In China, state firms have technological resources but it is the non-state firms that have the entrepreneurial perspective and talent. As such, it is clear that for software SOEs to work well, a particular set of conditions must hold such as avoidance of over-diversification, exposure to competition, appointment of entrepreneurial senior managers, and so on. The state can also act to develop valuable software specializations through non-software SOEs. For example, both Brazil and Uruguay have created financial software exports through development of, and investment in, their banking and financial services sectors.

Trade There has been a proven value in trade protectionism for young industries to allow time for import substitution and the growth of related capabilities. For example, in Brazil import controls allowed substantial operating system-related capabilities to be created. Where this protectionism is absent, countries remain largely dependent on imports (Correa 1985). Having said this, import policies - whether bans, quotas or tariffs - are of limited use given the intangibility of software which allows any policy to be circumvented with increasing ease (Heeks 1995). There is also a 'natural' local market protection based on language, regulations and knowledge of local needs. It is therefore hard to advocate a state regulatory approach to software trade.

Multinationals (MNCs) As with trade protection, there are clear gains from regulating the activities of multinationals or - more accurately - clear losses from allowing them to act unfettered. However, regulation of multinationals has been fraught with problems in practice for two reasons. First, by their nature, MNCs can act globally while states can only act nationally. Second, states are often caught in the weak and contradictory position of trying to encourage MNCs while trying to control them. If regulation is to be attempted then it needs to be targeted at certain times and sectors. If the gap between domestic and foreign skills and technology is very large, one might as well allow the multinationals in to infuse new skills and technology. If the gap is very small, then local firms should be competitive and regulation can again be minimized. Control is only worthwhile to protect local firms when there is a medium-sized, 'catch-upable' gap (Mody 1989). Unfortunately, defining gap size is not an exact science.

Industrial licensing Few governments have attempted to regulate companies' entry into or exit from software production. Evidence from India - where licensing was widespread during the 1970s and 1980s - suggests that it is often counter-productive, removing the incentive and route for firms to become competitive.

Export subsidies In almost all developing countries, the software export market provides greater returns on investment than production for the domestic market. As such, there is little justification for export subsidies to be paid by the state to software firms.

Conclusions: The role of government in software industry development

A global review of the 'right kind' of government policy for software industry development and exports in developing countries indicates that wide-ranging state intervention is still essential to this industry. The common element guiding all the interventions has been the failure of the market to provide the quality or quantity of inputs which are critical to software industry success. As well as addressing the obvious inputs such as capital and labor, intervention has been needed to cover inputs such as market information and new development techniques. While state intervention has been required most where market imperfections are greatest, it has also been found to be beneficial where, thanks to economies of scale, the state can be the most efficient provider. Examples include provision of core software skills and some items of marketing assistance and infrastructure. Finally, intervention may also be needed where market mechanisms produce outcomes that are not deemed to be in the best long term interests of country, as seen in the emergence of overly-competitive industries in the absence of best practice action and, perhaps, in the need for legislation on IPRs.

Clearly, the form of state intervention has changed over the past twenty or so years. Regulatory measures - some of which will still be of value in countries initially creating a software industry - are now giving way to measures which promote the growing industry and promote its access to inputs. Such measures are complex and multi-faceted compared to the relative simplicity of earlier intervention. In most countries, too, the state is now working alongside the private sector and its own public enterprises, aiming for cooperative development rather than close control.

Of course, the list of interventions should not be taken as meaning that government intervention is a guarantee of software industry development, nor that state intervention - even promotional intervention - is perfect. In practice, there have often been problems with intervention. In general terms, there have been delays, misunderstandings, inter-agency disagreements and - as seen in the case of software registers and hardware provision - interventions which have not had the desired effect. There have been other specific, common problems such as poor commercialization of academic innovations and weak links between business and academia for training (Baark and Heeks 1993, World Bank 1993). However, a shortcoming, even a failure, of government intervention is not a logical argument for recourse to the market. It should, instead, be an argument for improved intervention next time.

Interventionist measures are not always right the first time, and any given measure may become outdated by changing events. Therefore, just as important as the particular input addressed by promotional intervention is the general strategy of intervention. Successful intervention strategies are those which are responsive to the industry's needs, and which are flexible and iterative - always trying to improve in the light of past experience and changing circumstances. Because of this, one cannot universally prescribe a particular set of interventions which will bring success. Each country will have to choose the policy measures that suit its software industry best, based on continuous survey of the quantitative and qualitative nature of that industry. This is also true because of the constraints placed on the process of making software industry policy. Policy outcomes will ultimately be determined not by some objective, technocratic choice of the 'best path', but by a mixture of this 'best path' intention with the balance of power and interests of the various elements in a country's political economy (Heeks 1992a). The outcome will also be determined partly by external factors, especially the actions of the US government and US companies which may try to block certain state interventions while encouraging others.

One may conclude that the argument should no longer be one of 'State vs. Market' but a question of how to achieve the most from state and market working together. The continuum of importance here is not one which runs from 'All State' to 'All Market' but that which runs through a spectrum of different state responses to private industry (and autonomous public enterprises):

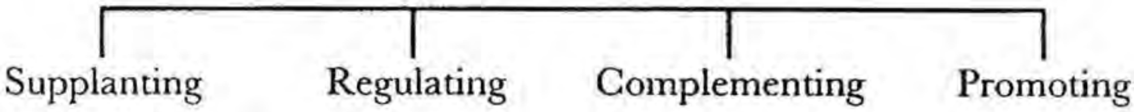

Figure 4.1 Government responses to private industry

Neither a completely state-owned nor a completely market-led approach to the software industry will create the conditions required for long term industrial development. Yet, with alternatives to the market being too rarely presented, many countries are being pushed under pressure of structural adjustment along a path from the regulatory state to the minimal state (path A in Figure 4.2).

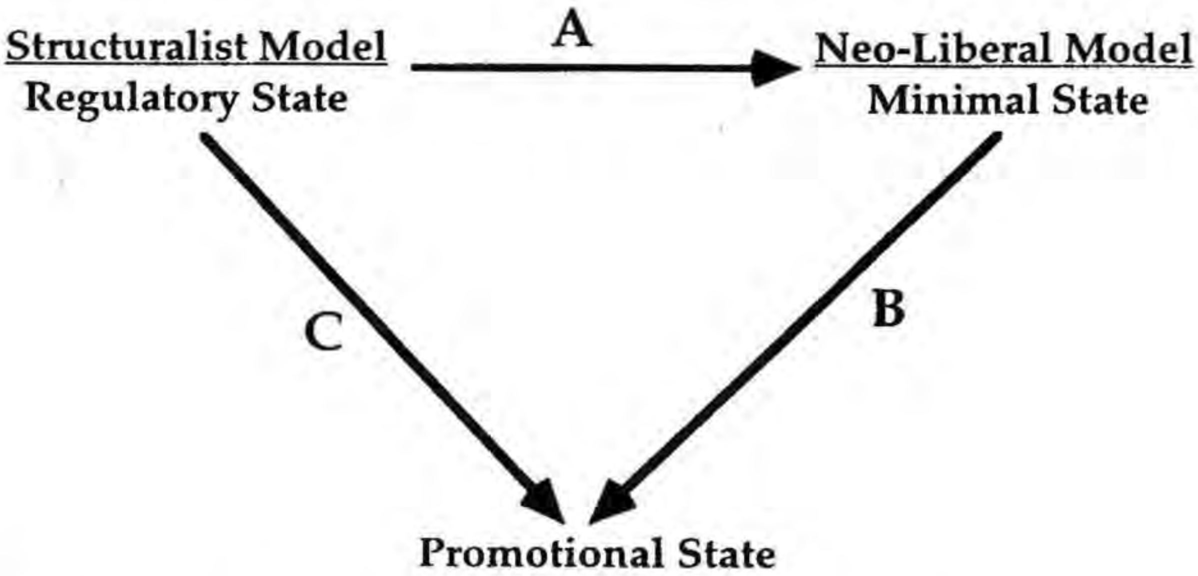

Figure 4.2 State roles and developmental paths

This path seems most likely to occur in countries where policy has been guided more by ideology than pragmatism; where politicians, business people and the public are accustomed to seeking simple solutions; where an inferiority complex predisposes the government toward external policy models; and where there is a continuing belief in the autonomous power of the state. Under these circumstances, policy may flip from one ideology to another - from overactive embracing of state to overactive embracing of market.[12] Unfortunately, there is likely to be a long and wasteful process before these states recognize the need to change once again and move along pathB.

Such countries sit in marked contrast to those who have recognized that the push should be along path C instead - from the regulatory state to the promotional state. Nations, such as those of South-East and East Asia, have been successful because - due to their particular political economies - they have been able to forge a cooperative alliance between state and industry rather than create a situation in which one or the other group is ideologically dominant. The state's role is seen as one that promotes industry and development rather than ideology.

Finally, one would never seek to deny the importance of sound financial management and of markets in the development of software production and software exports, but there are more than enough organizations and consultants around the world reminding everyone about this. What this chapter has reinforced is the much less fanfared message - that the state continues to play an essential role in the process of industrial development. This should be the basis for a renewal of confidence in the role of the state. Such a renewal is much needed within the state *but also* within industries such as the software industry. Too often, foreign and local software industry managers react to liberalization and the lifting of what they see as the 'shackles of state interference' by seeking a future devoid of state intervention. Many of them have a genuine psychological block about viewing government as anything but an encumbrance.

Government, industry and academia must work together to overcome these blocks. Managers in multinational subsidiaries and in local software firms must be persuaded to work with government in joint state-industry structures. By so doing, they can look to government to shoulder some of the industrial development burden and to act on a wide variety of fronts to reduce development barriers. If they cannot or will not be persuaded that some forms of state intervention are indispensable, these industrialists will be constraining the long term development of their own industries.

Notes

1 The findings presented here form part of an ongoing research project, initiated in 1987, into the development of software industries in developing countries. They are drawn from fieldwork in China, India and Singapore, and from the cited references.

2 In this chapter, the term 'software industry' is used to describe those companies or company divisions which earn the majority of their rev-

enue from sales of software consultancy services or software packages. Other sources of software, such as in-house production, will not be the focus, although governments can also act to promote this type of production - for example, through policy on research and development, training and spread of best practice.

3 Share of world software revenue outside the US, Western Europe and Japan is predicted to have grown from less than 10 per cent to roughly 16 per cent between 1985 and 1995 (World Bank 1993).

4 Such state action is not restricted to developing countries: 'To a significant extent the United States, Japanese and French governments have strengthened their software industries by a variety of measures' (Schware 1989).

5 Structuralism is a political ideology which favours state regulation and ownership, trade protection and other measures to contain what it regards as the shortcomings of existing global economic structures, including markets.

6 Typical developing country software firms require US$1,000—10,000 per capita start-up investment and US$500—5,000 per capita per year working capital (Heeks 1995).

7 The governments of Europe, Japan and the US have all invested billions of US dollars in basic software research in an effort to assist their domestic industries by developing skills and technological innovations.

8 Indonesia has been an exception, enacting its own protection law which largely ignores software not translated into Bahasa Indonesia, or which is not publicized for the first time in Indonesia.

9 The public sector can make up more than half the domestic market, as in India. Even in Western, market-oriented economies, the state is still normally the single largest domestic customer. In the US, for example, government forms around 20 per cent of the market (Coopers and Lybrand/IDC 1986; Gaio 1989).

10 This is not, of course, an analogy limited to developing countries. Software production in the West is still dealt with far more as an art, and far less with techniques of management science than many wish to admit.

11 A number of states have also invested in the development of their own new software tools and techniques. While this has certainly created skills within the development centres, the wider value has yet to be proven.

12 Evans (1992) illustrates the danger of such a situation in the dissipation of innovative skills built up within the state-owned *Computadores Brasilieros*. Once the state model had run into difficulties, the only solu-

tion was seen to be total private ownership. One might have expected something similar from India but the Department of Electronics — unlike much of the Indian bureaucracy — has striven since the mid-1980s to assist industry, and so is transforming itself from a regulatory to a promotional body (Dataquest 1993b).

5 Diffusion of IT and the competitiveness of Brazilian banking

Renata Lèbre La Rovere

Introduction

This chapter examines the rapid diffusion of information technology (IT) in the Brazilian banking sector. A bank's production process is particularly suited to benefit from IT diffusion, since it is organized around the storage and transfer of information. Automation enables banks to offer clients a diversified range of services and is an important tool for increasing competitiveness. In high inflation countries such as Brazil, a bank's competitiveness depends on its ability to rotate money quickly, which is possible only with the help of information technologies.

In Brazil, high inflation and high profits in the financial sector have stimulated banking automation. Diffusion of IT started at the end of the sixties and has followed the pattern observed in developed countries. Initially adopted in the bank headquarters, diffusion of IT has extended to support 'back-office' operations in branches, until finally it reached 'front-office' operations. In Brazil, however, IT diffusion was somewhat slowed by two factors. First, Brazil's economic crisis during the 1980s dried up investment in the national telecommunications infrastructure. Second, the protective policies for hardware production and resulting concentration of suppliers increased equipment costs, especially for small banks. Nevertheless, banks have been able to circumvent some of their inhibitors to the diffusion of banking automation by network sharing and direct participation in hardware production.

This chapter is organized as follows: The first section describes the institutional and economic conditions that stimulated development of banking in Brazil. The second section describes the technological paradigm, the third presents the evolution of banking automation in Brazil. The fourth section presents the methodology and results of a recent survey of Brazilian banks, and uses these results to assess the challenges for diffusion of IT in the banking sector in the near future. The final section draws lessons from the survey for other developing countries and discusses policy implications.

Informatics and telecommunications

Recent changes in Brazil's informatics sector

To analyze macroeconomic conditions that shaped IT development in the banking sector we must look at the official informatics and telecommunications policies. The Market Reserve for Informatics in Brazil was created at the end of the 1970s in order to foster an indigenous informatics industry in Brazil. It was implemented by the Brazilian Government to stimulate the development of Brazil's local informatics industry. It forbid imports of assembled personal computers and put heavy taxes on computer parts. Unlike other protective measures taken during Brazil's import-substitution process, this policy was selective, excluding the production of mainframes. At the time the policy was first implemented, personal computers were at the very beginning of the diffusion process. The fact that PCs gained considerable importance in the informatics industry worldwide helped Brazilian-owned firms expand rapidly. Brazilian firms' participation in sales grew from 32.6 per cent in 1980 to 60.3 per cent in 1990, and their share of employment grew from 51.6 per cent in 1982 to 77.5 per cent in 1990.

The market reserve policy did not directly affect bank decisions to invest in automation because most of their data processing during that period was carried out on mainframes. Nevertheless, the fast pace of banking automation in the 1980's led the Secretaria Especial de Informática (SEI) in charge of the Market Reserve to study banking automation. Its 1983 report recommended:

1 Make a study group to assess the feasibility of electronic fund stransfer (EFT).

2 Support sales and development of hardware, software and interfaces.

3 Build a network to exchange data between banks.

4 Develop communication protocols.

The first two recommendations were followed, while the third was only partially implemented and the last was not followed. Networks between different banks were built only when the banks needed to reduce costs. As for the failure to implement new communication protocols, the banks were concerned this could result in a security risk.[1] In addition, developing protocols would have required an agreement between equipment suppliers. The group that studied electronic funds transfer made several suggestions, but EFT did not grow as expected due to difficulties in standardizing equipment and sharing costs between banks and retailers.

In 1988, another study was conducted by SEI, this time jointly with the Federação Brasileira de Bancos (Febraban). Since automation was then well advanced, some problems were beginning to appear. The study identified the following problems:

1 lack of an adequate telecommunications infrastructure;

2 difficulties updating equipment;

3 difficulties dealing with large volumes of data.

The study recommended more use of distributed processing and more flexible rules for importing computer parts.[2] As for the telecommunications infrastructure, SEI had limited power since Brazil never made an effort to coordinate its informatics and telecommunications policies.

A seminar organized by SEI in 1990 verified that the problems identified two years earlier still existed Few suppliers dominated the market, supply of equipment was precarious, and maintenance was highly priced. Equipment from different suppliers used different protocols. Sometimes the same supplier introduced new protocols in new equipment. In addition, bank documents were not standardized making difficult their integration. Finally, neither banks nor the government had a clear position concerning the use of proprietary systems.

By the 1990s, the conservative government in Brazil had changed policy orientation. Restrictions on imports were lifted at the same time the Market Reserve System ended, allowing banks to update their equipment. SEI lost its regulatory power and was further reduced.

SEI's efforts and the Market Reserve System had helped banks to develop Brazilian skills in the software and hardware tailored for the banking sector. The decline in prices of personal computers — 45 per cent from 1989 to 1992 in real terms — that followed the end of the reserve system was important to banks since many were moving toward downsizing their equipment. In addition, since 1992 some large informatics companies, including Digital, Compaq, and Toshiba, have entered the Brazilian market, establishing joint-ventures with local firms or building new factories. This has given banks more options concerning equipment purchases.

Between 1993 and 1994, Brazil's informatics sector grew 12 per cent, with total 1994 sales of US$8 billion. Although banks today have more options concerning suppliers than in 1990, problems of standardization and agreement on communication protocols persist. These difficulties illustrate the lack of coordination between informatics and telecommunication policies. While the former was attempting to develop local technological capabilities, the latter was facing restrictions stemming from Brazil's external and internal debt. The result was a reduced investment in infrastructure.

Brazil's telecommunications sector

Until recently, Brazil's telecommunications sector was a state monopoly controlled by the Telebrás system created in the 1970s. This system consists of a holding company, 26 state carriers and Embratel — a company in charge of interstate and international calls. By the early 1990s, Telebrás had yearly revenues of US$7.8 billion, and had grown at an average annual rate of 11 per cent since its creation (Wajnberg 1992). Telebrás raised the telephone density rate lines from 1.75 per 100 habitants in 1962 to 5.9 in 1986 and 8.4 in 1993. The present rate is similar to that of Mexico with 6.9 in 1990 and South Africa with 9.3 in 1990. In spite of this increase, however, the way the carriers were formed through the forced acquisition of smaller telcos has created large discrepancies in the quality of services provided that still exist today. An index developed by Telebrás based on congestion of interstate lines, velocity to repair phones, quality of phone repairs and waiting time to complete a call shows a difference of 42 per cent between the best and the worst carrier (Patury 1994). State telephone density rates reflect the differences existing between the poor North-east region and richer regions as shown in Table 5.1. For example, telephone density rate in large cities like Rio de Janeiro and São Paulo is around 16.1, while the rate in the Maranhão state it is only 1.92 lines per 100 inhabitants.

Table 5.1
Brazil's telephone density rate (lines per 100 inhabitants)

State	*Telephone Density Rate*
Distrito Federal (Brasília)	21.00
South-east	9.27
South	7.11
North	5.76
North-east	5.59

Source: Patury, F. (1994), 'Congresso devera mudar telecomunicaoes', Jornal do Brasil, 16 January.

Since in Brazil there are no restrictions on the size of banks, this discrepancy in telephone density creates problems for a banking sector relying upon nationwide networks. Banks face difficulties, expanding their branches in the North-east due to its precarious telecommunications infrastructure.

Resources destined for the telecommunications sector began to fall after 1976, when the government gave priority to other strategic sectors. As shown in Figure 5.1, Telebrás' funding situation deteriorated further between 1982 and 1986 when its tariffs were controlled to fight inflation, and taxes on state enterprises were raised to fight public sector indebtedness. After 1986, Telebrás managed to raise investment by increasing its own contribution to investment from 13 per cent of the total in 1974 to 64 per cent in 1992. This was possible because Telebrás charges a large fee to new users. Instead of leasing lines as in other countries, Brazilian users buy their lines, at a cost of US$2,000. On the other hand, monthly telephone charges are among the lowest in the world. This does not mean that Brazilian users always pay less for monthly use, since Telebrás overcharges for interstate and international calls in order to subsidize local service.

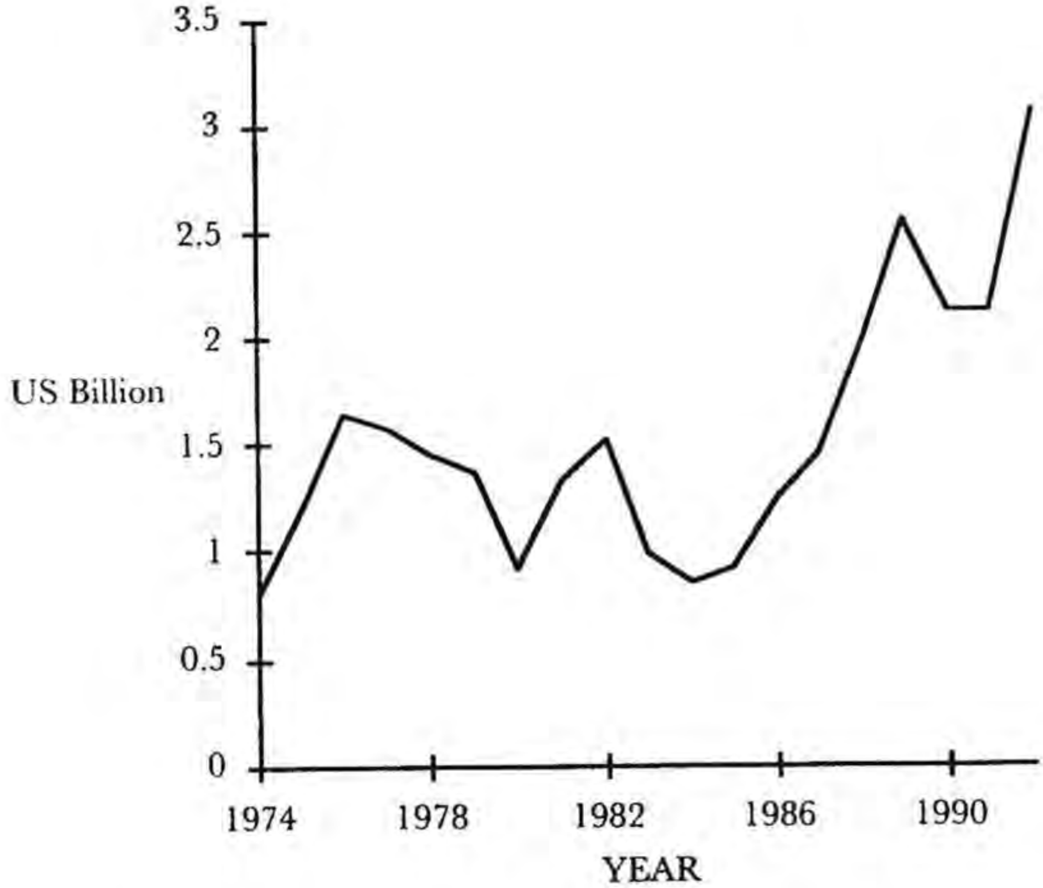

Figure 5.1 Yearly investment of Telebrás (US$billion)

Source: Compilation of data from internal Telebrás reports.

The decline in investment between 1982 and 1986, coupled with a growing demand for telecommunications services, impaired the quality of lines. Telebrás was able to reverse this situation after 1986, but the average percentage of calls not completed in Rio de Janeiro and Sao Paulo is 35 per cent, well above the national average (see Figure 5.2).

Telebrás' capacity to keep up with demand is questionable. According to Wajnberg (1992), the present level of investment — US$ 3 billion per year — is sufficient to provide only 700,000 voice sets per year. Since Brazil already has 11 million sets and demand by the year 2000 is estimated to be 28 million, there will be a considerable deficit if investment continues at present levels. It is difficult to assess investment in telecommunications since technology is evolving so fast and there are many choices involved. Nonetheless, the present level of investment clearly will not satisfy demand.

Investment in IT by Brazilian banks

In 1994, bank investment in automation was higher than Telebrás' investment in infrastructure. Investment in telecommunications infrastructure grew during the 1990s as the Brazilian government tried to solve the bottlenecks created in the 1980s. Embratel is building a fiber optic network that will link all of Brazil's major cities. The installation of fiber optic cables in Rio and São Paulo was started recently, increasing the bandwidth of terrestrial lines. It still is not clear whether this new infrastructure can cope with the growing demands of banks and other users.

Users of telecommunications in the service and industrial sectors try to overcome the obstacles imposed by the deficient infrastructure in different ways. Large users are more concerned about the quality and velocity of data transmission than with costs. These firms use satellites and private networks. Medium-sized firms prefer network sharing or outsourcing. Small users have few options and complain they are discriminated against by Embratel. In addition, the waiting time for access to services is typically longer for these users (La Rovere 1995). The private networks used by large firms are based on different systems, so their capacity to communicate with other large firms is limited. Thus, Brazilian firms are characterized by a fragmented model of data communications that will impair their competitiveness in the long run. At a time when most countries are discussing information super-highways, Brazilian firms seem to be building several secondary roads.

To solve problems associated with lack of resources, the Brazilian government recently opened the telecommunications sector to competition. Although telecommunications is still considered a public service and thus is controlled by the government, today any private firm can become a provider of basic or value-added services. The government intends to create a regulatory body to supervise competition. By changing regulations the government is attempting to attract foreign direct investment, not only in telecommunications but also in other sectors formerly monopolized by state-owned companies. If the government takes too long to define regulations in these sectors, it will undermine the already limited ability of state companies to compete with private companies. It is not clear how Embratel's network will be managed.

Thus for Banks, while the restructuring of the telecommunications sector will improve choice and provision of services, the uncertainties involved in

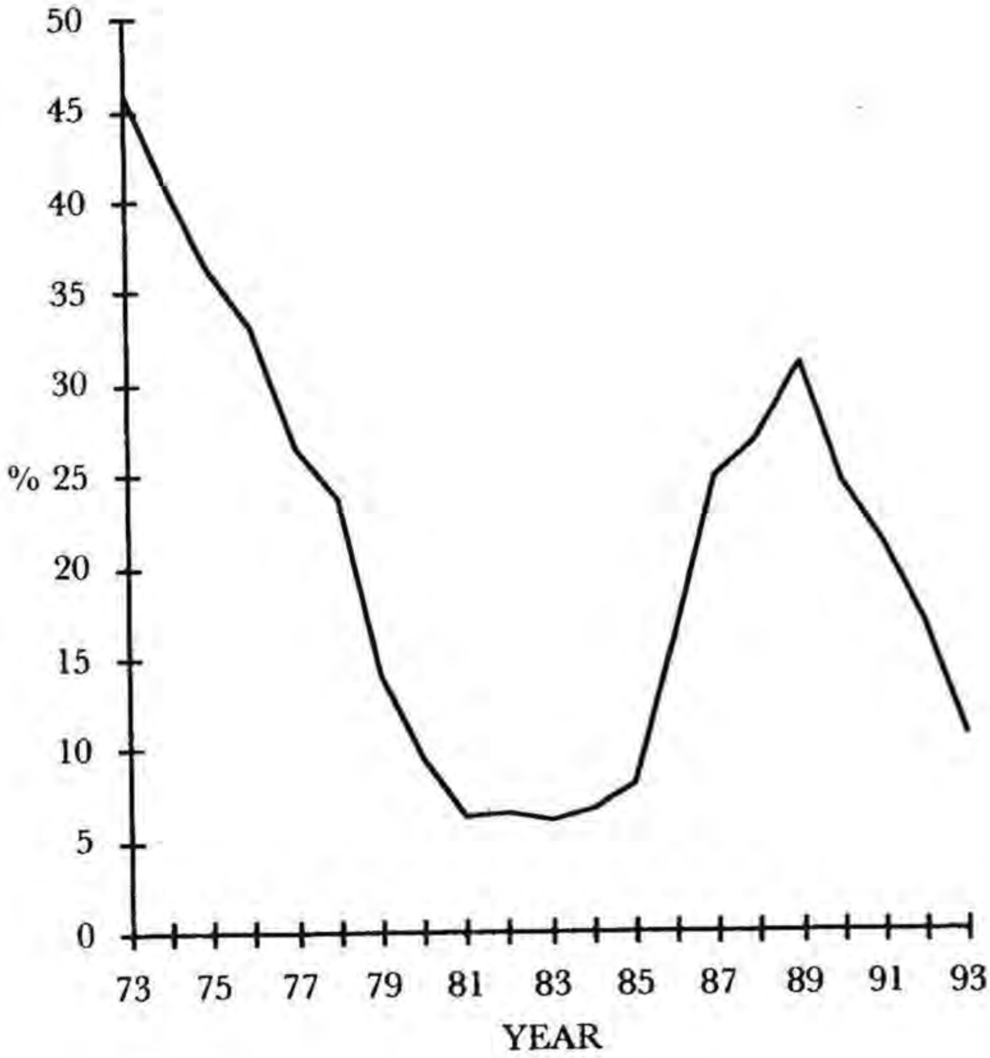

Figure 5.2 Ratio of interstate calls not completed

Source: Telebrás, internal data.

the regulatory environment may lead to further fragmentation in data communications, undermining abilities to communicate from one bank to another.

Explaining banking automation

Banking was one of the first sectors in Brazil to use IT. Three main factors contributed to this use:

1 the high informational content of banks' products;

2 the need to integrate transactions made in different locations;

3 the high revenue of banks (Diederen et al. 1990).

The technological paradigm of banking automation identified by De Wit (1990) is useful for evaluating the importance of IT to Brazilian banks. Banking automation exhibits the following pattern. In the first stage, automation of the payment system and inter-bank transactions occurs. In the second stage, back-office operations are automated; while the decentralization of activities, with agency automation and introduction of ATM's, takes place in the third stage. During the first two stages data processing is centralized, while during the latter there is a transition to distributed processing and equipment downsizing. Buzzachi et al. (1995) call the first and second stages 'mass automation', and the third 'smart automation'.

IT investment varies according to the stage. During the first stage the main investment is in mainframes, while during the second and the third stages, investment in data networks is most important. During 'mass' automation, innovation is centered on equipment, while during smart automation, innovation is focused on the services offered. The innovative activity of the 'smart' automation stage leads to a diversification of electronic banking services. In developed countries, the mass automation stage occurred during the 1960s and 1970s, and the smart automation stage in the 1980s.

Factors that stimulate the diffusion of electronic banking services in developed countries include the definition of standardized procedures by central banks, the laws concerning electronic fund transfer, and the size of banks (Buzzachi et al. 1995). The size of banks is important since network services benefit from economies of scale, and larger banks are less risk-averse and have market power. Today, banks in developed countries process their documents electronically and are increasingly offering services based on IT, including ATM's, multimedia, EDI and electronic mail networks, as shown in Table 5.2.

The Brazilian banking sector

Brazil's banking sector has 247 banks, 207 of which are private and 40 public. These banks have 17,045 branches that employ 657,200 people and on average process 350 million checks per month. Brazilian banks underwent a process of concentration process during the 1960s due to reforms in the financial sector. Between 1965 and 1986, the average seven-firm concentration ratio — a measure that compares deposits, lending volume and net assets of the seven largest firms in the industry with the whole industry — for deposits, lending volume and net assets grew 106 per cent (Frischtak 1991). This process of consolidation increased bank revenues and stimulated a strong rise in the number of branches as shown in Figure 5.3. The rise in the number of branches was also stimulated by the diversification of bank activities during the 1960s. Brazilian banks not only have a diversified product line that comprises insurance, brokerage and mutual funds, but they also handle the payment of taxes, social security, unemployment duties, and utility bills.

Table 5.2
IT-based services offered by banks in developed countries

Over 150 transactions possible in ATMs	Electronic point-of-sale	Notebooks for insurance brokers
On-line database and hotlines for customers containing financial information	On-line database about clients (for bank managers)	Multimedia systems in bank's branches, shopping centers and conference centers
Balance and record of transactions by cable TV, phone, fax and e-mail	Financial EDI	Video conference kiosks linking customers and bank employees, to discuss mortgages, investment in mutual funds
Inter-Bank On-line System -- fast transfer of funds among banks in different countries	Home Banking	Internet-based banking

For a long time, Brazilian banks benefited from speculative activities linked to high inflation, especially in the 1980s. Figure 4 shows the average annual return on sales (net profit/revenue) for Brazil's 50 largest banks compared to average return of the 500 largest non-financial firms between 1973 and 1992. For the period, the average return was 16.09 per cent for banks and 10.12 per cent for non-financial firms. It was these high returns which gave banks sufficient funds to invest in banking automation.

Following the technological paradigm of banking automation, Brazilian banks first automated payment systems and inter-bank transactions. Data processing was adopted according to a centralized model. Fast growth of branches during the 1970s increased the need to automate back-office operations in order to speed up data processing. During this period, the two leading banks decided to enter directly the production of equipment, due to the problems mentioned above. One of them — Itaú Bank — created a new company, Itautec; while the other — Bradesco — bought shares in existing informatics and telecommunications companies in anticipation of IT integration.

The supplier companies offered products not only to Itaú and Bradesco but also to other banks. Their experience with banking automation was important for IT diffusion. Today, two firms specializing in banking automation equipment — Itautec and Tecnologia Bancária — are among the 50 largest informatics companies in Brazil. The former is owned by Itaú; the latter by a group of medium-sized banks. In 1993, Tecnologia Bancária generated a return on sales of 28.2 per cent, while Itautec earned 6.4 per

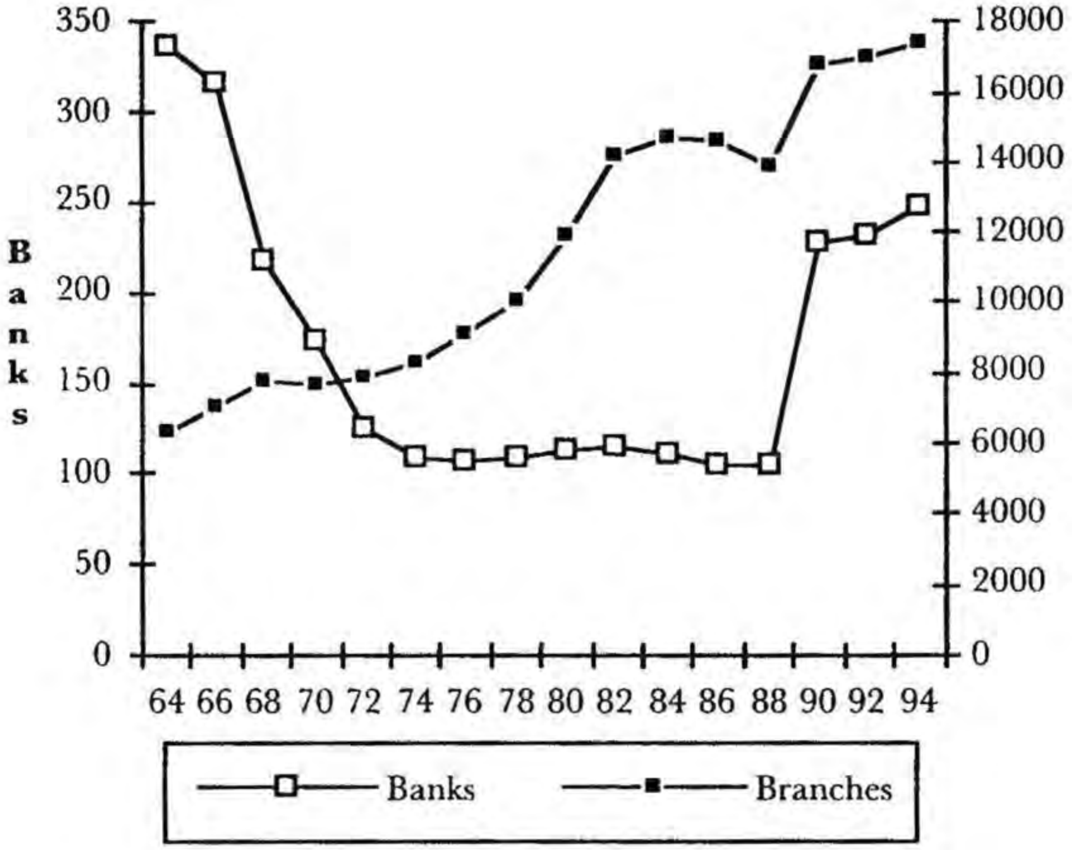

Figure 5.3 The Brazilian banking system

Source: Internal Reports, Federacao Brasileira de Bancos, Sao Paulo.

cent on sales. This was very good compared to the 2.4 per cent average return of informatics suppliers in Brazil that year. In addition, Itautec was the leading seller of personal computers in 1994.

Rising inflation after 1986 (see Figure 5.5) increased demand for bank services since they could protect customers from loss of purchasing power. Banks thus proceeded to automate agencies to cope with this increased demand. Having reached the third stage, banks are now competing by diversifying automated services. Table 5.3 describes some of the IT-related services now available at many banks.

Between 1991 and 1993, banks invested US$ 2 billion annually in automation, and US$ 4 billion in 1994. Between 1992 and 1994 the number of ATMs grew from 2,200 to 11,000 in number. In July 1994, the new stabilization plan of the Brazilian government sharply increased the compulsory deposit on checking accounts, thus reducing bank profits derived from 'floating'. The gains associated with floating or inflationary profits were estimated to be one third of bank gross revenues in 1993 (*Exame*, 23 November, 1994). With the stabilization plan, these gains were expected to

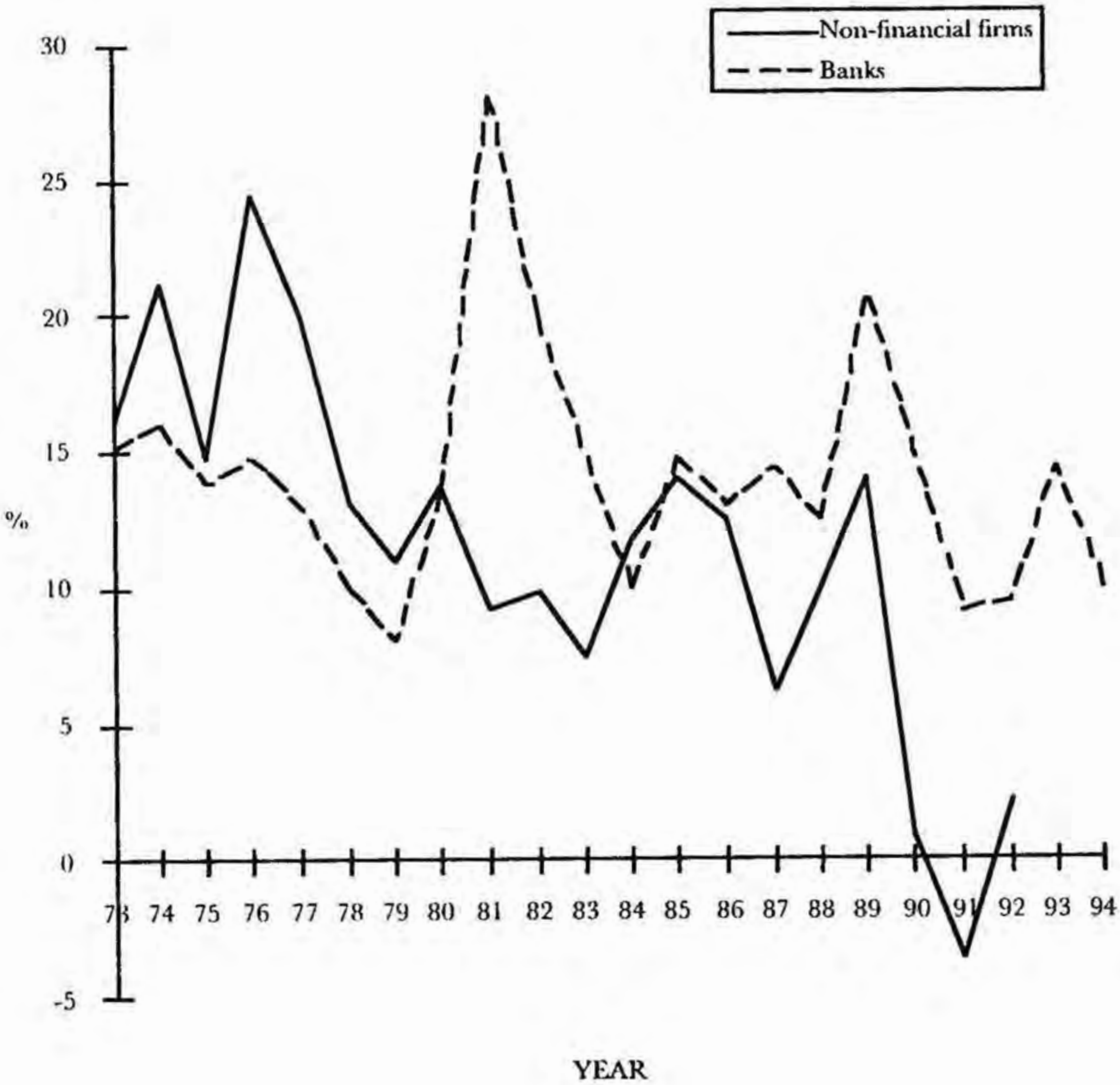

Figure 5.4 Return rates of banks and non-financial firms

Source: Editora Abril (1993), 'Bancos: o Sucesso que Incomoda', Exame, 23 June, pp. 65—9.

be reduced sharply. However, the loss of revenue associated with the stabilization plan was attenuated by high interest rates (also linked to the stabilization plan) which helped to maintain banks profitability. In addition, Brazilian banks can increase their revenue by charging more for their services. For example, bank tariffs in Brazil represent 1.1 per cent of total assets, while in the US this ratio is 2.1 per cent. The prospects for the banking sector in Brazil are thus positive, despite the reduction in profitability.

The immediate effects of the stabilization plan were a reduction of 10 per cent in the number of daily documents processed and a reduction of 20 per cent in the number of people going to branches. In an environment of low inflation, banks expect an increase in competition based on the quality since

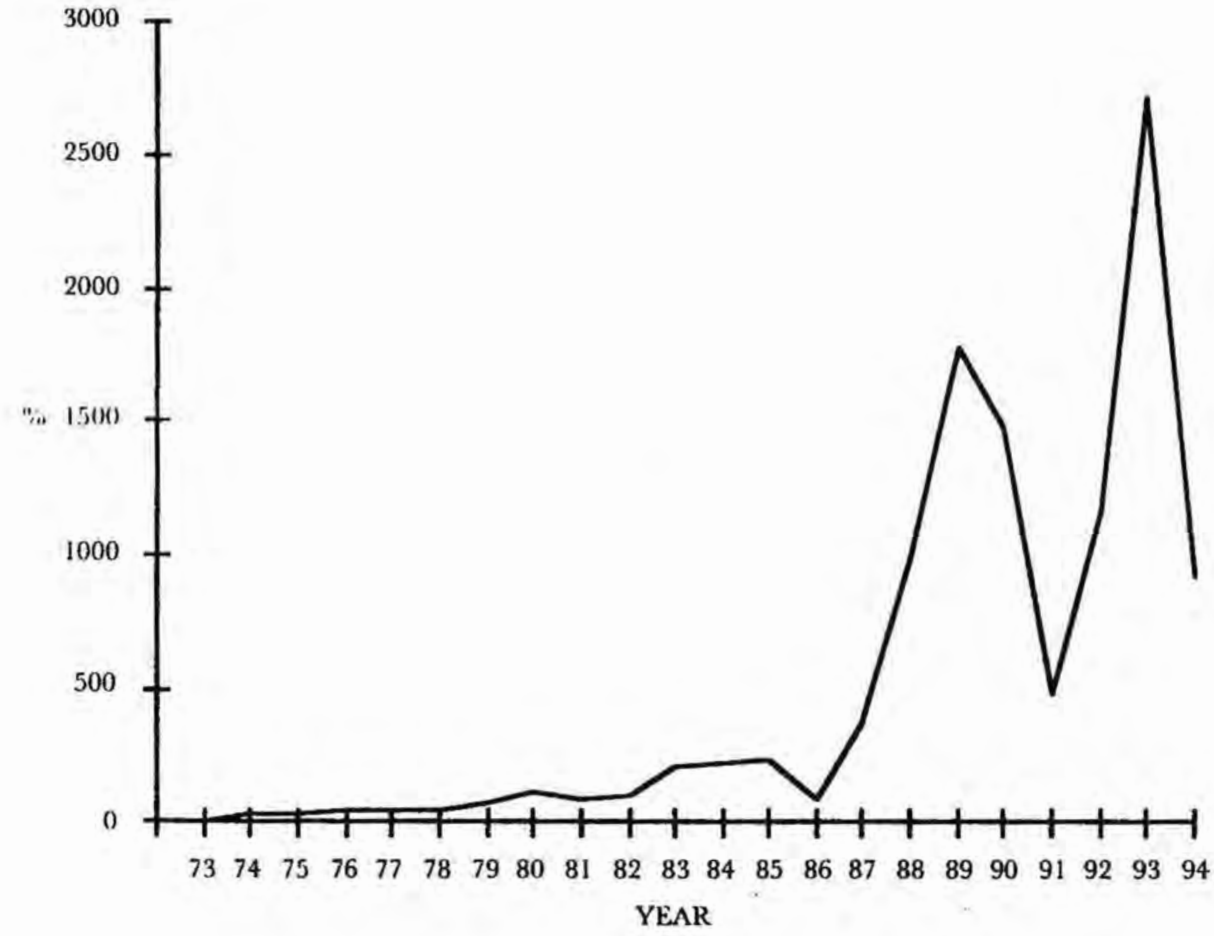

Figure 5.5 Inflation in Brazil

Source: Internal Data, Fundacao Getulio Vargas, Rio de Janeiro.

customers will not only try to protect their money from inflation but will also expect fast service. Accordingly, they are increasing and diversifying the level of automation. New IT-related services such as financial databases or ads in electronic newspapers have been launched recently.

A survey of Brazilian banks

IT diffusion can be explained by different models. According to Bar et al. (1989) there is a 'telecommunication learning cycle' with two stages. During the first 'automation' stage, firms use telecommunications to reduce costs and speed up operations. During the second 're-organization' stage, firms use telecommunications to 'transform the way their employees interact and work, tapping the technology's potential to articulate more efficient and effective work processes' (Bar et al. 1989, p. 18). Some models are more detailed. For example, Venkantraman's (1991) model of IT diffusion has five stages. During the first stage, IT is perceived as a utility, and firms automate processes in order to reduce costs. In the second, IT is perceived as a strate-

Table 5.3
IT-based services offered by Brazilian banks

1	Balances, record of transactions, transfer operations and check orders by phone or e-mail or pagers
2	Balances, record of transactions and debt notices by fax
3	Electronic point of sale
4	Notebooks for insurance brokers
5	Palmtops for customers to request information remotely
6	Sale of show, soccer games and air shuttle tickets by ATM's
7	Telephone with screen that provide data about the account
8	On-line database, available in three languages, containing financial information about 23 countries
9	Home delivery of cash
10	Multimedia systems in bank's branches, shopping centers and conference centers
11	Balance and record of transactions by cable TV (still being implemented)

gic resource, and firms start to link the 'information islands' created in the first stage into a network. In the third stage, the firm uses IT to redesign business processes and modify organizational routines. In the fourth stage, the firm's network is redesigned to increase efficiency and improve relations with clients and providers. In the final stage, the scope of the business is redefined as the firm gains competitive advantages through the use of IT.

Despite differences in the content of the stages, there is a general consensus in the literature that IT diffusion is an *evolutionary* process that involves changes in firms perceptions and uses of IT. In the early stages, when firms use IT essentially to reduce costs, their perceptions of IT as a competitive tool is less clear than in latter stages.[3] Thus, we can assess the stage of IT diffusion through information on investment in informatics and telecommunication networks, and surveys of firm perceptions regarding the benefits and obstacles of IT diffusion.

During 1993, a survey was conducted of a representative sample of 15 banks which together accounted for 51 per cent of the branches in Brazil's banking sector. The survey contained questions about the bank's investment in IT, the type of equipment it used, and the perceived benefits of and obstacles to IT. In addition to these questionnaires, interviews with informatics managers — and in some firms with the president's assistant — were also conducted. The data obtained indicate that investment in informatics equipment is highly correlated with the bank's size[4] ($r = 95.72$). Banks with automated facilities represented 83.7 per cent of the sample, which suggests that Brazilian banks are well advanced in automation. In addition, IT diffusion is perceived as a competitive tool by most banks, since it was adopted to increase data availability and quality (see Table 5.4).

According to Bar's (1989) classification scheme, the largest banks in Brazil appear to be at a transition point. The use of data networks is starting to modify their work processes, because it is stimulating a decentralization of data processing. This decentralization is in turn encouraging downsizing. The medium-sized banks are still at the automation stage. Although there is a clear 'follow-up' strategy as they attempt to offer the same services as big banks, it is relatively more expensive to change their equipment and thereby modify their work processes. Small banks, on the other hand, have a window of opportunity, since they can easily downsize their equipment and thus make the transition to more efficient work processes utilizing updated technology. These banks are trying to combine up-to-date equipment with personalized services that bigger banks cannot offer. Their potential as users and diffusers of IT is important. Overall, decreasing equipment prices will continue to stimulate downsizing.

Table 5.4
Benefits of data networks

Benefit	*Per cent of answers*
More availability of data	100.0
Quality increase	86.6
Velocity increase	86.6
Cost reduction	60.0
Workforce reduction	46.6

Source: Data collected by author. Benefits ranked by importance.

In terms of Venkantraman's (1991) model, the interviews revealed that while small banks are in the third stage of IT diffusion, most large and medium-sized banks are in the fourth stage and the largest banks have reached the fifth stage. Bradesco and Itaú not only own firms that are important informatics suppliers, they also own companies that provide telecommunications services. Now that the telecommunications sector in Brazil has been liberalized, these banks plan to use their experience with private data networks to offer network services to other firms.

Obstacles to IT diffusion

The scenario of rapid IT diffusion in Brazil's banking sector presented above must be tempered by Brazil's inability to cope with present problems. The most serious problem is the lack of an adequate telecommunications infrastructure. According to the survey, banks considered poor telecommunication the biggest obstacle to IT diffusion. Table 5.5 lists the most common problems cited. By 'poor telecommunications infrastructure' banks mean congested lines, which are common in urban centers, and inefficiencies which result from the division of functions inside the Telebrás system. For instance, to set up a data network a firm must deal with Embratel and the local carriers in each state covered by the network. Embratel is a company that was created to manage inter-state and international calls. It belongs to the Telebras system and the only relationship it has with local carriers is as supplier of inter-state and international calls. Embratel claims that most pending contracts are delayed because of local carriers. As a result, the waiting time for new service can be over 180 days. The high cost of transmission lines results from the cross-subsidy policy. Telebrás is reviewing this policy as large users of Embratel complain about costs. The high cost of equipment stems from producer concentration, while inadequate technical assistance is linked to deficiencies in technical training in Brazil.

Table 5.5
Obstacles to data networks

Obstacle	*Per cent of answers*
Poor telecom infrastructure	93.3
Insufficient resources to invest	86.6
High equipment cost	66.6
Inadequate technical assistance	60.0
Lack of specialized workforce	26.6
Lack of scale	26.6
Lack of customer interest	20.0
Few information about the system	20.0
High cost of transmission channels	13.3

Source: Data collected by author. Obstacles ranked by importance.

Other important problems, such as lack of resources to invest and high equipment costs, are related to supplier concentration and tend to become less important as banks move towards downsizing their equipment. As mentioned before, prices of personal computers and workstations are falling rapidly as a result of the end of the market reserve system. Tariffs on imported equipment still remain at 30 per cent.[5]

Banking automation and competitiveness

Competitiveness can be evaluated based on three different sets of elements. The first is related to individual firm characteristics including technical capability, cost structure and skills of personnel. The second is defined at the sectoral level, and includes tax structure, government incentives, local content in production, and technology endowments. The third set encompasses macro characteristics such as infrastructure and government regulation.

Within the banking sector, IT diffusion clearly led to an increase in bank competitiveness that benefited customers. The large banks, as leaders of the automation process, set patterns of behavior and developed products that were adopted by the others. Outside the banking sector, the largest Brazilian banks acquired a significant technical capability in developing and supplying networks to support automation. Banking automation in Brazil also led to increased skills in the maintenance of network equipment. Large banks in Brazil are thus becoming service providers. The convergence between banking and information provision has been also noted in developed countries (Miles and Wyatt 1991, Gude 1994). However, as Miles and Wyatt (1991) observed, firms in developing countries find it difficult to be competitive in the provision of network services, given the competitive advantages that competing firms from developed countries already have.

In Brazil's case, the changes being considered in the regulatory framework for the telecommunications sector would allow foreign firms to become service providers without restrictions. AT&T is looking for local partners to enter the Brazilian market as soon as regulations have been defined. As a result, the best strategy for large Brazilian banks to improve their competitiveness and guarantee their presence in the service provider market is to enter joint-ventures with foreign firms.

Although persistent inflation was a powerful stimulus for bank automation, the lack of coordination between Brazil's informatics and telecommunication policies in effect has slowed the pace of IT diffusion. Automation was encouraged by SEI, but telecommunication policies led to an increase in costs. Further, institutional and economic conditions led to different patterns of IT diffusion according to the size of the bank. Large banks are heavy users of IT and therefore are competing by offering different automated services to their customers. Medium-sized banks are trying to follow the large banks, while small banks are relying on personalized services. In all cases, however, IT is an important competitive tool since banks can increase the quality of their services by adopting these technologies. But it is also necessary to consider the structural characteristics that shape competitiveness.

Much of Brazil's low competitiveness in provision of telecommunication services, and its difficulties in expanding banking automation stem from the poor quality of its infrastructure. However, the advantages banks gain by using IT will enable them to become providers of information services now that the telecommunications sector in Brazil is more open to competition. As the quality of Brazil's infrastructure improves with new foreign and private investment, the largest banks will enter competition in the market of value-added services. Nevertheless, if the government is slow in defining the rules regarding competition in the information services market, the competitive position of large Brazilian banks will be damaged. Thus, the definition of a new regulatory framework is vital to the competitiveness of Brazilian banks.

Regulation in the telecommunications sector has changed dramatically over the last twenty years. Deregulation started in developed countries, but has become increasingly popular in developing countries as well. The form and pace of deregulation depends on a country's stage of development, its existing telecommunications and informatics infrastructure, and various cultural and political factors. In developing countries, two trends are prevalent. On one hand, the newly industrializing Asian countries have invested heavily in their telecommunications infrastructures in order to increase digital lines and set up international trade networks. On the other, Latin American countries have watched their telecommunications infrastructures deteriorate in the 1980s due to lack of investment resulting from high levels of external debt. As a result these nations recently began to privatize their telecommunications sector (La Rovere and Fagundes 1995). While the privatization of telecommunications in Latin America has been successful in increasing investment, in many cases, it has also encouraged greater market concentration and increased dominance by foreign firms at the expense of local firms.

Brazil's main challenge concerning IT diffusion is to devise a model in which public and private firms cooperate to create a telecommunications infrastructure which reduces bottlenecks and enhances diffusion. The Brazilian experience in banking automation illustrates the importance of an integrated industrial policy to support the informatics sector, the telecommunications sector, and the provision of information services. In the case of Brazilian banking, the absence of such a policy hampered the development of competitiveness.

Several lessons emerge for developing countries from the Brazilian experience. First, developing countries should build a modern telecommunications infrastructure using either state-owned enterprises or regulated private firms. Second, developing countries should define an integrated policy for IT development which takes both informatics and telecommunications into consideration, and attempts to identify those areas in which the country can become internationally competitive. Carefully managed partnerships with foreign firms may be an appropriate way to improve the competitiveness of local firms. Finally, the IT policy should create a regulatory framework which limits the formation of monopolies that may hamper the competitiveness of local firms.

Notes

1. A similar situation took place in France the preceding year. See Pastré (1982).
2. Import rules were very strict then, only those parts not produced in Brazil could be imported, and even then tariffs were high. This resulted in a large benefit to equipment suppliers.
3. We came to this conclusion comparing results for the banks with results for other service sectors. See La Rovere (1995).

4 The distinction between large, medium-sized and small banks was made according to the number of employees. We chose this criterion rather than size corresponding to capital, because banks in our sample with comparable capital had different strategies according to the number of employees. Large banks in our classification have more than 7,000 employees, medium-sized more than 2,000 ,and small up to 2,000 employees.

5 The tariff for finished products is 45 per cent. On the other hand, parts not produced in Brazil do not pay an import tax. However, a value-added tax (25 per cent) is charged on the price, including the import tax. As a result, final prices for finished products are 82 per cent higher in Brazil than in their original countries.

6 Strategic information systems planning: experiences from Hong Kong

Stephen Elliot

Introduction

Measurement differences notwithstanding (Weill and Olson 1989, Butler Cox 1990, Hochstrasser and Griffiths 1991), Information Systems (IS) are believed to be capable of supporting competitive advantage (Porter 1980, Ives and Learmonth 1984) which may be sustained when aligned with a firm's strategic objectives, structure and practices (Clemons 1986, Scott Morton 1991). Perhaps as a result of these studies, Information Systems planning at the strategic level has assumed increasing importance in firms over the last decade (Porter and Millar 1985, Earl 1989, Keen 1991).

Surveys of managers in the USA from 1980 to 1989 established strategic planning and associated areas as the single most critical issue facing IS management (Niederman et al. 1991). Similar emphasis has been placed on strategic information systems planning by management in other developed countries, including the UK, Australia and New Zealand (Parker and Idundun 1988, Watson and Brancheau 1991, Galliers et al. 1994, Broadbent et al. 1994). Less attention has been given to surveying management issues in developing countries, although separate comparisons of issues in Singapore, Taiwan and Hong Kong have been conducted. The results from Singapore and Taiwan, while being quite tentative, indicate greater emphasis on short term issues than in developed countries, but with strategic planning given increasing future importance (Rao et al. 1987, Harrison and Farn 1990). A survey undertaken in Hong Kong in 1990 showed a more general alignment with Western rankings. The top issue of concern was retaining, recruiting and training IT staff, which was short term oriented; however, this issue was closely followed by IS/IT planning. Seven of the top ten issues in Hong Kong were included in Western studies (Saxena and Gulati 1990).

Organizations can exploit IT for benefits at several levels. At an operational level, benefits may be limited to cost displacement, reduced processing time or, in manufacturing systems, standardized levels of output. The greatest benefit to be gained from computer-based systems, however, occurs when the systems are aligned with strategic goals through the process of Strategic Information Systems Planning (SISP) (Scott Morton 1991). SISP is the process of determining a portfolio of computer-based applications which can assist an organization in realizing its business goals as well as searching for applications which have the potential to create an advantage over its competitors (Lederer and Sethi 1988).

The significance of Strategic Information Systems Planning (SISP) to firms in most developing countries has not been established. Indeed, the dynamics of IS decision making in these countries at strategic or any level have yet to be identified. Avgerou and Land (1992) note, 'There are significant aspects of information systems in developing countries which are poorly understood. These include:...the prevailing rationality in decision-making processes; and the cultural aspects which affect the use and value of information, the communication and decision-making processes and the work procedures. Still, research in such areas is almost non-existent.'.

Lack of research into either IS decision making or management issues should not necessarily be seen as a lack of interest in these areas. The importance of SISP in Western firms, and indications from the limited research conducted to date, strongly suggest the potential importance of these areas to firms in developing countries.

This chapter reports the findings of case study research into SISP decision making practices in indigenous firms in Hong Kong, and on the development of models of good practice based on the experiences of these firms. The practical utility of these Hong Kong-based models is then considered for firms in other developing countries, particularly in Asia.

The research project

Hong Kong, one of the four 'Dragons' of Asia (with Singapore, South Korea and Taiwan), is designated by the World Bank as a developing country; however, it would seem that this booming, bustling economy would have little in common with many developing countries. Part of the difficulty in dealing with developing countries as a whole lies in defining of the characteristics of developing countries (Avgerou 1990). Since the countries are so diverse, research findings based on any one country will, of necessity, require testing for relevance in any other country to which those findings are applied.

The objectives of this research are to:

1 determine the critical factors and processes used in SISP decisions by indigenous companies in Hong Kong, and

2 devise one or more models of SISP by comparison with, and likely structural modification of, Western models.

The purpose of these models is to provide assistance to indigenous firms in developing their level of utilization of Information Technology. While the research is conducted in a single economy it is anticipated that these models may be of general applicability to developing countries in Asia.

Questions considered in this research are:

1 How do organizations decide to use or not to use IT?

2 What factors and processes are most important in these decisions?

3 How do these factors and processes compare with those used by organizations in Western countries in their decisions to invest in IT?

4 Can Western models of the utilization of IT be directly applied or structurally amended to enable their use by firms in developing countries?

Research design and process

Following consideration of the research questions and examination of potential research methodologies, a case study approach was selected. Case studies are appropriate for exploratory and explanatory research since they are able to capture a greater depth and breadth of detail on the subject's activities. Rigor was established in the research by adherence to Yin's (1989) model for case study research. Primary research findings are based on triangulation of longitudinal interviews, observation and documentation. Construct validity is established by triangulation, chain of evidence and formal review by the interviewees for verification. A case study protocol (as proposed by Yin 1989) was utilized to support the objective of reliability. Literal replication was sought from the selection of local companies in the same sector, of varying size. Replication was sought within economic sectors as a minimum, and between sectors as an ideal.

Empirical research was undertaken in two iterative phases in 1992 and 1993 in Hong Kong to identify current SISP practices (Elliot 1994). The research consisted of case studies of indigenous firms in two sectors: manufacturing and banking. The research sites were selected to support analytic generalizations due to their diversity. The sites included: firms in manufacturing and financial sectors which, respectively, experienced low and high sectoral levels of IT utilization; firms with experience in the use of IT rang-

Table 6.1
Profile of research sites in Hong Kong

Sectors		*No. of firms*	*Size*	
Manufacturing				
Textile & Garment	spinning	1	No. of employees	250 - 700
	knitting	2	Annual revenue	US$ 6.5 m. - US$ 51 m.
	cut / sewn	2		
Banking				
Locally incorporated licensed banks		4	No. of employees	850 - 2,500
			Total assets	US$ 1.6 b. - US$ 7.8 b.

ing from less than two to more than 20 years; firms having experience with a range of systems at operational, tactical and strategic levels; and firms ranging in size from 250 to more than 2500 employees. While the research outcomes would be further strengthened by greater diversity, such as additional sectors, wider range of sizes of firms and, from the point of view of international application, firms in other countries, it is suggested that there is sufficient diversity to support the inter-sectoral models and other outcomes proposed. The profile of the research sites is shown in Table 6.1.

In the manufacturing companies, interviews were held primarily with the person responsible for the operations of the company. Titles of the manager varied — especially in companies which formed part of a larger group with non-manufacturing interests, but included Managing Director, Director and Manufacturing Manager. In addition, interviews were held with the person in the company responsible for computing, if one had been appointed. In the banks, interviews were sought with the manager of a strategic business unit as well as the manager responsible for IS. Of the four banks, the strategic business unit (SBU) manager in two sites was an executive director of the bank. In the other two sites, one manager was responsible for retail banking operations, and the other was the bank's corporate secretary. Consequently, both IS and strategic management perspectives were obtained. At each site, the computer installation was visited and operations observed.

Decision making factors

The major factors identified are those on which manufacturing and banking sites would base their IT investment decisions if making those decisions today. These factors include those on which previous decisions have been made, adjusted in light of their subsequent experience. The factors were unprompted, and were not selected from a list of alternatives. Priorities were assigned after consideration of all factors.

Decisions to use IT - factors in manufacturing

Due largely to its manufacturing industries, Hong Kong has historically been one of the world's major trading economies. Its textile and garment industries in particular have become so internationally competitive that Hong Kong has been considered, 'the world's leading exporter of clothing products.' (Kurt Salmon Associates 1992). Hong Kong's manufacturing industries in general, however, are facing decline. Potential solutions to recover their competitiveness include increases in productivity and use of technology.

The major factors influencing IS/IT strategic decision making in the selected manufacturers are shown in Table 6.2. The business requirements specified included improvements in productivity (several responses), improvements in production processing speeds, and improved control over business. It was noted that the business requirements for a firm may differ between its off-shore locations. Operational factors included compatibility with existing equipment (which was a major factor for some equipment but a minor factor for others), capacity, growth path and reliability of vendor. (For further details, see Elliot 1993). In the tables below, company names have been abbreviated as follows:

HKW:	Hong Kong Worsted Mills Ltd
PK:	Peninsula Knitters Ltd
SHK:	Sun Hing Knitting Factory Ltd
MG:	Manhattan Garments (International) Ltd
WTG:	Wing Tai Garment Industry Holdings Ltd

The full list of company name abbreviations appears in Appendix 1.

Decisions to use IT - factors in banking

The banking market in Hong Kong is intensely competitive. In 1993, there were 31 locally incorporated, licensed banks and more than 130 overseas incorporated, licensed banks. The overseas banks include 79 of the world's largest 100 banks (KPMG 1994). Due to the large number and profile of major international banks, products which are available in the most advanced international banking markets quickly make their competitive presence felt in Hong Kong. This reduces the possibility of niche product mar-

Table 6.2
Major factors in IT decision making: manufacturing

Major factors	*HKW*	*PK*	*SHK*	*MG*	*WTG*
Business needs and requirements	1	1	1	1	1
Financial return	2	2	2	2	2
Management Information	1(a)				3
Operational factors		3(b)	3		
Commitment of top management			4		

(a) The major business requirement identified was to have precise management information on the operations of the firm in order to improve response and control in the rapidly changing business environment.
(b) Operational factors would become priority 2 for production systems

kets, and increases the necessity of constantly reacting to new competitive forces. Even among the locally incorporated banks, considerable equity is held by foreign-owned banks, so home town advantages are limited. Finally, the local retail market is dominated by three huge international banks, leaving a small percentage for the remaining banks to contest.

The major factors influencing IS/IT strategic decision making in four selected, locally incorporated, licensed banks are shown in Table 6.3. The business requirements specified include the necessity of providing competitive products or supporting strategic positioning of the bank (many responses) and improvements in the speed and accuracy of processing data. Improvements in productivity were not specifically mentioned by any bank. The necessity, however, for computer systems to process the millions of transactions each week was recognized by all banks. The distinction may not appear to be significant but is mentioned to show that banks have had experience with IT over such a long period that productivity gains from computerized transaction processing may just be seen as the way business is conducted, and not as an additional business need or requirement. Anticipated savings in operational costs due to the introduction of computers was explicitly rejected as a major factor by several banks. This may also indicate sensitivity by banks to the actual or potential concerns of staff.

Regulation of banks is vested in the Hong Kong Monetary Authority. Within a general government policy of minimal intervention in the market, the Authority establishes requirements from time to time which must be met by all banks. An example of these requirements is the establishment of a backup computer site for banking operations. These requirements must generally be met in the medium to long term. Banks varied in their view of the importance of these requirements from imperative (major factor) to rele-

Table 6.3
Major factors in IT decision making: banking

Major factors	*BEA*	*BX*	*LCHB*	*WLB*
Business needs and requirements	1*	1*	1*	2*
Reqs of HK Monetary Auth.			2	1
Financial return	2			
Management Information				3
Operational factors				4

** Includes computing capacity planning to support current systems with high anticipated rates of growth, as well as to support additional business requirements in the future. Also includes recognition of the operational life span of a computer and the necessity for upgrades / replacements in order to meet business needs and requirements.*

vant to the bank's medium and long term plans (a minor factor). For the purposes of comparison with other sectors, the Authority's pronouncements are seen as regulatory requirements which are incorporated into the business requirements of all companies. Financial return includes cost as a factor as well as cost benefit and returns on investment. Operational factors reflected a bank's policy to more closely integrate the operation of existing systems.

There was remarkable unanimity between the major factors in decision making for the utilization of IT in banking and manufacturing firms. Meeting the needs and requirements of the business was the single most important factor in these decisions. The second most important factor in manufacturing was financial return, which was not rated as highly in the banks. It is important to remember that the factors identified by the sites were unprompted, that is the interviewees did not select from a prepared list. In the following tables, bank names are abbreviated accordingly:

BEA:	Bank of East Asia Limited
BX:	Bank X requested confidentiality
LCHB:	Liu Chong Hing Bank Limited
WLB:	Wing Lung Bank Limited.

The full list of company name abbreviations appears in Appendix 1.

Based on the research findings, it is possible to propose an inter-sectoral model of the major factors on which firms base their investment decisions. The inter-sectoral alignment strengthens the findings. As seen in Table 6.4, the most important major factors are the needs and requirements of the business and the financial criteria. The factors are listed in order of importance. The order is subject to variation in manufacturing firms for decisions on production equipment. In this case, operational factors — primarily compatibility with existing equipment — were second to business requirements.

Table 6.4
Inter-sectoral IS/IT investment decision making model

Priority	*Major factors*
1	Business needs and requirements *
2	Financial return
3	Management Information
4	Operational factors

* Includes regulatory requirements.

The major factors identified are consistent with those in Western models for investments in IT. A review of IT decision practices in 80 large companies in the US, UK, Australia and New Zealand was undertaken in 1990. The survey found that the most important factors in decisions to invest in IT were to support business objectives and to meet financial criteria, *in that order* (Bacon 1992). The lower emphasis on financial return was unexpected in banking institutions. It may be seen as a characteristic of the Hong Kong banking services market due to its high financial return. For example, Carse (1993) reports profitability increases in 1992 of between 25 and 45 percent. In 1993, the strong growth continued but at lower levels with average asset growth of 14.4 per cent and profit growth of 16.4 per cent (KPMG 1994). Analysis of the responses indicated that financial return was particularly important for the banks at non-strategic levels of investments. Given the extreme exposure to international competition and the effective absence of barriers to entry, it is not unreasonable that strategic investments in IT are made in support of business imperatives.

Decision making processes

The processes identified are those which sites would adopt in IT investment decisions if making those decisions today. As with the factors, the processes shown incorporate prior experiences. Table 6.5 (at end of chapter) shows there is remarkable unanimity between the major processes in decision making for the utilization of IT in banking and manufacturing firms. This degree of alignment in decision making processes between manufacturing and banking was unexpected. The research question anticipated common purposes in the processes (Parker et al. 1989) but not the common processes themselves.

The major differences between sectors were: the level of involvement of the CEO in the manufacturing firms; increased formality in the bank's processes and differences due to the presence or absence of an in-house IT staff. Manufacturing companies relied on external consultants for systems development and modification, while in-house IT staffs in the banks undertook capacity planning and task monitoring. Apart from some variation in processes by manufacturing firms, depending on whether the system is for production or the office, differences were all considered to relate to variations in firm size and experience in the use of IS/IT. It was not apparent that any other differences related to specific sectoral characteristics which could preclude development of an inter-sectoral model.

The full list of company name abbreviations in the following table is shown in Appendix 1. When considering Table 6.5, it is important to remember that the processes identified by the sites were unprompted, that is the interviewees did not select from a prepared list.

Inter-sectoral IT investment decision making model

Based on the research findings an inter-sectoral model of the major processes for IT investment decision making has been developed. It appears in Table 6.6. The overall objectives in using these processes are the minimization of risk and maximization of return to the organizations when making an IS/IT investment decisions. The objectives and major processes of each phase in the Inter-sectoral IS/IT Investment Decision Making Process Model are described below.

Preparation The objective of this phase is to provide a framework within which future corporate activities may be undertaken. This is an on-going phase which incorporates environmental scanning for the purposes of market intelligence and final identification of promising technologies as well as strategic business and IS planning.

Requirements determination The current and foreseeable future requirements of IS/IT are determined in this phase. Requirements encompass those resulting from: business and IS strategies from the previous phase; increases in capacity of current systems due to incremental growth; and additional capacity due to proposed systems. The capability of suppliers to deliver required products and services and the future directions of their product development are critically examined, as are the levels of financial commitment and returns on investment.

Formal RFPs In this phase a range of potential suppliers is identified. These suppliers are given an opportunity to bid for the business of meeting a firm's requirements. This bidding process is formally accomplished through a 'Request for Proposals' (RFP) or 'Request for Quotations' (RFQ) and subsequent responses from qualified suppliers. The objective is to provide the firm with alternative solutions for its requirements.

Table 6.5
Inter-sectoral IS/IT investment decision making process model

Objective	*Major Processes*
Preparation	Environmental scanning Corporate Strategic Planning Strategic IS Planning
Requirements determination	Capacity forecasting Vendor(s) capabilities reviewed Consultation with user(s) Requirements specified Costs : Benefits identified
Formal RFPs	Candidates determined Preparation / circulation of RFP
Evaluation	Reference site checking Trials Evaluation of product(s) vs requirements
Proposal	Preparation of proposal
Approval	Review / revision with senior management Approval by senior management / CEO / Board (as required)
Monitoring	On-going monitoring of performance and capacity Formal evaluation of investment Technology scanning

Evaluation Proposals from the RFP phase are evaluated for suitability through assessment of the performance of the product(s) proposed in reference sites; performance of the product(s) specifically for the firm in trials; and by comparison of the product(s) or service(s) with corporate requirements. The objective of this phase is to increase the potential for a selected product to meet the firm's specified requirements.

Proposal The major outcome of this phase is a proposal to corporate management for the product(s) and service(s) to be acquired. This proposal is based on the outcome of the evaluation phase.

Approval Subject to the agreement of corporate management and financial delegation authorities, the approval phase may be simple or complex. A proposal for incremental upgrade of existing equipment may be within the delegation of a senior manager and may be quickly approved. A major IS/IT investment program may require endorsement by several levels of management and final approval by the Board.

Monitoring This phase is on-going since it monitors and measures the performance of current IS/IT investments. The objectives of this phase are both prudent management practice in evaluating past investments and the scanning of technological developments to identify products and services with the potential to create strategic advantage.

Variations may occur in the utilization of the processes depending on the significance of the investment. Minor investments may not warrant the costs involved in a full set of processes and production technology typically requires more extensive trials. Note that the inter-sectoral model incorporates a formal process for the evaluation of investments, which is based on the current activities of a third of the sites. This monitoring process is included since formal evaluation of investments is strongly recommended for all firms, if for no other reason than as an input into future strategic IS planning activities. All manufacturing firms and 50 per cent of the banks recommended seeking assistance from a consultancy for various processes. Firms with limited experience in IS are strongly advised to seek assistance. Alternatives to consultancies, each with their own distinct advantages and disadvantages, are assistance from vendors, industry bodies and reference sites.

The major processes identified are completely consistent with Western models of the processes for IT assessment and adoption. Elements of four Western process models — issue driven, technology driven, opportunistic, and normative - were included (Huff and Munro 1985). Further, the processes identified are consistent with tests to judge the effectiveness of decision processes proposed by Parker and colleagues. The processes are project oriented; on a recurrent cycle; working with limited resources; and predominantly using some form of quantifiable decision making criteria (Parker et al. 1989). These authors also propose tests for the subsequent planning processes which may not be directly applicable since their focus is on consensus building within the organization. The strongly hierarchical nature of indigenous organizations in Hong Kong and in many other developing countries may reduce the importance of any process of consensus building.

Decisions not to use IT

The research design called for the examination of decision making to both utilize and not utilize IT. Unfortunately, none of the selected manufacturing companies which participated in the research nor any of the banks were non-users of IT. The selected sites were investigated to determine if they had at any stage considered utilization of IT and had declined to proceed. All but one of the selected sites had this experience. Therefore, the research findings on decisions not to use IT are based on organizations which are experienced users of IT but which have in specific instances decided not to use IT.

Decisions not to use IT - manufacturing

Computer systems are recognized as not providing a solution for every manufacturing problem. Four of the five firms had performed evaluations on IT at various times and had decided not to proceed with its use. In each case the decision was based on the factors and processes previously identified. The reasons given for these decisions were:

> 'Not justified in support of business requirements or cost-effectiveness.'
> 'After investigation they didn't meet business requirements, and didn't meet economic requirements.'
> 'Didn't meet requirements of company and not cost effective.'

The Managing Director of the fourth company explained that they had not declined to invest in IT, but had, 'postponed a decision in order to focus senior management's energies on the part of the business that makes money'. In other words, areas of higher return to the company received priority. The fifth manufacturer was relatively new to computerization and had only experienced positive evaluations.

Decisions not to use IT - banking

Computer systems are also recognized as not providing a solution for every banking problem. All four of the banks had performed evaluations on IT at various times and had decided not to proceed with its use. In each case the decision was based on the factors and processes previously identified. The reasons given for these decisions were:

> 'The optical signature storage and verification system was evaluated and declined as the signatures were not sufficiently clear for Chinese characters.'
> 'After evaluation, we decided it was not suitable. i.e. the cost was too high and the technology was not mature'
> 'The technology was no longer the latest technology.'

'The total cost became prohibitive.'

The reasons given are consistent with the factors specified above, however, cost figured more highly than would be expected from the tables of factors. A higher ranking for the financial returns factor would also be more consistent with both the manufacturing firms and with international experience. Two explanations may be applicable. First, since the banking market in Hong Kong is driven by strong competition and high levels of growth, major decisions on IT investments are made on the basis of survival, rather than financial return. Therefore, major decisions are consistent with the major factors identified. Second, there are many minor IT investments which could be made to support particular products. In these minor decisions, cost and financial returns become more significant. Examples of major investments are the mainframe platform and mainframe backup machines which each cost in the region of US$5 million. Minor investments include optical signature storage and verification systems, automated passbook printers and microfilm storage of internal reporting. Consequently, cost is seen as having a greater influence on non-strategic levels of decision making for IS/IT.

Discussion

In addition to the reasons identified above for firms not utilizing IT, there are other issues which should be considered. Haigh et al. (1990) conducted a survey into computer applications in 66 small scale manufacturing firms in Hong Kong. In that survey 50 per cent of non-using respondents considered computers unnecessary or too expensive. The remaining 50 per cent indicated an intention to utilize. This survey concluded that there were a large number of small firms whose managers/owners were not aware or not convinced of the potential benefits of even low cost computers such as PCs (ibid.). This earlier finding is not supported by the current research. The selected companies clearly understand the potential benefits of IT, but also recognize from experience that those benefits cannot be expected in every situation.

The emphasis on cost effectiveness in the decision not to use IT may reflect the high costs of IT and IT services in Hong Kong. Many articles have noted price differentials for IT between the US and Hong Kong (Riley 1993, Wilson 1993, Wong 1993). The importance of price as a factor in the level of IT utilization is, however, not completely clear. Customer satisfaction surveys of users of mini and mainframe computers show the top 10 concerns do not include price. System reliability, support, and performance aspects are the major concerns (Tennant 1992). While the importance of pricing is not clear, the fact remains that selected companies consistently considered financial returns and cost effectiveness as the second most important factor in decisions to utilize IT. Therefore, the higher prices of IT solutions in Hong Kong cannot be discounted as a significant disincentive for their adoption. Unlike many developing countries, Hong Kong does not suffer from excessive duties on imports of IT. Consequently, price levels are determined by vendor's anticipated returns.

Any examination of decisions not to utilize IT must also consider constraints associated with the nature of the business. The importance of this type of constraint can be seen from the following analysis of production details for cut and sewn clothing firms. In general, 'making cost' is 6-9 per cent of the retail price (Kurt Salmon 1992). Labor costs are 22 per cent of making cost. Half of the industry's workforce remains employed in sewing, and 75 per cent of sewing time is materials handling (HKGID 1991, HKGID 1992). At the same time, manufacturers are operating on very small profit margins. Consequently, while the potential benefits from IT can be clearly identified, it is of critical importance that firms evaluate each proposal for the use of IT and determine the extent to which those benefits can be achieved. As one of the interviewees put it, 'It is easy to spend $1 million on computers, but hard to earn [$1 million]'.

In contrast to manufacturing, there are few, if any, constraints on the use of IT in banking due to the nature of the business. Banking was initially identified as being an industry in which IS/IT could have strategic importance (McFarlan and McKenney 1983). In SISP models, banking is seen as one of the highest potential users of IT due to the high information intensity of the value chain and the high information content of the products (Porter and Millar 1985). This potential has been realized. Spending on IT in US commercial banks was estimated to be US$15 billion in 1990. Investments in IT and telecommunication-based information systems have resulted in the introduction of a wide range of new banking services, a high growth in the volume of banking services, and reduced the cost of processing transactions (Mallampally 1992).

Assessing the impact and use of IT

The impact of IT

When considering the outcome of decisions to utilize IS/T it is important to establish the relevance of technology to the enterprise. CEOs and senior management were asked to identify the perceived impact of their existing computing systems on their organization. The impact was considered for three separate categories of systems: operational, tactical and strategic. Operational systems deal with the day to day operations of the firm, and responses in this category included accounting, payroll, computer integrated manufacturing, CAD/CAM, retail banking and Automated Teller Machines (ATM) systems. Tactical systems deal with the management of operational systems, and responses included management information systems and support for decision making at the departmental level such as 'what-if?' analyses and departmental budget forecasting. Strategic systems deal with the longer term directions and operations of the organization as a whole. Responses were limited in this category of systems, but included ac-

Table 6.6

Impact of existing computerized systems on nine organizations

Level of Impact

Level Of System	*No Systems*	*Low*	*Low - Medium*	*Medium*	*Medium High*	*High*
Operat-ional	—	1 Mfg.	2 Mfg.	—	—	2 Mfg. 4 Banks
Tactical	2 Mfg.	1 Mfg. 2 Banks	2 Mfg.	1 Bank	—	1 Bank
Strategic	5 Mfg. 2 Banks	2 Banks	—	—	—	—

cess by senior management to Reuters and FOREX information systems, CNN and the preparation of ad hoc analyses and reports to support strategic decision making. Table 7 provides a summary of responses on impact.

These results are consistent with several studies of Western firms which show that there is overwhelming emphasis on operational systems and comparatively little use of strategic systems (Li and Rogers 1991). Table 6.7 provides further evidence of the similarities between Asian and Western use of computerized systems.

It is interesting to note that in two manufacturing firms, tactical systems were considered to have a greater level of organizational impact than in some of the banks. This appears to reinforce the point that it is not the sector nor the value of the investment in IT (that level being several orders of magnitude higher in the banks) which determines the importance of computer systems to a company.

In order to support further analysis on the level of impact on their organization, firms were asked if they could run their business profitably and effectively without computer systems. The result was the continuum shown in Table 6.8. This continuum illustrates the capability of IS/IT, even at the operational level, to have a significant and strategic impact on an organization. This suggests that strategic level planning is necessary for the most effective use of IS/IT.

The use of IT

Evaluation of the use of IT was based on interviews with managing directors and senior staff. The key measure was their level of satisfaction with the Information Systems. The companies all considered their IT systems successful and most felt that IT had provided a competitive advantage. Manufacturers found the benefits from production systems readily quantifiable and measurable. This ease of measurement helped to promote their use. Manufacturers found benefits from office systems more uncertain since they are difficult to quantify and measure. This difficulty may retard the utilization of office systems.

Did their systems help increase their competitiveness? One respondent said, 'Yes, in general for both production and office systems. The degree of increased competitiveness cannot be easily quantified, but as far as this company is concerned, the answer is yes.'. Another noted, 'Competitive benefits from production systems are very easily measured. Office systems: yes, but can't quantify.' According to one managing director, the nature of the competitive advantage lay '... in the way in which we are able to standardize processes, obtain expected results and do them all faster'.

A typical response by a bank to the question 'Were their systems considered successful?' was, 'Oh, yes! You must computerize to survive, particularly in processing the millions of transactions each week.'. Banks had no difficulty measuring the benefits of operational level systems but had difficulty once the benefits of the system extended beyond direct financial return in operational level systems. For example, one interviewee noted, 'Cost

Table 6.7
Results to question 'Could you run your business profitably and effectively without computer systems?'

Yes	*Probably*	*Probably not*	*No*
1	1*	1	7*

* *One manufacturing firm considered it could probably run the office systems without computers but could not run its production systems.*

effectiveness is one measure, but not all benefits can be quantified.'. Another said, 'It is easy to calculate the benefit from an operations level system. It is difficult to calculate the competitive benefit or to isolate how much business has been gained.'

Difficulty in measuring the return of IT investments may retard the utilization of more complex and strategic systems. While each company must ultimately determine its own measures of success, assistance in ways to measure success in smaller office systems and in more complex tactical and strategic level systems appears to be necessary. Three of the four banks considered they had achieved competitive advantage through IT. For example, one bank felt they had gained advantage, 'Not over international competitors, but certainly over local banks.'. The second bank noted, 'We have obtained competitive advantage, for example with the ATM network.' The third bank saw many advantages. It noted, 'The first example was soon after the first computer system was installed. More than 40 per cent increase in new customer accounts was recorded after the introduction of the system to enable customers to access accounts from any branch. Previously customers had to go to their domicile branch as this was where their balances were kept.' Finally, the fourth bank did not see any competitive advantage from the use of IT. They saw IT as improving their competitiveness, but not providing an advantage.

Summary of research findings

Based on longitudinal case study of indigenous firms in Hong Kong, SISP models of the factors and processes involved in strategic level decision making to adopt IT have been developed. The aim in developing these models is to provide assistance to other indigenous firms in their use of IT. The uniformity of decision making factors supported the proposal of an inter-sectoral IS/IT Investment Decision Making Factors Model (see Table 6.4). The successful experiences of the selected sites warrant their use as IT role models. Since the Factors Model is based on their common experiences it is strongly concluded that less experienced firms could benefit from the application of this model to itheir SISP decision making.

An inter-sectoral IS/IT Investment Decision Making Processes Model (see Table 6.5) — based on the major processes which were common to the firms has also been proposed. Some variation occurs within firms regarding their decisions for production or office systems, and according to the size and nature of the investment. Variation also occurs between firms depending on their level of experience. Notwithstanding these variations, the uniformity of core processes in all firms is sufficient to support the proposal of a model. Since the Processes Model is based on the common experiences of the selected sites it is concluded that less experienced firms could benefit from the application of this model to their SISP decision making. Finally, factors and processes used in decisions to utilize IT in these Hong Kong firms have been found to be substantially similar to those used in firms in the US, UK, Australia and New Zealand.

Decisions not to utilize IT were found to be based on the same major factors and processes as decisions to utilize IT. Several significant factors and a business constraint were identified which contribute to lower levels of use of IT. Since one of the major factors in decisions not to utilize IT is financial return, the higher prices of IT solutions in Hong Kong or other developing countries compared with the US cannot be discounted as a significant factor in explaining the lower levels of utilization of IT. Findings on this factor, however, were not conclusive. The second significant factor is the perceived lack of availability of suitable IT based systems. This lack was seen in production systems for specific industries, such as woollen spinning and banking. Examples were given of products for which banks perceived demand but which were not mature enough to be considered retail banking products. Finally, a significant constraint on the utilization of IT appears to be the nature of the business. All industries should not expect to achieve the same level of use of IT, nor expect to use IT for the same purpose. Larger productivity improvements in cut and sewn clothing manufacturing, for example, may be gained from improved work practices (such as materials handling) than from investments in IT.

Evaluation of the use of IT was based on interviews with managing directors and senior staff based on their level of their satisfaction with the Information Systems. All of the companies considered their IT systems successful, and most felt that IT had provided a competitive advantage. Benefits from production systems were found to be readily quantifiable and measurable and this ease of measurement promoted their use. However, manufacturers found benefits from office systems more uncertain since they were difficult to quantify and measure. This difficulty may retard the utilization of office systems. Banks found no difficulty measuring the benefits of operational level systems but had difficulty once the benefits of the system extended beyond direct financial return in operational level systems.

The difficulty of measuring the benefits of IT was raised in an IS Research Colloquium (Crawford 1985) and has been the subject of considerable work (Lincoln 1986, Hawgood and Land 1988, Weill and Olson 1989, Kumar 1990, Clemons 1991, Weill 1992). In 1992, Farbey and colleagues found that despite the range of available evaluation techniques, very few were actually used in practice. Therefore, evaluating the success of IS/IT systems based on the level of management satisfaction is not unreasonable. It recognizes that each firm must carefully consider its own situation, define its own requirements and determine if an IT solution is available, suitable and financially viable. Based on the experience of the research sites it can be concluded that simple, relevant, accurate, easy to use techniques for measuring benefits could increase the level of use of IS/IT by reducing the uncertainty of IT investment decision making.

Implications for developing countries

At this point it is useful to compare and contrast the lessons learned from the Hong Kong study with general conditions in developing countries. It is also appropriate to consider whether experiences of firms in the more advanced developing countries such as Singapore, Hong Kong, Taiwan and South Korea represent unique situations, or whether they are a valuable source of role models for other developing countries. This evaluation begins with a comparison of developed and developing countries based on those characteristics most likely to influence use of IT. Major differences between developed and developing countries have been identified by Lu and Farrell (1990). They identified six major factors or areas of difference which can influence the level of IT utilization. This categorization has been supported by a review of existing literature on factors influencing the success or failure of IT in developing countries. (Odedra-Straub 1993). The factors are:

1 economic and social conditions (including wage levels, IT prices and the importance of smaller family owned businesses);

2 political/legal aids and constraints (such as policies with the effect of encouraging or discouraging use of IT);

3 national infrastructure (availability and reliability of power supplies and telecommunications);

4 education (availability of educated and experienced IS professionals and computer literate managers/end-users);

5 cultural conditions; and

6 management practices (planning horizons, centralized autocratic authority, use of specialized staff).

Some of these factors (such as political/legal, infrastructure and general education) require action at a national or regional policy level, while others are within the scope of the firm. In the following discussion it is necessary to consider the relative importance of each of the factors to a particular environment and to note the factors that can be directly influenced by individual firms. A brief discussion of several of these factors follows.

Economic factors

Structure of GDP One of the most important economic conditions is the relative distibution of Gross Domestic Product (GDP) by sector, as seen in Table 6.9. Countries in which agricultural comprises more than 50 per cent of GDP (such as Afghanistan), can be expected to use fewer computer systems than industrial countries. Mixed economies with important agricultural, manufacturing and service sectors (such as India) are likely to have high levels of IT use in some areas and low levels in others. The relative size of the service sector can also influence the level of utilization of IT. Yap and Walsham (1990) argue that organizations with more knowledge and information workers than material workers tend to use more computers. Therefore, countries with very small agricultural sectors and highly developed service sectors such as South Korea and Taiwan (where services comprise more than 60 per cent of GDP) can be expected to have high levels of IT utilization - which they do. (Asia Yearbook 1993).

Wage rates In developing countries, wage levels are lower than in developed countries. Table 6.10 presents an international comparison of labor costs in the clothing industry, which shows that the cost of labor in some developing countries is between 3 and 42 per cent of the comparable cost in the US. Consequently, there is significantly less incentive in developing countries to replace labor with capital intensive technology. Although this will result in lower levels of IT utilization in developing countries than in, for example, the US, it will not necessarily result in lower levels of competitiveness.

Table 6.8

Structure of GDP in selected countries

	Agriculture	*Manufacturing*	*Service*
Afghanistan	79.9	5.7	14.4
Burma	39.5	9.0	51.5
China (GNP)	35.8	48.7	15.5
Hong Kong	0.3	17.2	82.5
India	29.5	20.6	49.9
Philippines	21.3	25.5	54.2
Singapore	0.2	17.4	82.4
South Korea	8.1	27.5	64.4
Taiwan	3.7	34.2	62.1

Source: Asia Yearbook, 1993

Cost of IT IT prices in developing countries are frequently much higher due to transportation costs, duties and tariffs, higher vendor cost structures and lack of competition. (Odedra 1992, Odedra-Straub 1993). Saraswat and Gorgone's (1991) survey of 123 papers presented at international conferences and published in journals found the major perceived disadvantage of IT in developing countries was its high cost. This cost compounds the disincentive to replace labor with technology.

Nature of business Developing countries have a large proportion of small companies, many of which are family owned. Yavas et al (1985) found that smaller family-owned businesses with less formal procedures are less likely to utilize computers. Therefore, it may be unrealistic to expect high levels of utilization in smaller indigenous enterprises. Other constraints due to the nature of business include the greater potential for improved efficiencies from investments in areas other than IT, or the lack of availability of IT products appropriate to business requirements.

Cultural factors

One frequently cited reason for low levels of IT utilization is cultural differences between developed and developing countries (Tricker 1988, Robey et al. 1990, Siddik 1990, Zhang and Angell 1990, Zhao and Grimshaw 1991, Ojo 1992, Ryckeghem 1992, Woherem 1992). It has been suggested that a mismatch between the cultures of developed and developing countries causes the failure of IT systems in developing countries, which in turn impacts the levels of IT utilization. Analysis of papers on this issue can be divided into two major groups: those based on empirical research (Robey et al. 1990, Siddik 1990, Ryckeghem 1992), and those based on anecdotal evidence, personal experience or reviews of literature (Tricker 1988, Zhang and Angell 1990, Zhao and Grimshaw 1991, Ojo 1992, Woherem 1992).

One complication for researchers in developing countries is that they may be restricted from reporting conclusions which are critical of local organizations and management. A review of several cases suggests that culture is being used as a scapegoat for failures which in other countries would be attributed to poor management (Robey et al. 1990, Siddik 1990, Ryckeghem 1992, Cane 1992). This practice appears not only in individual cases but also in nation-wide evaluations of the use of IT. (Zhao and Grimshaw 1991). Reviewers of inter-disciplinary literature - especially reviews by IS researchers (including this researcher) - of literature on cultural differences, also run the risk of attributing too much to cultural factors. One outcome is that conclusions may be drawn regarding the applicability of

Table 6.9
International comparison of labor costs in the clothing industry (Wage Rate in US$)

Hong Kong	*Taiwan*	*South Korea*	*Singapore*	*Malaysia*
2.90	3.50	3.00	2.80	0.95
China	*Philippines*	*Indonesia*	*Thailand*	*USA*
0.25	0.70	0.25	0.65	8.32

Note: All wage costs are in US$/hour and include fringe benefits.

Source: Kurt Salmon Associates, 1992 p A103-4.

Western developed IT which are not supported by empirical research.

The purpose of examining this area is not to discount the rich cultural differences between countries, nor to diminish real problems which may arise in specific instances due to cultural clashes. Instead, a closer examination of the experiences of indigenous organizations in their implementation of IT could lead to suggestions for the improvement of local management practice. Therefore, problem areas in these organizations may require further analysis to identify their root causes. In considering cultural issues, it is necessary to distinguish between ethnic and organizational culture. It is beyond the capability of business to influence ethnic culture, but it can modify organizational culture through appropriate management practices. These management practices include areas such as planning horizons, centralized autocratic authority and the use of specialized staff. These areas are the only major factors capable of being addressed by individual business. A base level of organizational knowledge and experience in IS/IT is a pre-requisite for effective SISP. Once this experience has been obtained, specific management education programs may be required to develop the IT awareness of business proprietors and managers to a level where they understand both the potential strategic benefits of IT and the planning procedures which will assist in its successful implementation.

Conclusions

Given the wide diversity of developing countries and of firms within these countries, the models developed from Hong Kong experiences have been reviewed to identify problems which may arise from their application in less developed economies. Based on Lu and Farrell's (1990) analysis of the factors influencing the adoption and utilization of IT, it appears that Hong Kong and the other 'Dragons' do differ from most developing countries in significant ways. Most important are the Dragons' highly developed service sectors - which contribute to a higher incidence of computer usage - and their relatively higher costs of labor. For example, international comparisons of labor costs in the clothing industry (Table 6.10) shows that labor costs in the US are two to three times greater than in the Dragon countries, which in turn are three and twelve times greater than in other developing countries. Consequently, there is even less incentive in most developing countries to substitute labor with capital. Similarly, the factors identified by Lu and Farrell (1990) which are relevant at the firm level also differ between the Dragon economies and other developing countries. For example, the presence of a highly developed service sector in the Dragons may increase the availability of IT sales and support services.

But while areas of difference may be identified between Hong Kong and developing economies such as the Philippines or China there does not appear to be any intrinsic reason for precluding the application of either or both of the proposed IS/IT Investment Decision Making Models without modification to firms in developing countries, particularly since the models are applied at the firm level. Further research is required to identify any local conditions in a specific country which may restrict the applicability of the models. One significant restriction on the application of management models such as those proposed above is that the managers of local firms may not know these models exist. Thus, management education may be an important prerequisite for increasing the use of IS/IT by organizations in developing countries.

A framework of good practice for SISP decision making by enterprises in Asia's developing countries has been proposed with factors and processes identified and likely benefits listed. It is anticipated that this framework will provide principals and managers of firms in other developing nations with less experience in the use of IS/IT, but who seek the benefits IT offers for increased competitiveness, with assistance in their decision-making activities.

Table 6.10
Major processes in IT investment decisions

Major processes	*HKW*	*PK*	*SHK*	*MG*	*WTG*	*BEA*	*BX*	*LCHB*	*WLB*
Ask friends in industry	X								
Monitoring of technology on-going by CEO / COO	X		X(a)	X(c)	X				
IS Dept advised of firm's future plans						X	X	X	X
Capacity forecasts prepared based on current requirements and future plans						X	X	X	X
Requirements determined (d)	X	X	X	X	X	X	X	X	X
Discussions with vendor on IT able to meet requirements					X	X	X	X	X
Other vendors considered for major upgrades / replacements						X	X	X	X
Computer purchases by competitors reviewed							X	X	X
User divisions consulted as required						X			X
Development of business plan		X(a)	X(a)	X					
Development of technology plan									X
RFP candidates determined	X	X	X	X	X(b)	X	X	X	X
RFP or RF quotes	X	X	X	X	X(b)	X	X	X	X
Evaluate RFP (include trials and reference sites checking)	X	X	X	X	X(b)	X	X	X	X
Prepare proposal	X	X(a)	X(a)	X	X	X	X	X	X
Reviews with senior management	X	X	X	X	X	X	X	X	X
Approval by Mgmt C'tee		X							

Continued from Previous Page

Major processes	*HKW*	*PK*	*SHK*	*MG*	*WTG*	*BEA*	*BX*	*LCHB*	*WLB*
Approval by CEO / Board	X	X	X	X	X	X	X	X	X
Consultant recommends requirements and specs. for office systems	X	X	X	X	X				
Consultant company develops customized office systems	X	X	X	X					
Extensive trials of potential production systems					X				
On-going capacity monitoring						X	X	X	X
Monitoring of IT developments ongoing by senior IS staff						X	X	X	X

(X) Process undertaken by this firm; (a) production systems only; (b) office systems only; (c) CEO is also Chairman of Hong Kong Productivity Council; (d)includes business requirements, functional requirements and consideration of off-shore implications of functional requirements

Note: Unless otherwise attributed, the source of all tables and quotations is Elliot 1994.

Appendix 1 — Abbreviations for Company Names

HKW	Hong Kong Worsted Mills, Ltd
PK	Peninsula Knitters Ltd
SHK	Sun Hing Knitting Factory Ltd
MG	Manhattan Garments (International) Ltd
WTG	Wing Tai Garment Industry Holdings Ltd.
BEA	Bank of East Asia, Limited
BX	BankX requested confidentiality
LCHB	Liu Chong Hing Bank Limited
WLB	Wing Lung Bank, Limited

7 The goal-concern-points technique: a Caribbean case study

Robert Betrand France

Introduction

In developing countries, the problem of selecting and implementing information system (IS) solutions is aggravated by conditions such as inadequate physical infrastructure, limited access to quality information and knowledge about information technologies (IT), limited availability of appropriate tools and skills, limited capital, and lack of local experience. The extent to which these conditions contribute to the difficulty of developing IS's varies among developing countries. Inadequate physical infrastructure can impose severe limitations on IS solutions (Sadorsky 1993). Inadequate and costly telecommunication facilities may make some of the proven technological solutions non-viable. The reliability of electrical power and the availability of quality parts and service also impacts on the type of IS solutions that are feasible in developing countries. The constraints resulting from inadequate physical infrastructure in a developing country often necessitates the use of innovative approaches to selection and implementation of IS solutions.

In developing effective IS development strategies and plans, it is important to have available quality information and knowledge sources, in particular, forms of reusable experiences that are appropriate to the context of the developing country. Such an information infrastructure provides a framework for evaluating and selecting appropriate technologies and solutions. When the information infrastructure is inadequate it can impair an organization's ability to plan and implement an effective IS. Limited access to current technical journals, books, magazines, documented experiences, and experts makes it difficult to carry out an informed determination and analysis of IS capabilities and solutions. In addition, the time between major IS upgrades is likely to be longer in developing countries than in more developed countries. Periods of ten to fifteen years are not uncommon in the service sector discussed in this chapter. Often experiences are not adequately documented. As a result, it is not likely that such organizations will be in a position to reuse previous experiences.

Given the severe constraints under which organizations operate in developing countries, it is critical that the information systems they select and implement closely match their needs in a cost-effective manner. Failure to select an appropriate system can adversely impact the operational and financial health of the organization. Careful attention to the evaluation and selection of proposed system solutions is needed to ensure that the proposed system meets the organization's goals, and that the solution is viable and cost effective. Often IS selection and implementation approaches used in more developed countries require resources that are not readily available, and structures that are often inadequate in a developing country. Thus, organizations in developing countries need to adapt existing approaches or create new approaches that leverage the available resources.

In this chapter, we describe our experiences with upgrading the IS of the St. Vincent Electricity Services (Vinlec), the supplier of electricity in St. Vincent and the Grenadines. In particular, we describe the Goal-Concerns-Points (GCP) technique developed and used in the evaluation of proposed system solutions. The technique provides a disciplined approach to system evaluation that focuses on how well proposed solutions match the stated goals of the organization. The GCP was developed in the context of the Vinlec project and thus is based on the resources that were then available to the project. These resources are typically available to most service-oriented organizations in the Caribbean.

In the second section, we summarize our experiences with analyzing Vinlec's IS needs. The analysis resulted in a set of recommended goals for the new IS. The third section describes the GCP technique and shows how we applied it to the evaluation of proposed IS solutions. In the fourth section we outline the strengths of, and some problems with, the GCP technique. The final section concludes by outlining our plans for further developing the technique.

Analysis of the IS

Vinlec is structured around three divisions: Financial, Engineering, and Human Resources (HR). The Financial division is responsible for customer services, accounts receivable and payable, and inventory. The Engineering division is responsible for electrical generation and transmission systems, and the Human Resources division is concerned with hiring and training, maintaining employee records, and environmental health and safety matters. Both the Engineering and Human Resources divisions are located at a site that is approximately six miles from the site of the Financial division.

In 1990, Vinlec carried out an analysis of their current IS. They were experiencing a number of problems with the system, mainly related to its memory and communication limitations. The IS was then based on a batch processing system centered on a ten year old minicomputer (henceforth referred to as the main computer), and focused on producing customer bills and processing payments. The main computer was housed in the Financial division. Computing resources for the Engineering and HR divisions consisted mainly of personal computers running word processing, statistics, database, and spreadsheet packages. There was no electronic communication link between the main computer and the personal computer systems at the site of the Engineering and Human Resources divisions.

The objective of the analysis was to provide Vinlec's management with clear recommendations for a new IS structure. Management made it clear that the intention was not to replace the existing IS with a new system that simply supported the existing work environment. Instead, Vinlec's management was interested in adopting new technology that enhanced worker productivity and quality of service.

The analysis process

The analysis was carried out over a two month period. An informal steering committee consisting of the General Manager and the Financial Controller was set up to guide the analysis, which was performed by an independent consultant (henceforth referred to as the analyst). The analysis process consisted of the following four phases:

Determination of Analysis Goals (Phase 1): The goals of the analysis were identified during meetings with members of the steering committee.

Information Elicitation (Phase 2): The consultant carried out a number of interviews with key Vinlec personnel (identified by the steering committee and other employees), and examined system documentation.

Consolidation and Modeling (Phase 3): As information was collected, the consultant modeled his understanding of the system. This involved consolidating the information collected, analyzing it, and incorporating new insights into the models. As more was learned about the system the models became more precise.

Analysis of System (Phase 4): The models of the system were analyzed and validated, and solutions proposed.

The above activities were not carried out in a strictly sequential manner. Rather, the process was iterative. For example, Phases 2, 3, and 4 were carried out for a single department or group of departments, and then repeated for another department and a larger group of departments. During the entire process, the goals identified in Phase 1 were refined by the steering committee. The iterative nature of the process is consistent with similar experiences in both developed and developing countries (see Robey, Gupta, and Rodriguez-Diaz 1990 for an account of experiences in a developing country). Below is a summary of the most important guidelines to emerge from our experiences with the analysis process:

1 It is important to gain the cooperation and confidence of the employees. The steering committee ensured that key employees were informed of the purpose of the analysis. It was made clear before and during the interviews that the analyst was not evaluating the performance of individuals, and that the focus was on improving the working environment and not eliminating jobs. In general, Vinlec's employees understood the objectives of the study and this made the interview process easier.

2 It is important that interviewed employees feel that they are contributing to the process of change. During interviews, employees were encouraged to suggest improvements to their work environment. After each interview the consultant consolidated the information and presented the result to the interviewed employee for review. This not only served to confirm the consultant's understanding of the information obtained, but also provided the employee with evidence that their input was valued.

3 In modeling the system, it is important to use notation and terminology familiar to employees. This makes it easier to obtain feedback about the models. In this respect, the analyst maintained a personal dictionary/thesaurus of terminology used in the environment and used the terminology in all models presented to employees.

4 Graphical models were more effective than textual models. The consultant found that data flow diagrams (DeMarco 1978) with some customized notation and system flow charts were effective communication aids.

5 It is helpful to have a basic understanding of an employee's job and some idea about the employee's experience before going into an interview. With such information the interviewer can tailor the interview to the characteristics of the employee. This is helpful in focusing the interview. Pre-interview information was obtained from job descriptions and from the employee's supervisors.

6 In carrying out interviews within a department it is useful to start with a brief interview of the department's head, followed by in-depth interviews with department employees, and close off with an in-depth interview with the department head. The objective of the initial interview with the department head is to get a general overview of the de-

partment's activities. The more in-depth interviews with employees serve to supply the details of these activities. In each interview the employee was typically shown a graphical model — for example, data flow diagrams — reflecting the consultant's current understanding of the department's activities and emphasizing the interviewed employee's job function. The employee was then encouraged to add details and/or point out inconsistencies in the analyst's model. Employees were also encouraged to point out problems such as bottlenecks and to suggest improvements. The detailed model of the department's activities obtained as a result of these interviews then was used as the basis for a more in-depth interview with the department head.

The success of the analysis at Vinlec can be attributed to the efforts made to involve key employees in all phases of the analysis. The employees awareness of the study's objectives and their feeling of direct involvement in the change process contributed to the level of cooperation experienced.

Problems identified by the analysis

The analysis identified a number of problems with the existing information system. Some of these problems are outlined below.

Limited growth potential Vinlec's customer base had increased to the point that current files were straining the storage capacity of the system. Projections on the customer base indicated that the system's capacity would soon be exceeded. Furthermore, the system could not support additional workstations and other peripheral devices. Lack of support for new applications was also a growing concern. Employees were becoming increasingly aware of the variety of ways computer systems could be applied to their work. This was particularly true in the Engineering division, where demands for improved computing support for engineering activities were frequent. Engineers trained in universities and other training institutions were exposed to automated tools that could make them more productive in their work environment. Such tools often did not exist on the system. There was also a heightened awareness of the potential benefits personal computing could bring to the work environment. Unfortunately, the existing system could not adequately support personal workstations with the desired processing capabilities.

Proliferation of personal computer systems As pointed out above, there was an increased demand for additional computing resources which resulted, in some cases, in the acquisition of personal computer systems. It was fairly obvious that Vinlec was suffering Stage 2 of the Nolan stages theory as described in Kant (1984). Individual departments were acquiring computer systems, and while the individual purchases were justified on department-level cost/benefit grounds, less attention was paid to investment optimization across departments and divisions. As demand increased, management became concerned with questions such as: Are the new acquisitions consistent with Vinlec's mission and operating objectives? What is the return on investment? Issues related to compatibility of files, and software were also raised by management and employees that shared information with other departments. The decision by Vinlec's management to carry out a study of its information processing needs reflected a desire to gain greater control over computing resources.

Poor communication facilities Information shared by the Engineering, Financial, and Human Resources divisions were often stored on separate systems in incompatible formats. Transfer of data between divisions was exacerbated by their geographical separation. Data was transferred physically between the two sites because there was no electronic communication link between the systems at each site. In some cases, the information retrieved from one site had to be manually entered into a computer system at the other site.

Outdated work procedures The existing batch processing system could not adequately meet Vinlec's goals of increased worker productivity and heightened quality of service.

Results of the analysis process

The result of the analysis was a set of goals for the new IS. The major goals were:

Growth potential The new system should be able to respond to new hardware and software technology without changing the entire system.

Improved coordination of functions The system should enhance coordination of functions across the Company's divisions.

Improved quality of service Customers should perceive an improvement in the quality of services provided by Vinlec.

Increased productivity The system should facilitate more efficient work processes.

In the next section we outline how the goals were used to develop a set of system-level concerns which was used to evaluate proposed system solutions.

The Goal-Concerns-Points (GCP) evaluation technique

After the analysis, Vinlec invited selected vendors to propose solutions to their problems. The vendors were given information on the existing system including the analysis report and invited to visit Vinlec's sites. This resulted in the submission of two proposals. Vinlec then undertook an evaluation of the proposals.

A number of objective approaches to evaluating IS solutions have been developed in the context of more developed countries. Some of the popular approaches are based on the Return On Investment (ROI) concept, where the impact of the IS solution on the return on investment is assessed. The appropriateness of ROI-based evaluation techniques has been questioned recently by Hochstrasser (1994) and others. The inability of such approaches to effectively measure non-tangible IS benefits is seen as a serious shortcoming. It is often argued that a more appropriate evaluation approach is one that measures the extent to which IS solutions match organizational goals (Willcocks 1994).

In Kant's (1984) book the following deceptively simple approach to IS solution evaluation is suggested: 1)determine the decision criteria, 2)establish the relative importance of each criterion, and 3) rate solutions on how well they fulfill the criteria. Although the process structure is simple, the sub-activities are not necessarily easy to carry out. The approach we used can be viewed as an adaptation and an elaboration of Kant's process. The proposed IS solutions were evaluated using the Goal-Concerns-Points (GCP) technique. This technique is based on the Goal-Question-Metric (GQM) approach, used for analyzing the goals of a software development project, developed at the University of Maryland (Basil and Rombach 1988).

In the GCP technique, goals are broken down into sub-goals, each of which may in turn be further decomposed into sub-goals. This decomposition process continues until the goals can be expressed in terms of a set of independent system-level concerns. These concerns are then classified and grouped, and each concern is associated with a range of points, where a point is a subjective, relative measure of the extent a proposed solution addresses the concern. The GCP technique provides the direct traceability of evaluation criteria to IS goals, and is thus more likely to result in the selection of a solution that best fits the goals. The relationship between goals, sub-goals, and concerns is not necessarily hierarchical. Some concerns may be related to more than one sub-goal or goal. We refer to the structure of goals, sub-goals and concerns as the *GCP network.* In practice, the development of the GCP network is not necessarily strictly top-down. There may be some system-level concerns initially stated as goals and later connected to other high-level goals.

Figure 7.1 describes the evaluation process used in Vinlec's evaluation. Figure 7.2 shows a partial GCP network for the goal of 'Increased Productivity'.

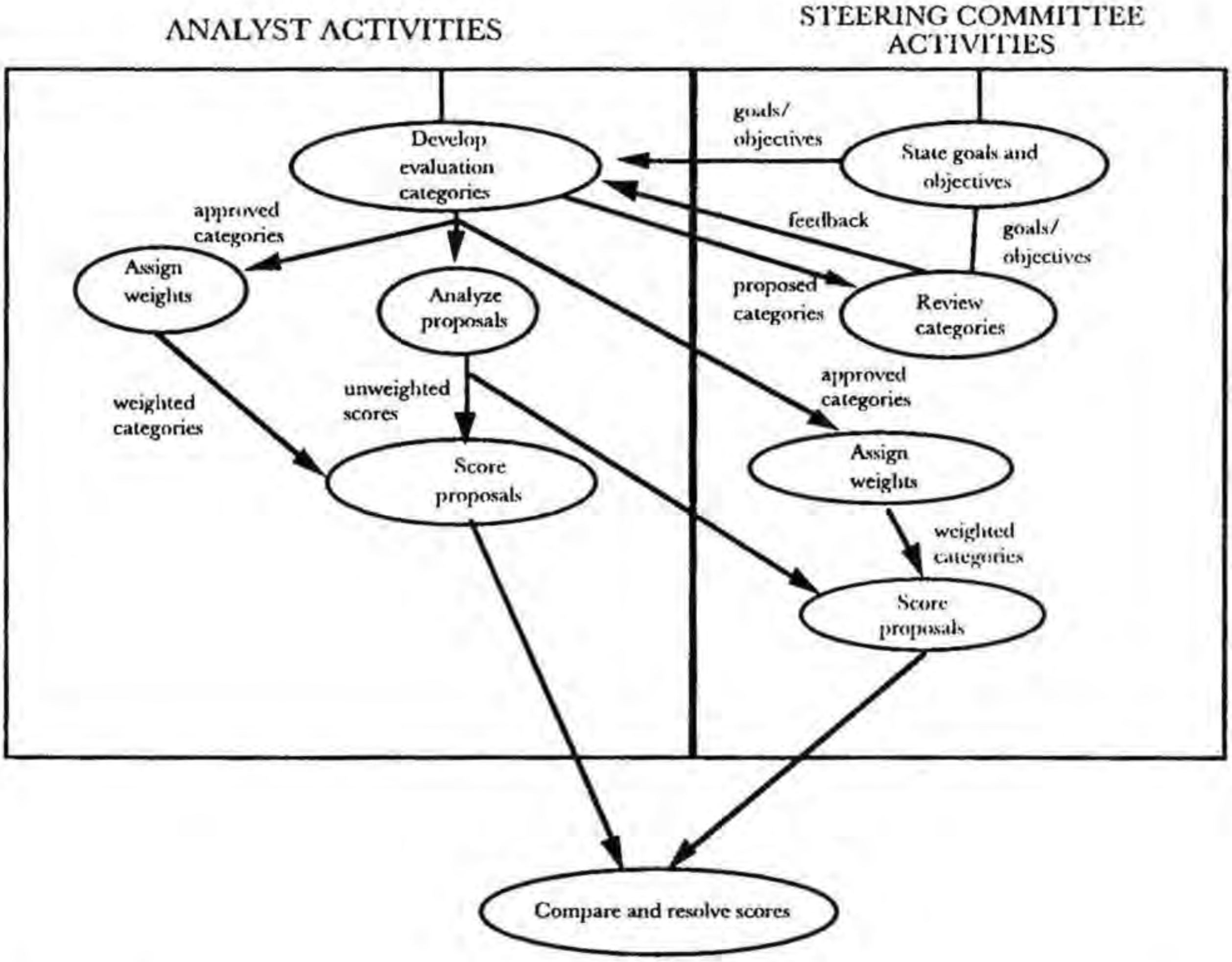

Figure 7.1 Evaluation process model at St. Vincent Electricity (Vinlec)

The process guiding the application of the GCP technique can be more generally described as follows:

1 Determine organizational and IS goals.—(i. Analyze the current system (the analysis process described in the previous section can be used here); (ii). Elicit organizational goals from management.

2 Using the goals identified in previous steps, identify IS specific concerns (requirements) and refine to concerns that can be readily identified as relatively independent features of IS solutions. As this is being done, maintain relationships with goals and higher-level concerns.

3 Using the network, classify and group concerns and associate point ranges with bottom-level concerns and major groupings.

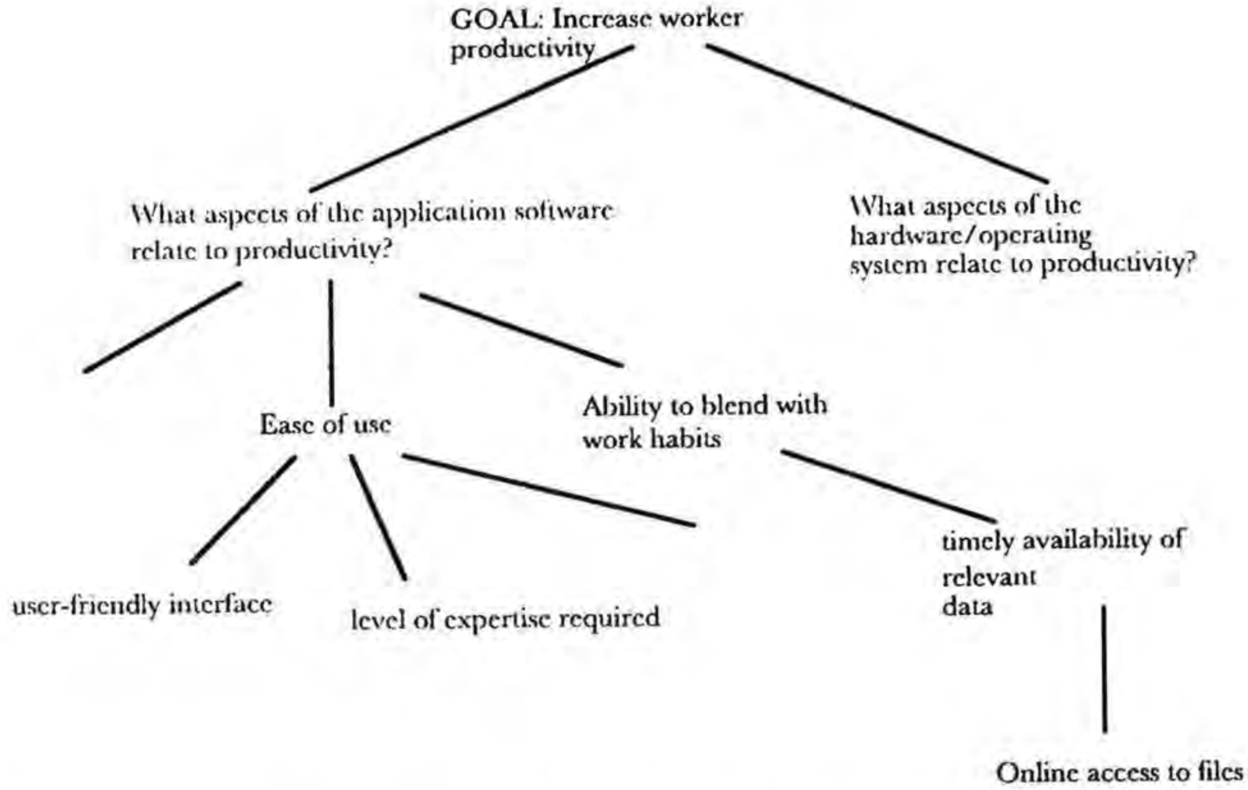

Figure 7.2 A partial Goal-Concerns-Point (GCP) network

4 Assign weights to each group of concerns associated with a point range. The weights characterize the IS priorities of the organization. Assignment of weights by more than group of persons is preferred, so as to minimize the effects of biases.

5 Assign points, apply weights, and tally scores.

6 Compare scores obtained from different groups of persons. Resolve major discrepancies. Resolution may involve going through another round of weight assignments and score calculations.

Using the GCP technique we derived a large number of concerns, thus there was a need to organize them into categories. The following were the final categories we used:

1 Capacity to meet system requirements: The concerns in this category relate to the hardware and software needs. Examples of concerns in this category are: type of network topology (star, bus), adequacy of proposed storage (upper limits), transaction processing performance, support for attaching PCs, type of file system, and printing capabilities.

2 Capacity to meet future system requirements: These concerns pertain to the system's growth potential and address issues such as limits on attached peripherals, communication related limitations, and support for incorporating anticipated new technology.

3 Required applications: These concerns address qualities of required software (Billing, Payroll, Inventory, database software).

4 Conversion and Installation: These concerns relate to the conversion and installation procedures and their impact on the working environment.

5 System management: Examples of concerns in this category are quality of staff required to manage the system, and quality of system administration software.

6 System qualities: This category consists of concerns related to system reliability, availability, security, and maintainability.

7 Training and documentation: The concerns in this category pertain to the type, availability and location of required training, and to the adequacy of the documentation supplied with the system.

8 Contractual relation: Concerns in this category pertain to the nature of the contractual relationship between the company and the vendor.

9 Operating environment: Concerns in this category pertain to special environmental conditions required for the proper functioning of the system, for example, wiring, temperature, and space requirements.

Concerns that did not fit into any of the above categories were put into a category called 'Other'. The initial set of categories was developed by the analyst and reviewed by the steering committee. After the necessary changes were made the steering committee and the analyst independently assigned weightings to each category and sub-category reflecting their perspectives on the relative importance of each category. The analyst then analyzed the proposals using the final set of categories. The analysis resulted in the production of evaluation score sheets, one for each proposal, in which points were assigned to each concern reflecting the degree to which the proposal addresses the concern and the viability of the solution in Vinlec's environment.

The evaluation score sheets were then passed to the steering committee which applied weightings to the sum of the points in each sub-category and category. The analyst also applied his weightings independently. The analyst and the steering committee then met to discuss and resolve differences in weightings and to select a vendor. In this particular case, the weightings applied by the steering committee and the analyst were very close, reflecting that both had consistent views of system goals.

The GCP technique was developed in response to a need for an objective evaluation approach. In evaluating the IS proposals the evaluators found it difficult to objectively match broad goal statements to system features. This made justification of system features more of an exercise in `hand-waving' than in reasoned judgement. Given the cost associated with implementing the solutions and the criticality of the IS to Vinlec's mission it was imperative that a selection be based on more solid grounds.

In developing countries the price of implementing an inappropriate IS is more likely to be higher than in more developed countries. When an inappropriate IS is implemented, subsequent effort is needed to align the system to organizational- and system-goals. This is in addition to the effort needed to evolve the IS to meet changing goals. In developing countries, such activity may require frequent communications with overseas vendors, purchases of parts not readily available within the country, and costly on-site fixes carried out by experts from overseas. Furthermore, an IS that is not aligned to organization goals can severely impair personal and organizational productivity. Some developing countries may not be in a position to shoulder the burden of such costs. For these countries it is worth determining from the start of an IS development project the extent to which proposed IS solutions meet the intended goals.

The GCP technique makes clear the connection between organization-level and system-level goals, and features described in IS proposals. The resulting goals-features structure is used as the basis for evaluating IS solutions. Achieving all the goals may not be possible in most circumstances (achieving one set of goals may sometimes have a negative impact on another set of goals), thus it becomes important to rank the goals in order of importance. This is achieved in the evaluation by assigning weights to the category of features associated with a goal (or a set of goals). A goal may be decomposed into lower-level goals and it may be necessary to rank these lower-level goals as well, thus weights may also be assigned to sub-category of features.

The degree to which an IS solution implements a feature is recorded by a value (points) taken from a scale of values (e.g., 1, 2, 3, where 1 is poor, 2 is marginal, and 3 is good). The assignment of weights and values is a subjective activity and we advise that more than one person carry out this activity. Any significant differences should be analyzed and another round of assignments should take place. The iteration between assignments and analysis activities should continue until the assignments converge within some specified boundary.

Strengths and weaknesses of GCP

The GCP technique can also be used to assess the adequacy of currently installed IS's. An organization can check whether an existing IS is meeting its system goals by developing a set of concerns for the system and scoring the system against them. The evaluation will point out goals that are adequately addressed by the IS, and more importantly, identify deficiencies. The ability to trace system-level concerns to goals, and vice-versa, allows one to assess how closely an IS matches its stated goals. It is not likely that an IS will satisfy all goals completely, but it helps to have some indication during selection of how far it satisfies the goals. Management is thus aware of some of the deficiencies in a selected IS solution and can plan accordingly.

Identifying concerns, and distinguishing between concerns and goals are not easy tasks. However, there is no real need to make a distinction between concerns and goals since concerns can be thought of as system-level goals. Deciding when to stop decomposing goals is a matter of judgment. When concerns that are relatively independent of each other are obtained, one should start considering cut-off points. In our application of the technique we used the proposals to determine the cut-off point; when we reached a relatively independent concern that could be assessed directly from information in the proposals then we went no further. This meant, of course, that we had to normalize the proposals, since they did not contain the same level of detail. To normalize the proposals we sent the vendors drafts of our categories and asked them to provide any missing information, and/or additional features that they thought might address the concerns. The result of this activity helped to clarify some of the information in the proposals. Furthermore, the vendors were better able to provide relevant information about their proposed systems, given the concerns. This suggests that it might be worthwhile to provide vendors with a GCP derived set of concerns at the time proposals are requested.

Another problem with the technique is the difficulties involved in managing a large number of concerns. The GCP network can become large and complex fairly quickly, and somewhat difficult to manage manually. To alleviate this problem we started to identify categories of concerns early in the process, and referred to the categories (of which there were a small number) rather than the concerns in the GCP network. We also maintained a separate list of currently identified concerns for each category. As decomposition progressed categories were added, redefined, and decomposed.

The breakdown of goals to system-level concerns and the assignment of points to the concerns requires expert knowledge of the available technology and awareness of the information system constraints of the developing country. It is also very easy for biases to creep into the evaluation approaches, given the subjective nature of point assignments. We suggest that organizations that wish to use the GCP approach use an independent evaluator, and carry out independent weightings, as was done in the evaluation described in this chapter. Differences between the independent evaluator's final score and the score assigned by the organization (based on their weightings) may suggest hidden goals and/or biases which may need to be discussed openly.

A weakness of the current GCP approach is that there is no cut-off total score below which a proposal/system is considered unsatisfactory. We are currently working on incorporating this feature into the technique. Another problem with the GCP technique is that it does not adequately take into consideration risks. In evaluating solutions, risk analyses provide additional insights into the robustness of proposed solutions and into the costs associated with handling problems that may occur as a result of implementing and using the solutions. In our evaluation, the risks were implicitly considered while assigning points to concerns, some of which were documented as part of the evaluation approach. However, this is not a satisfactory approach since it does not provide enough information to determine the coverage of the risk analysis, nor does it provide explicit documentation of the cost of risk management. We are currently working on extending the GCP to explicitly include risk analysis. In this respect, we are looking at incorporating formal risk analysis techniques, based on ideas described in Charette (1989) and others into the evaluation framework, and having explicit documentation of the costs associated with managing risks for each solution.

Conclusions

In general, the GCP technique can be applied in goal-driven environments in which there is are significant costs associated with badly-aligned ISs. While the use of the GCP does not guarantee a perfectly aligned IS, its use is more likely to make management aware of the degree to which proposed solutions meet their goals, and thus be in a better position to make an informed selection decision.

An important ingredient to the successful application of the GCP is explicit expression of well-defined organizational and system goals. Medium to large size businesses can benefit from the use of the GCP, since goals tend to be more well-defined than in the case of government agencies and departments. Governments can use the GCP to evaluate IS solutions for well-defined problems or projects. On the other hand, the application of the GCP technique can result in a better understanding of the goals that a system should satisfy. In such situations the goal structure can also be viewed as a major result of the activity. Within the context of IS-related projects involving a number of government agencies, and in which the relevant goals are not initially obvious, the GCP technique can be used to develop and document a goal structure that consolidates concerns that are relevant to the project. Using the GCP one can identify goals that conflict (expressed in terms of features that are incompatible with each other, e.g., incompatible data organizations), thus making it possible to resolve conflicts before implementation.

The assignment of points and weights to categories and features identified in a GCP hierarchy requires expert knowledge of goals that are relevant to the project and the technology associated with the features. The assignment of points and weights should be undertaken by groups that include expertise in both aspects. In the context of government agencies, the IS department (or the Data Processing Department, as it is still called in some developing countries in the Caribbean) can provide the necessary expertise on technology, while the project managers can provide the expertise on the goals. In fact, we envisage that for government projects, the IS department (or its equivalent) will play a major role in evaluating proposed IS solutions for government.

The need for technology experts may be viewed by some as a stumbling block in the use of the GCP technique in contexts in which such expertise is not readily available. On the other hand, a technology expert should always be consulted when evaluating IS solutions. The GCP technique provides a more focused utilization of expert resources in that it provides a framework (in the form of the goal structure) for carrying out the evaluation. We realize though that the cost of bringing in experts may be prohibitive to some organizations in developing countries. One way of minimizing the need for expert knowledge is to codify such knowledge and make it available as an expert system. This may be possible for vertical domains of knowledge which are very mature, that is, in which there exists a considerable amount of development experience from which clear relationships between goals and features can be extracted and reused. Examples of such domains may be inventory, accounting, and vehicle management systems. We are currently investigating GCP automation possibilities based on the codification of expert knowledge for utility organizations.

Continued assessment and development is necessary to ensure that an IS continues to satisfy ever-changing organizational goals, and to take advantage of new technologies. Since the study, Vinlec has recognized the need for continued assessment and development of it's IS, and has appointed an Information System Administrator charged with directing the development of its information system. At present, the Administrator reports to the Financial Controller, but has a line relationship with divisional heads.

We are currently improving the GCP technique and developing automated support for its use. We have applied this technique only once, but the experience we gained indicates that it is an evaluation technique that can be effectively applied in organizations within developing countries. There is a need for further experience that can only be gained through the application of the technique.

Our experience indicates that the GCP technique encourages management to explicitly state and refine information system goals. An automated, expert tool that allows management to define and refine their goals, using expert heuristics, can only enhance the use of the GCP technique. It is also possible that such a tool can also provide automated support for assigning points to concerns based on a well-defined, codified characterization of the organization's IS environment. Such a tool may minimize the need for an expert evaluator.

Part II

PRACTICAL CHALLENGES (CASES)

8 Computers and culture: cases from Kenya

Dominique Van Ryckeghem

Introduction

Although Sub-Saharan Africa (hereafter referred to as Africa) is still the least computerized continent, the number of computers acquired in these countries is rapidly increasing (Odedra et al., 1993). However, unlike other countries — such as Brazil, South Korea or India — that are both producers and users of information technology, African countries remain users. Information technology, particularly the computer, is not culturally neutral; it often reflects the nature of the country that developed or manufactured it. Computer technology assumes a particular (rational) world view and an individualized approach based on values such as efficiency, rapidity and functional rationality. Since African nations are primarily *importers* of information technology, many factors have influenced technology transfer and application. In addition to institutional and managerial problems,[1] users constitute another important factor which affects appropriate technology use.

The purpose of this chapter is to explain what 'happens' when computer technology is used in an African setting.[2] African social practices and cultural values differ markedly from Western practices, and as a result, are likely to impact African users' attitudes toward computers. This chapter examines the relationship between culture and computer technology use from both a theoretical and practical perspective. From a theoretical perspective, the relationship between various elements of culture — such as world view, socialization, the role of hierarchy, oral tradition, time conception , communalism, etc. — and computer use is examined.

Based on this analysis, a general, analytical model is proposed to explain how culture affects technology implementation and use. The model comprehends the relationship between culture and technology use on three levels: 1)culture influencing technology use, 2)technology use influencing culture, and 3)culture mediating technology utility. This model is then applied to the specific question of computer use in an African setting. Daily observations of computer use and interviews with 150 Kenyan users provide the empirical basis for this analysis.[3] Particular attention is given to the impact of Africa's cultural heritage on the behavior and attitudes of African computer users. The chapter concludes with general observations about the effect of culture on technology use and specific policy recommendations for African nations attempting to ensure more effective use of information technology.

Western culture and technology development

Western civil society as we know it today is the result of 'modernization' which consists of two fundamental processes: *rationalization* and *structural differentiation* (Zijderveld 1983). With the decline of medieval society, the rational construction of a free society became the principal objective of modern society (Lemaire 1976). Man would not only master nature but decide on the form of society as well. The bare foundations for this rational attitude were established by the Greeks. They distinguished *physis* (nature) from *nomos* (law, institution) — a distinction between what exists spontaneously and what is made by men (the world of customs and institutions, of norms and values). By separating these two realms, magic could endure in one sphere, rationalism in another.

Though the rationalization process is rooted in Greek civilization, Western civil society broke with all previous types of society through another process: the predominance of the economic sphere (Lemaire 1976). Participation in the economic sphere meant that abstraction was made from other aspects of the human experience, as for instance the family or aesthetic or religious experience. Freed from all links with non-economic activities,the 'economic' was allowed to develop in a optimal way. People could now meet and interact as economic subjects only — as producers, owners or sellers of goods, working people, etc. Additionally, all human activities came to be performed in a more isolated way while economic activities dominated. The substantiation of the economic had transformed total human existence, as it became subdivided in different, heterogeneous spheres through the process of structural differentiation. The work sphere, for instance,became different from the family sphere, the leisure sphere, and so on.

Among other things, the rationalization and structural differentiation processes gave rise to a particular world view. Modern science for instance is built on the belief that nature can be questioned by way of experiments, and that only information perceived by the senses is a valuable source of knowledge (Prigogyne and Stengers 1990). The mechanistic approach of modern science belies an emphasis on critical discussion and verification.

This world view contains a particular conception of time. First, time is linear: it is segmented like a road or a ribbon extending forward into the future and backward to the past (Hall 1981).[4] Second, time is abstract: it has been separated from concrete action. As a result, time has become a kind of resource while action has become a way to spend time. Time may be spent in order to acquire money, knowledge, power or love. When time has not been spent, the promise still remains to acquire or become all those things. In this respect, Westerners believe that they enhance their potential or possibilities for action by doing everything in a fast way. They 'save' time; inertia is contrary to prevailing norms (Elchardus 1994, Luhmann 1982, Zerubavel 1980).

Rationalization and the predominance of the economic have had implications for the life style of individuals. For one thing, human beings have become more 'atomized' (Zijderveld 1983, Lemaire 1976). Since a person is believed to be free and to act autonomously, he may acquire worldly goods through a free trade relationship with other autonomous subjects. For another, the relations between people become more abstract. They learn how to restrain their impulses and emotions and delay their satisfaction. Coupled with a linear concept of time, this encouraged people to think in the long term (Elias 1982). Finally, functional rationality — the rationality of means and procedures applied for the realization of a specific goal — as a pattern of meaning, is the logical outcome of a 'rational' culture where the economic predominates. Efficiency is the key to a particular work ethos where the individual performs according to his capabilities and responsibilities, while functionality is the key to understanding the reconstructed linkages between the differentiated life spheres.

Technology may be defined as the materialized application of science and/or knowledge. Technology (development) is culturally determined (Pacey 1983). Science as a separate life sphere, including the presence of specialists who adhere to a culture of experimentation and verification has enabled the construction of sophisticated technologies. The urge for efficiency is characteristic for all Western type technologies.

Computer technology is at the heart of cultural determination since it is a form of codification of theoretical or intellectual knowledge laid down in machines and procedures (Frissen 1992). Originally designed to enhance productivity per time unit (reflecting a linear time concept), its procedural nature also demonstrates the presence of 'functional rationality'. Further, with the transition from mainframe and mini systems to micro-computers, values such as autonomy and initiative have been incorporated into the apparatus' architecture (Jouet 1989). Following this 'cultural' transition, the user has become much more important. It is his/her choice to approach the machine in a 'game like manner', or to ignore the available potentialities such as autonomy, flexibility and interactivity. Those characteristics, together with the urge to control, and the striving for perfection, form the core of the cultural characteristics of computer technology.

Culture, however, is not a unified pattern. Designers and users of technology may have conflicting values that emerge at the moment of implementation and/or actual use. This section examines two practical examples that illustrate the importance of the user's perspective and how this perspective is related to culture.

Example 1: The Videodisc in Western culture

The first example — the 'videodisc' — is based in part on Flichy's (1991) study. In 1980, RCA prepared to launch its videodisc. The American press could not stop praising the system for the individual consumption of images. For example, Business Week predicted that the videodisc market would grow quite rapidly and soon surpass the videocassette. This early optimism was shared by a number of financial experts, since the videodisc did not seem to have any major technical problems and the price of the player was about \$500. The price of VHS (videocassette) recorders, which had appeared in the American market in 1979, was still about \$ 1,300 dollars. Thus, in 1980 it was reasonable to conjecture that there would be a large market for a product that, although not having precisely the same functions, was priced decidedly lower. RCA conducted market studies which predicted sales of 200,000 units in the first year, 800,000 in the second, and 2,000,000 in the third. Moreover, a large promotional operation (budgeted at \$20 million) was planned.

After three years of effort, however, only 500,000 videodisc players had been sold. The losses of the operation were \$600 million, making it perhaps the biggest commercial failure in the history of communications. How could this have happened?

First, on the demand side, the firm ran into unexpected competition from videocassettes. Confronted with an abundant flow of largely redundant television programming in the late 1970s, North American television viewers wanted to be able to chose the time they watched television. As a result, the 'family' videocassette recorder had an advantage over the videodisc. However, initially the cost of reproducing videocassettes was too high to create a viable market for the sale of prerecorded cassettes. That being the case, the videodisc looked like the publisher's only choice. But, contrary to expectations, a system of videocassette rentals was established that permitted the birth of a true market. Second, on the supply side, the management of the relationship between the development of players and of videodiscs also proved to be deficient, since purchasers of the hardware bought more software than had been predicted. This caused problems because the difficulties RCA had distributing the player, inhibited investment in manufacturing the disks. In short, American TV-viewers (the users) rejected the videodisc while the distribution of videocassettes and recorders have grown continuously.

Cultural elements such as the autonomy of the user, individualism, importance of leisure time, or technology mindedness may explain this outcome. The question remains however, precisely how the interaction between culture and technology use takes place. In general, culture may be said to influence technology use and vice versa. But apart from being a variable that influences (and in turn is influenced), culture also plays a mediating role in the perception of technology's utility.[5] The following model interprets the videodisc story against this background.

Level 1: Culture influences technology use The differentiation between work and leisure time, the importance of the family sphere as opposed to the work sphere, encourages particular social practices such as TV viewing. Together with receptive attitudes towards new items or tools, Western culture provided a fertile soil for both videocassette and videodisc. However, the overall acceptance and extended use of video, and the rejection of videodisc suggests that another cultural characteristic was involved — the autonomy of the viewer (user). In this respect, the utility of video and videodisc was perceived very differently.

Level 2: Culture mediates the utility of technology use Video provided the user with a vital (but unrecognized) social value — 'viewing autonomy' and the ability to manage time (Burgelman 1992). Hence, the VHS machine provided the means to organize leisure time in an efficient way (functional rationality). Although videodisc was a cheaper, more sophisticated technology, it could not provide the advantages video offered.

Level 3: Technology use influences culture Incorporation of new tools may inhibit new social practices and/or give rise to particular attitudes such as a change in viewing habits or the appreciation of leisure time. Rental of videocassettes and the subsequent extensive use of video probably contributed to the expansion of the 'TV culture', while private households also began to acquire video camera's as leisure items. In other words, new social practices emerged from the combination of TV with video and video camera's.

If the relationship between Western culture and a Western type technology is a complex matter, the compatibility between African culture and a Western type technology must be considered a 'black box'. The preceding model, however, can be a useful tool to gain insight into the concrete interaction between African culture and Western technology as the following example borrowed from Ackermann (1981) illustrates.

Example 2: Gas stoves in an African culture

Around 1975, the Senegalese Government wanted to promote the use of gas stoves in urban dwellings, and gradually replace the charcoal stoves that were then widely used. The government's decision to promote the use of the gas stove was based on two considerations: 1)the extensive use of charcoal would contribute to deforestation; and 2)the country produced an excess of butane gas which could be utilized. Therefore, in 1975—76, an intensive campaign was conducted to induce people to buy and use gas stoves. The gas stove was presented as modern, clean and fast; in short, the preferable thing to have and to use. In fact, quite a few people bought gas stoves; between 1975 and 1978 their use increased from zero to 80,000 while the use of charcoal stoves declined. However, the gas stove had at least one important drawback for its Senegalese users; it could hardly be used for the preparation of traditional tea. Apparently, the stoves were such that the flame level could not be properly regulated. Serving good tea to the family and especially to guests is a very important aspect of Senegalese social life, and it was felt that tea could only be properly prepared on a charcoal fire. Thus, the desire to prepare good tea and the desire to use the 'modern' gas stove soon came into conflict. In fact, many people kept the gas stove as a piece of furniture in the house without using it, also because of fear of accidents.

Level 1: Culture influences technology use Fear of gas and the importance of traditional tea on the one hand, and the receptivity to items considered 'modern' on the other, provided a doubtful basis for public acceptance of gas stoves in Senegal. As a result, people bought gas stoves but barely used them. People did not respond to the rational arguments of the government. From their point of view, the utility of the gas stove was limited.

Level 2: Culture mediates the utility of technology use The so-called clean and expedient cooking instrument had limited utility since it could not be utilized to prepare traditional tea properly. However, the fact that people did not get rid of the stoves shows that the gas stove still proved useful, but from a less practical point of view (as a status symbol). The utility of the gas stove was more like that of a modern piece of 'furniture' rather than a practical appliance.

Level 3: Technology use influences culture Technology use might lead to a change in attitudes or new social practices. Since the gas stove was barely used and its utility came to be perceived on a symbolic level, it was unlikely that new social practices would emerge. It might however have had an influence on local attitudes regarding other 'modern' items.

Computer technology use in an African culture

This section contains a description and analysis of computer technology use in Kenya based on three case studies conducted during 1993. The author visited one public research institution and two private organizations (a company and an NGO) located in Mombasa and Nairobi respectively. Following the ethnographic method for data collection and analysis developed by James Spradley (1979, 1980),[6] this analysis is based on personal interviews with about 50 individuals at each site and incorporates other sources of secondary data The discussion focuses on only those characteristics of computer usage common to all three sites. These characteristics are divided into three categories: 1)computer learning, 2)computer usage, and

3)computer problem solving. Analysis of the empirical data uses the 3 levels of culture-technology interaction proposed above, and direct quotes from the interviews have been incorporated into the analysis.

Computer learning

The first exposure to computers were consistent with attitudes toward every 'new' item. In general, the introduction of the computer as a new working tool evoked feelings of interest, fear, uneasiness, and sometimes reluctance. Almost every user had been trained by attending specific training courses. In all 3 cases, this was the regular way applications were learned, although not everyone who received training put the acquired knowledge into practice. This is especially true of persons in senior positions. On the job training in computer technology was almost non-existent. Only those persons who had not received any training but were confronted with computers got some assistance from colleagues or computer experts. A real autodidact, however, was very hard to find. For example, one user said, 'I had seen people using LOTUS already. But I did not have [a] hand on it until I went to the course'. Another stated, 'I hope to be trained sooner or later...'.

Computer usage

On a general level, computers came to be used in a highly specialized manner. Particular computer tasks were assigned to specific persons or specific positions or ranks. For example, in all 3 cases data entry was assigned to data entry clerks. Other particular tasks included data analysis, word processing, presentation of figures, making charts, and search databases. Some computer jobs had become specializations as such, rather than the computer being used as a tool for people on various job levels. This specialized way of handling computers, where delegation was common, contributed to a pattern of fragmented usage. Few persons had an overview of complete computer processes, and most were familiar with software applications only up to a certain level.

Although all 3 sites were moving to PC networking, stand-alone use continued to prevail while PC networking facilities were seldom used. Automating tasks were prevalent,[7] and programming was limited to specialists who had difficulties when more extended programming was required. The following comments underscore these points. One interviewee noted, 'Almost every one is connected to the Banyan server but very few use networking facilities'. Another noted, 'Pagemaker is used in the Publishing Department. Just one person knows how to work with it... what he does, is train the others in particular areas of it, but he is the only one who can handle the final process'. This final comment is perhaps the most poignant. 'One day, 3 men were sitting before one screen: the scientist reading the data while the second person was telling the third which keys to press'.

Given these conditions, users generally adhered to well known procedures. In the case of menu-driven software, users stated that they only used the options for which they had been trained. They were not always aware what other accessible options did. Similarly, users seldom resorted to 'essaying' novel items for themselves. Reasons for not trying new items varied, but when 'trial' did occur, it was usually at the request of higher echelons. For example, one user noted, 'You have indeed access to various options but you do not know which one will give you the information that you want. In that case, it is easier to call [someone else]'. Another's comment was typical: 'You always start off with what you know. Then, if someone tells me I need that package because it will help me, only then will I go into it. But somebody has got to tell me first'.

Communication and information exchange using computers, whether formal or informal, were rare. Which opportunities software packages offered, what kind of facilities existed within packages, and in what way these could be relevant to particular tasks were not real topics of conversation among users, as the following comment clearly illustrates.

> Scientists come to me [for statistical analysis] because they lack knowledge especially when it comes to computer technology and software. I then first look if there is an option of delegation [to the data section]. If not, I do it myself.... What I do, is exactly what they want.... Although I know that further analyses could be made, I do not propose to do them. If they do not ask for more, it is like that.... They never come for modeling, only for analyses. The people here do not know what modeling is. You have to tell them before they know the possibilities....It has not arisen yet. There is not much interaction in that way.

Computer problem solving

Problems arose in the process of computer learning and continued to exist for a long time. Two problems were widespread: difficulties in handling procedures, and inadequate absorption of computer logic. One interviewee explained, 'Most are trained in DOS. If they follow a training in our unit for whatever package, they have to start with DOS. But they forget it immediately'. Another non-African provided this example: 'The programmer was asked to write a user friendly program for consultation on our scientists' database. But he did not start from a well-defined concept with a beginning and ending. He has not made one flowchart. He began thinking about the first screen and wrote down a PASCAL routine. After a while, he got stuck.'

In all 3 sites, problem solving was the full assignment of a particular person and/or department. Transferring computer problems was the most common way of dealing with them, since users did not perceive them as their responsibility. Assistance and, hence, learning from others was quite prevalent for procedural problems, but program facilities were much less used. Only some individuals consulted manuals and even fewer resorted to trial and error. People also decided to stick to manual task execution. This was especially true for senior staff, who had received training but had not put the acquired skills to use. Their reasons varied. Some perceived computer use as a difficult, time consuming effort, while others associated computer use with 'minor' secretarial work or were not interested in it at all. To reduce errors, computer products were placed under strong supervision.

The following comments illustrate basic attitudes toward solving problems arising from computer use. One user stated, 'When a problem comes up, I define the problem and search for the right person [to solve it]'. Another said, 'I do not often sit down and read manuals .... It is difficult to just sit down and read. It takes time, a lot of effort and commitment...I call those who are more [computer] literate'. A third user stated, 'Within the unit, we ask for each other's assistance....We have reference manuals but we do not use them often. Only when the situation has come to the worse'. Finally, from the perspective of a 'problem solver', 'His or her profession is not computer, so they call me for solving the problem....It is my profession, it is a task assigned to me. That is how they think and because it is my job, I have to answer their queries.'

Conclusion

In short, almost all users had completed a training course. Pragmatism and conformity characterized their attitude toward the computer — they only used computers for essential tasks, and common tasks were mainly handled in a standard fashion. Users did not demonstrate much variation in their work with computers. They seldom tried new things unless they had an immediate reason for doing so. Computer use was also specialized and fragmented. In the case of computer problems, specialized 'problem solvers' were frequently used. An attitude of 'trial and error' or consulting manuals was much less common.

Applying the 'culture-technology use' model to Kenya

Culture influences technology use

The conformity and pragmatism which characterized Kenyan computer use are culturally 'loaded' since these attitudes exist in other phenomena such as educational patterns, religion and world view. The Kenyan way of life is marked by 'cultural' socialization, where obedience and subjection are valued, and open conflicts avoided. Political discourse for instance denies the reality of conflict (Mbembe 1985). According to the Kenyan theologist John Mbiti (1992), pragmatism and realism are characteristic of African religion and the concurrent world view. He notes, 'African peoples look for the usefulness of the universe to man....But man is not the master in the universe, he is only the user. For that reason, he has to live in harmony with the universe.' (1992, pg. 43). However, placing man at the center of the universe, does not correspond to valuing the lone individual. The African, as Chernoff (1979) describes him, finds 'meaning' within a social network. Consequently, a highly valued sense of social harmony accounts for emphasizing group needs over individual needs. In brief, the ideas of harmony, conformity and pragmatism are consistent throughout existential matters such as man's position in the universe and his 'social group membership'. This communal sense is important to understand the role that work fulfills in one's life. People execute their jobs primarily because they consider it a duty toward their families.

But the sense of harmony, the relativity of the individual within the group, and thus the avoidance of open conflicts, characterize attitudes within the workplace as well: conformity and pragmatism stand side by side. Complying with demands is thus the way to deal with work tasks as well. Particular job exigencies seldom are issues that develop into a fierce quarrel. With this cultural background, the computer user accepts new work tools rather easily and apparently conforms to orders and expectations. Pragmatism is apparent in the fact that most users do not exceed the level at which they have been trained. They ask: 'Why make the effort to learn a new package or facility if not required to do so, and if it is not perceived as being directly useful? Why learn to solve your own computer problems when a person who is more familiar with it can be called upon anytime?' Or, in the case of seniors: 'Why put in the effort to learn to use computers when little benefit can be gained from it, and executing tasks can be delegated?'

Conformist and pragmatic attitudes are closely related to the hierarchical structure of the society, with work practices such as delegation and specialization serving to consolidate this hierarchy. Kenyan hierarchy is built upon traditional criteria such as kinship, residence, age and sex, but has become merged with the top-down authority characteristic of British colonial administration (Bourmaud 1988). Kin and lineage relationships, together with values of communalism, are still very important. Hence, work life is characterized by 'ethnic' symmetries and solidarities. Hiring a new employee, or social interactions within the workplace are often influenced by 'ethnic' considerations. Powerful top down authority, operating along ritualized institutional procedures such as strict task division, account for the organization of work within the 'modern' workplace. In a broad sense, juniors[8] execute while seniors[9] supervise and delegate. Consequently, efficiency characterizes junior positions while personal relationships serve as the guiding principle in senior jobs. Since computers are associated with efficiency, they have been categorized as a tool for executing tasks appropriate for both delegation and supervision. The resulting outcome of fragmented computer processes and computer knowledge is hence no real surprise. It may, however, prevent computers from coming to full fruition in work performance.

African concepts of time concern mainly the present and the past, and have little to say about the future, which in any case is expected to go on without end (Mbiti 1992). African time follows a fluent and cyclical movement: work and computer technology make part of that movement. The work pace has not changed with the use of computer technology, and neither have work attitudes. When the work volume increases, workers keep on reading the newspaper or chatting with their colleagues. When deadlines approach, one settles into overtime work. The computer is a tool that 'makes life more easy', not a tool that encourages people to work more quickly. Further, people do not have the tradition of making strict separations between work time and leisure time. Realities and interactions, either at work and in society, are not separated.

Within the Kenyan workplace, most practices function on the basis of communalism whereas individual initiatives are exceptional. The importance of social interaction in the workplace greatly exceeds the importance of solitary technology interaction. Conversely, computer technology, in which the initiatives of the individual user are valued, supposes a profound interest and curiosity towards technology.

This importance of social interaction reflects the Kenyan/African oral tradition. Work planning, servicing clients, or supervising, mainly involve personal meetings, visits, phone conversations, and discussions. Written tools, such as production schedules or agendas, have no role in this type of organization. Hence, the influence of oral culture may render certain computer applications — such as production scheduling or in-house electronic communication — irrelevant in the workplace or difficult to use. Programming requires a particular analytical approach, which can hardly exist without a strong written basis or where manuals are sometimes available, but rarely consulted.

Given Kenya's status as a 'developing' country, however, the condition of generalized scarcity may add to our understanding of the Kenyan computer user. Given that insecurity is a characteristic of any human society, its influence is particularly strong when coupled with scarcity. For example, how does one cope with insecurity when food, money, employment, shelter, water and electricity, or information are only scarcely available? The whole issue is strongly interwoven with social mechanisms and attitudes. In Kenya, people cope with scarcity and uncertainty in roughly two ways: pragmatic reflection toward almost every aspect of society, and the redistribution of money, goods or services based on kinship only, with or without church mediation. Redistribution along kinship ties has its basis in traditional society, where social preceded economic reproduction. Exchange of favors has been the substratum of a political and social system (Bourmaud 1988), and blended with 'modernity' and scarcity conditions, seems to have given rise to at least two characteristics of scarcity culture. First, lineage relationships now play an important role in the distribution of benefits from the modern Western, economic and political structure while scarce 'modern' assets have become status symbols. Nepotism and corruption can be seen against this background. Second, solidarity on a societal or even organizational basis is hard to find. The social group from which the individual derives meaning, remains traditional and is the most secure. Within the workplace, kinship can influence decisions about hiring and firing, but also about mundane matters such as the preferential allocation of assignments and training courses. Regarding work attitudes, pragmatism and the ambition for a better life complement each other. People seek small gains and petty fraud both internal or external to the workplace is widespread. For example, on individual stated, 'Political connections work good [to get a job]. We call them 'godfathers'. (Q: How does one proceed?) Always in a bar. You can make an arrangement, you can also meet by 'accident'. Then you talk to the political person, pay him some beers, tell him about your problems. You call him the next day and it may be settled'.

The direct 'useful' interpretation of things further interferes with information scarcity. Information may be scarce but people have not developed nor do incentives exist for developing a tradition where information sources are sought vigorously. People get their information through social interaction and newspapers. Few people seem to visit libraries or documentation centers. With regard to computers, neither users nor their senior supervisors seek information on computers. That would be considered the role of specialized computer departments. Individual initiatives for information seeking and updating are seldom observed.

Culture mediates the utility of technology use

To learn or use computer technology is considered useful for financial and/or professional reasons. Familiarity with computer technology enhances a junior employee's chances for keeping their jobs, and for further computer training, job promotion and better survival rates in the job market. Workers feel more closely involved in the 'modernization' that Kenya is going through. Within their own job levels, senior employees perceive computers as useful for financial rather than professional reasons. Many senior employees attend training courses. Computer training seems motivated by interest and opportunism. Interest corresponds with the motivation encountered in junior jobs as computer technology is viewed as an integral part of 'contemporary' society. Opportunist motives are found when seniors consider training an objective in itself and consequently do not put their acquired knowledge into practice. They are interested almost solely in the perks that come with training — money, a trip abroad, a certificate, etc.

For example, one interviewee put it this way. 'They don't like anything more then going abroad to attend courses. And they are smart. They budget in their proposals for training. That money they use to get their own training, and abroad! X has just come back from the States. He paid an enormous amount for those courses. While he learned the same things as we provide in our training sessions. And I am sure he will never use the computer anyway. That is one of the persons who keeps on thinking that computer work is secretaries' work'.

Pragmatism and adherence to formalism take precedence over values such as efficiency. Within the workplace, efficiency may be the result, but it is not the driving force behind work. The same is true for experimentation. Since the computer is primarily perceived as a tool that 'makes life more easy', working a long time on a program, investing a lot of time in learning new items, or in solving problems, is seen as completely illogical.

Computer utility is interpreted almost solely on the basis of the advantages offered by automating. Lots of users have only a little knowledge about other domains where computer technology may be beneficial — for instance, informating applications or using the computer as a planning or communication tool. Incentives to go beyond current uses are rare. In general, people do not have a tradition of going to exhibitions, consulting journals, manuals etc.; there is not an 'information culture'. Nor do they take solitary initiatives in the workplace, reflecting the strong communalism and conformity. Moreover, since most seniors judge computer technology on its automating capacities only, and computers are not considered useful within their own job levels, their interest is already limited. This attitude shapes their position toward juniors and computers — they do not interfere or provide encouragement. Looking for further computer knowledge apart from basic training is almost exclusively confined to computer professionals.

Kenyan work practices — such as strict task division and specialization — appear to harmonize with the logic of automating. Both account for splitting a work process into small, delineated units performed separately. However, divergent assumptions underlie the pretense of harmony which parallel the particular historical and cultural background of both work practice. In the Western perspective, automating derives its meaning from productivity and efficiency. Automating involves a systematic approach toward a task. With a means-end perspective, functional rationality is the driving force in the workplace. This assumes that the worker can perform according to a pure economic logic, cut off from other social or political concerns.

Within the Kenyan context, however, political, social and economic realities are interdependent, both internal and external to the workplace. Task division and hierarchical status — and hence specialization — are ritualized procedures which connect the African to the larger social world, and thus *encompass* the economic and the political spheres rather than *separating* one from them. Consequently, computer use may be specialized, but it is not perceived from the Western means-end perspective. Using functional rationality and thinking about computer technology in terms of task performance only very rarely occurs. As a result, computer technology is not always put to its full use within the margins of task performance.

In brief, the utility attributed to computer technology by Kenyan workers is, in the first instance, substantial.[10] Knowledge about computers can be a means to a better life or may be financially rewarding. This rationality absorbs the notion of the computer as a 'work instrument'. The expectation is that computers elicit pleasant benefits such as job diversity, and easier task performance. The functionality of computer technology with regards to specific tasks is clearly of lesser concern to many people.' It goes without saying that the interpretation of utility can differ widely from organization to organization.

Technology use influences culture

Computer technology may influence culture by its presence alone or by the way it is used. When more widespread and utilized, computers will disseminate into more aspects of Kenyan society. Depending on the roles they fulfill, changes in culture may come about in the longer term. If the computer is viewed primarily as a work tool, computer use may have a profound impact on work processes, and consequently, on society in general. But the opposite may also be true; computer practice may not induce substantial change.

If users persist in utilizing computer technology in a rather 'conservative' way by sticking to automating applications and 'refusing' to solve the computer problems they encounter autonomously, the influence of computers will be minimal. The only difference with previous task fulfillment would be that the same tasks are now performed with computer technology. As long as computer technology does not co-generate new tasks, applications or work practices, the margins of culture change are limited. On the other hand, if computer technology gains wider acceptance in society, a different outcome can be imagined. A powerful factor in this respect is a pragmatic attitude. When computer technology is continuously reinterpreted in light of changes in society, the same pragmatic attitude that proved obstructive for thorough computer use, could lead people toward a more profound interest in automation. Both an accrued interest and a better understanding of information processes can enhance the absorption of the 'logic' associated with computers. This might enable the emergence of functional rationality and/or a 'trial and error' approach to computer use. On a more general level, computer technology might — in conjunction with changes that are already taking place —influence oral culture and the way it emerges within the workplace.

A dynamic view of computer technology and culture accepts the probability of both outcomes since it takes into consideration both culture's adaptive capacity and computer technology's flexibility. But the application of computers in a useful way depends on what is considered meaningful. Therefore, predicting the perpetual use of computers remains speculative.

The impact of computer technology on Kenyan cultural characteristics is uncertain. A gradual integration of computer technology into more aspects of Kenyan life could induce changes in work practices and attitudes. As a constituent element in the 'modernization' process, it could also place the long-standing traditions of oral culture, time perception, or social structure into question. A dynamic view of culture and computer technology, however, suggests that culture can adapt, and that technology can be appropriated.

Conclusions

To conclude, culture has three major influences on the user's approach toward computer technology. Elements such as cultural socialization, hierarchy, communalism, time conception, oral tradition, and generalized scarcity provide the background for the way technology is: 1)accepted, and 2)used, and 3)the way its utility is perceived. In the long term, computer technology use may itself have an influence on existing cultural values and social practices.

Conclusion

Computer technology incorporates a world view that corresponds with Western modernization. The distinction between *physis* and *nomos* enabling rationalization, the differentiation of life spheres, a culture of experimentation and verification, an individualized life style, timeliness, functional rationality, are all incorporated into the machine computer. The African continent, however, has no such history of modernization. Although Africa has a history of both great empires and pastoral communities, a clear distinction between a natural and a human order never emerged. Man is not the master of nature and society as Westerners assume, but the user. For that reason, he must obey the natural law, and the moral and mystical order which are all part of that universe. The differentiation in life spheres and the dominance of the 'economic' is non-existent in African history, although contact with' Western' countries has led to 'modernizing' changes in this respect. Processes of rationalization and differentiation merge with assumptions rooted in African culture. As a result, people may use computers, but they will probably depart from a less efficient, functionally rational, autonomous, critical and experimental approach.

According to the African world view, the usefulness of the computer is questionable. The interpretation of its usefulness does not strictly regard work issues but encompasses ones 'total' life. Kenyans ask: 'How can computer technology help me or my family?', 'Can computer technology be associated with my hierarchical status?' Conditions of generalized scarcity complement this attitude. People come to the workplace to earn an income first, the execution of the job or work performance comes second. Consequently, work motivation is not based on functional rationality. Nor is the insertion of computer technology in work tasks perceived from a separate means-end perspective. Cultural socialization and traditions of hierarchy and decision making provide little basis for autonomy and initiative, while the lack of a critical and experimental tradition may explain the conformist and pragmatic attitude toward computer use including problem solving. Finally, traditional cyclical perspectives of time and a relatively recent written tradition in most African countries coupled with strong remainders of oral tradition may further explain the African work style and the problems users encounter.

The theoretical and empirical analysis presented in this chapter suggest a number of policy recommendations. It should be clear by now that enhancing direct utility only — for instance, giving people bonuses for computer work performance — does not necessarily alter the user's attitude or approach toward the machine. The user's limited autonomy and lack of experimentation, partly due to cultural socialization and communalism, may not be changed at all. If policy is to take culture into account, a dynamic perspective of the interaction between culture and computer technology must be considered. The three analytical levels herein suggest policy makers must:

1 determinate an appropriate computer policy regarding computer training, applications, etc. and anticipate problems regarding implementation and use (level 1: culture influencing computer technology);

2 know which computer stipulations will be seen by users as constituting an enhancement of computer utility (level 2: culture mediating the utility of computer technology);

3 anticipate possible conflicts regarding culture and/or cultural change (level 3: computer technology influencing culture).

In the case of Kenya and perhaps other African countries, elements such as time conception, communalism, remainders of oral tradition, hierarchy and cultural socialization should be acknowledged directly in the computer policy. Specifically, a training course could be designed from a less technical point of view where experimentation, critique, autonomous problem solving are learned and valued. Since decision making, communication and planning are mainly based on social interaction, social interaction should be the way users are informed about computer issues and discuss them. For example, organizing meetings within job categories to discuss user questions, their interests, problems, etc., could create a 'work' culture — and eventually, a more functionally rational culture — around small units or user groups. It might also help to re-integrate the fragmented computer technology processes on the individual user level.

Against the background of generalized scarcity and the pragmatic utilitarian 'world view', learning and using computers seems interesting to the users as long as it offers substantial benefit. A creative policy which appeals to the values of users could be quite helpful in promoting computer use. Finally,if users utilize computers to a greater extent, and get more involved in 'informating' applications, existing work practices, organizational structures and concurrent attitudes may come under pressure. For instance, when a computer policy is designed to give users more responsibility in order to stimulate autonomy, experimentation and problem solving, changing attitudes may threaten the prevailing hierarchical and specialization principles. Such changes, however, can only partly be anticipated.

Notes

1 Those include lack of skilled personnel and human resource development facilities, lack of information technology (IT) policies or strategies, lack of clear understanding of the potential offered by IT, poor management etc.

2 Computer technology may fulfill a modest but substantial role in a development process because of its information-building capacity and malleability. Since computer technology is a means to generate better and faster data, it offers the *possibility* to add structurally to an accrued fount of information and even knowledge in a developing country. No matter how a development process is conceived, information and knowledge are elements, inherent to this process. Moreover, computer technology is a malleable technology, one that has the capacity of being applied in many ways to many purposes (Adkins 1988).

3 Because of the limited information available on present African life and work culture, we selected a qualitative methodology for the garnering and analysis of our data (Spradley 1979, 1980). Hence, no representativity can be derived from our case studies data. The aim of the chapter, however, is not a statistical generalization (cf. representativity) but an analytical one: the empirical evidence is used to illustrate an analytical model of how culture works at the moment of concrete technology use.

4 The growing separation between work time and leisure time is one point where linear time conception (time may be divided up) and structural differentiation (work and leisure as separate entities) meet.

5 This is based on the analytical definition on development and culture (Klitgaard 1992).

6 Three cases were studied from July to August 1993: 1 public research institution and 2 private organizations (a private company and a NGO) formed the organizational settings to study computer use. The first case was located in Mombasa, the second and third in Nairobi. The choice for very divergent settings was deliberate: if users would demonstrate similar characteristics in their approach towards computers, these could relate to cultural aspects of a higher order than the organization in itself. The empirical evidence was gathered through observations, interviews with users (more or less 40 per case), case-documents, and complemented with a diary, local articles (e.g. 'The Nation', 'The Weekly Review') and literature on Kenyan and African culture. The collection and analysis of the case-material was executed according to the etnographic method of the American antropologist James Spradley (1979,

1980) (known as The Development Research Sequence Method 1979,1980).

7 Zuboff (1989) makes a clear distinction between automating (the speedier execution of already existing tasks) and informating tasks (encompassing the understanding and analysis of operations).

8 The term 'junior' is used to denominate secretaries, clerks, office messengers etc.

9 The term 'senior' is used to denominate scientists, sales representatives, managers, etc.

10 Substantial rationality entails that values precede in interpreting reality. Functional rationality is a pure methodical approach: goals are settled and means to achieve those goals are sought for. Functional rationality superseding substantial rationality is characteristic for Western modernization (Zijderveld 1983, Frissen 1992).

9 Infrastructure and institutions: the case of public health in Mongolia

Jørn Braa and Eric Monteiro

Introduction

This chapter presents a strategy for helping developing countries to learn about, master and exploit information technology (IT). We argue, by drawing upon changes in the perspective on economic development, that there is a need to support the development of localized knowledge by linking and aligning it with the institutions and infrastructure of technological development (Braa, Monteiro and Reinert 1995, Hyden 1994, Nelson 1993, Perez 1983). Fagerberg (1988) explains differences in economic development between countries and regions by differences in technological development. This is consistent with recent directions in economics which emphasize technical innovation and learning when accounting for economic growth (OECD 1991). Since the distribution and exploitation of IT is closely linked with economic development, the application of IT tends to be concentrated in the most modern sectors of the economy and regions of a country — and world. Since IT is a key factor in technological development — and thus economic development (ibid.), it follows that a side-effect of IT might be the maintenance or increase of differences in technological and economic development between the North and the South, and between regions and sectors in the South (and North as well). The rapid development of telecommunications aggravates this tendency by dividing 'networked' sectors, areas and countries from 'non-networked'.

In this chapter we discuss ways in which this tendency can be counteracted in developing countries by the use of IT to promote development of deprived sectors and regions. Unfortunately, there are no established ways of using IT to develop areas and sectors that lag behind in the modernization process. Since there are no off-the-shelf solutions, new solutions must be developed through a process of trial and error — a process that generates learning.

Elsewhere we have made a distinction between context-free and context-sensitive aspects of IT (Braa, Monteiro and Reinert 1995). We argued that a process of learning is necessary to address the problems of context-sensitivity and to exploit and adapt IT in appropriate ways at local level. To institutionalize such a process of learning we argue that development needs to create an environment for learning about appropriate use and exploitation of IT in areas sheltered from international competition. This is what the North has done historically, and it is what the North is currently doing in connection with its IT infrastructure or 'information highway'. The health sector, we argue, is a suitable candidate for such a protected area because: 1)it contains the whole range of problems and challenges regarding the exploitation and use of IT, and 2)it extends throughout the society — through all social classes, all geographical areas and all administrative units (WHO 1988, 1988b).

The remainder of our chapter is organized as follows. Since we draw upon the recent changing view of economic development, we start by giving a brief, historical outline of different views on the subject. A case study of the health care sector in Mongolia is then presented. Based on this study, we subsequently discuss and describe how issues related to the development of an information infrastructure fit into the changing perspective on economic development. We conclude by offering a handful of policy guidelines which follow from our earlier discussions.

Changing perspectives on development: The role of institutions

From 1955 to the early 1990s, Hyden (1994) identifies four distinct phases through which the development debate has passed. He distinguishes between the ideological perspectives of the architects of development — the policy makers and people occupying positions of power in governments and agencies, and the theoretical perspectives of the auditors of development — the scholars and academicians producing theory. We briefly review these four phases as they relate to our discussion.

1955—1965: 'Trickle down' and structural functionalism

The emphasis in this period was on the 'trickle down' effect of modernization from the 'Progressive elites' to the common man. The relative success of Europe in post-war reconstruction, making use of the Marshall Plan as a Keynesian tool, emphasized the role of government in the development process. The focus was not on equity but on growth which was to be achieved through public investments and the support of entrepreneurs in targeted fields. For example, 'progressive farmers' were given a key role in modernizing agriculture.

Structural functionalism, the first generation of development theory, stressed the integrative role of structures in society and emphasized structures over individual actors. It was built on the assumption that development is an evolutionary process, using Western democracy as the ultimate stage. It was based on the positivist assumption that development was equivalent to modernization and that anything traditional was backward and had to be abandoned. The theory was first constructed in the intense Cold War climate and grew out of the ambition to develop a 'grand theory' that could provide a counter point to the universalist ambitions of Marxist theory.

1965—1975: 'Basic needs' and neo-Marxist political economy

The period Hyden labels 'Basic needs' began with the radicalization of the development debate in the second part of the 1960s. Development was no longer equivalent with growth. Growth without equity, it was argued, was growth without development. The progressive farmer was abandoned in favor of the poor peasant and 'trickle down' was no longer considered adequate. Neo-Marxist political economy and dependency theory were the theoretical response to the radicalization of the development debate. Greater attention was given to equity as opposed to growth. Neo-Marxists stressed the international character of these structural constraints and the need for the poorer countries to emancipate themselves from their dependence of the richer nations. Development of the core, it was argued, led to underdevelopment of the periphery.

1975—1985: 'Small is beautiful' and neo-liberal political economy

The phase Hyden labels 'Small is beautiful' emerged in reaction to the centralized and state driven bias of the two former phases and was nourished by the general lack of success in implementing development programs. Thus, much greater emphasis was given to private and voluntary initiatives and the role of the state was down-scaled. Small-scale and private efforts were expected to achieve what large-scale government bureaucracies had failed to do. This phase of development ideology evolved along two fronts with rather different biases. One focused on 'grassroots' organizations and the involvement of people and communities at local level in implementing development programs. The other, focused on the market with initiatives by the World Bank and International Monetary Fund encouraging structural adjustment in direction of greater market orientation.

In this period, the doctrines of neo-liberal political economy were the dominant issues in the development debate, highly influenced by economists close to the World Bank. Development should occur by relying on the market forces. The neo-liberal 'rational-choice' theory influenced thinking about development in the social sciences. Contrary to both structural functionalism and neo-Marxism, the importance of individual actors was stressed. Development was seen as the aggregate outcome of a multitude of individual decisions. The 'oppressed' peasant gave way to the 'rational' peasant.

1985—Present: 'enabling environment' and new institutionalism

There has been a growing recognition that because they are small and dispersed, people-based institutions within the informal sector, agriculture, or elsewhere, cannot make much progress toward development unless they are incorporated into broader institutionalized networks. Local initiatives can only flourish and become viable if governments are ready to create an environment in which they are allowed to grow. Hyden defines an 'enabling' environment as open and pluralist, providing the conditions in which economic and political restructuring can take place in a constructive fashion.

'The new institutionalism' is the label Hyden uses for the theoretical counterpart to the enabling environment. The move away from the neo-liberal model was mainly based on its simplistic methodological assumptions — from the unseen hand of the market to the individual actor making 'rational' choices. It is increasingly recognized that value preferences — the backbone of 'rational' choice — are not given but shaped by the context of social interaction. Scholars are increasingly concerned with 'institutions' — the layer between individual actors and societal structures, as Hyden puts it. 'The new institutionalism' has a voluntarist perspective, but argues that social action is primarily integrative, aimed at going beyond self-interest. Although this theoretical perspective on development is still evolving, Hyden foresee an increased focus on institutional issues; both the question of how to strengthen them ('institution building') and how to use them as 'tools' for development.

This approach can be seen in the new economic theory and its concept of 'national innovation systems' (Lundvall 1992, Nelson 1993). These systems serve as enabling environments for technological learning and as arenas where learning may be institutionalized and generated through governmental support. An example is the creation of 'information highways'. This trend is a reaction to the prevailing neo-liberal perspectives and reflects the changing perspective on the development process.

The case of Mongolia

Two roads to the future

The collapse of Soviet Union triggered a process of economic and institutional reform in Mongolia based on a rather extreme form of (neo-liberal) market liberalism. For example, in the telecommunications sector prices have been set in such a way that only the richest companies can afford to use the emerging data network or international telephone lines, which are arguably the most expensive in the world. At the local United Nations Development Program (UNDP) office, we were told that it was common to send documents with people to Beijing so that they could be faxed from there. As Mongolian Telecom interprets the prevailing market ideology, their task is to make money, not to provide public services. This attitude is an extreme example of the 'neo-liberal' economic perspective described above.

At present, most developed countries endorse the use of public money to establish 'information highways'. This exemplifies the recent policy shift toward establishing 'enabling environments' and the 'new institutionalism'. Elsewhere (Braa, Monteiro and Reinert 1995), we have presented examples from South Africa which reflect attitudes toward telecommunications that are more in line with current trends. Since South Africa was liberated five years after Mongolia, these two countries clearly illustrate the shift in development perspectives outlined above. When Mongolia defined its new way forward, it was heavily influenced by the then prevailing neo-liberal political economy. The New South Africa, on the other hand, has defined its new policy in the Reconstruction and Development Program (ANC 1994) which reflects the concepts of the 'new institutionalism'.

However, the differences between the two roads toward development followed by Mongolia and South Africa cannot be fully explained within the framework of shifting perspectives. As a part of the Eastern Bloc, Mongolia had a centralized structure and planned economy. As a result of a popular uprising and a natural reaction to the breakdown of the Soviet Union, Mongolia — as well as the rest of the Soviet bloc — adopted the exact opposite policy of extreme market liberalism. Although reactions to the simplistic explanations of the 'neo-liberal economy' had already resulted in the emerging 'new institutionalism' by the time the Soviet Union collapsed, these new perspectives on development have had little impact on policies in the former Soviet bloc.

Methodology

During 4 months in the summer and autumn of 1993, one of the authors conducted an investigation of IT in Mongolia and of its health information system. The study was based in Mongolia's Ministry of Health (MoH), and its purpose was to propose ways of using IT in order to improve the health information systems both at the central and local levels. The study was carried out with the help two counterparts from the MoH — Nermunkh and Burendei — who also acted as interpreters. The main objective was to find more efficient ways to use information in local decision making. Methods used in the study were semi-structured interviews, participatory observation and discussions. A total of 90 interviews were conducted, written down and analyzed, 60 of which were from within the health sector. The other 30 were done with representatives from a broad range of institutions, organizations and occupations: the railroad administration, the central custom office, the state statistical office, the Ministry of Agriculture, the Ministry of Transportation and Communication, the Stock exchange and brokers, the University, new private IT companies, and herders. In total, one month was used visiting the regions of Siberia (Hufsgul Aimak), Gobi (Bayanhongor Aimak) and the central Tov Aimak. Health institutions on all level were visited, i.e. central level, Aimak level (province), Som level (municipality) and Bag level (former Brigades). The State Statistical Office and the Stock exchange/ brokers are users of computers and telecommunication and were visited in three Aimaks.

Background information

Mongolia is a large, landlocked and sparsely populated country in the northern part of Central Asia, located between Russia on the north and China on the east, south and west. It is about half the size of India, but contains only 2.2 million inhabitants. The geography includes steppe, mountain forests and Gobi desert. Averaging 1600 meters above sea level, Mongolia has an extreme continental climate with sharp seasonal and daily variations in temperature. Sixty per cent of the population live in towns and settlements — 3 industrial towns and 18 Aimak (province) centers — including 26 per cent in the capital city of Ulaanbaatar. Fifteen per cent of all rural families, or 136,000 people, live as semi-nomadic herders scattered in small groups of families. Most of the rural population — and nearly half of the urban population — live in traditional tents. One Aimak is divided into several Soms. The condition of infrastructure is poor in Mongolia; bad roads (or tracks), lack of petrol, and poorly developed telephone and postal systems.

Animal husbandry accounts for about 40 per cent of the Gross National Product and 34 per cent of all able bodied people are employed in this sector. Since the time of Genghis Khan Buddhism has been the religion of the Mongols, and Khublai Khan made Buddhism the state religion of the Yuan Empire of China. During the 16th century Tibetan Lamaism was established in Mongolia and strong links with Tibet were developed. During the 1920s Mongolia became a close ally of the Soviet Union. Tibetan Lamaism did not easily fit into traditional perspectives on development and modernization, and was particularly antitheitic to the socialist view of development exemplified by the Soviet Union. Under communism freedom of belief existed but religious feelings could not be openly expressed. In 1937, following the Stalinist system, 700 Buddhist temples and monasteries were destroyed in Mongolia. Since 1990 many hundreds have been re-opened and built. Worship of Genghis Khan and the glorious past — suppressed under communism — and a renewed Buddhism are main features of the new Mongolian nationalism.

Many changes have taken place in Mongolia's political and socio-economic situation since 1990. The country, formerly a part of the Soviet bloc, has changed from a single to a multi-party system, and is making the transition from a planned to a market economy. Today there is a severe economic crisis, characterized by shortages of food, medicines, fuel and everyday necessities. Unemployment is substantial. The Gross National Product (GNP) was estimated at US$780 per capita in 1986, but has fallen to an estimated US$299 in 1992, and was still decreasing in 1993.

Mongolia had been an integrated part of the Soviet command economy. Animal and mining products were exported in exchange for oil and all kinds of industrial products and machinery. Mongolia followed the Soviet approach to modernization, emphasizing giant industrial schemes. The governor of Hufsgul Aimak told us: 'The ideology of planning has now changed from the former 'giant is efficient' to the present 'small is beautiful'. He also explained how the changes had affected his Aimak — a huge and sparsely populated area of more than 100,000 square kilometers bordering Russian Siberia. With Soviet money, mines and industries were to be built together with a town constructed for a population of 100,000 people. A railway line was to connect the new town with Erdenet, a mining town constructed in a similar way. But there had been few state investments in the Aimak the last 15 years because, as the governor explained: 'Everybody waited for the Russian money. In the future we must rely upon the development of many small enterprises'. But how and when this new policy would produce investments and employment remained crucial but unresolved questions.

The existing health management and information system

A process of decentralization of governmental functions is currently underway. Power, functions and responsibility are being handed over to local governments. Within health care this has resulted in a major shift in policy — the decentralization of health management and a shift from curative to preventive care. In building these new decentralized structures the availability and support of appropriate information is of primary concern. So far the present Health Information System has failed to keep up with these changes. The existing information systems for data collection, analysis and reporting were implemented in 1965, and have remained basically unchanged. The systems are based on the needs of a centrally planned economy and a Soviet influenced health system with its bias on hospitals and curative care.

Although the health service infrastructure extends to the community level, the emphasize is on curative rather than preventive medicine. The three levels of health services are:

1 The Bag (former Brigade) health unit is the primary level of health service. About 1,600 of these have one 'feltsher' and no beds, about 50 have 3-4 beds and 45 bag health units have 10 beds and one physician. A feltsher is educated at medical college and is called 'little doctor'. There are 330 Som (municipality) hospitals, ranging from 10-100 beds and from 1-15 physician.

2 There are 30 centralized hospitals in Aimaks (provinces) and cities ranging from 200-600, beds and from 30-100 physicians.

3 There are 20 specialized hospitals located in Ulaanbaatar.

The health system consist of four vertical organizations:

1 The main hospital based curative system with referral of patients all the way from the bag to the central level.

2 The Infectious Diseases Control Centers which are responsible for the control of infectious diseases including immunization management and vaccine storage. A number of specialized centers and hospitals at the Aimak and central level are part of this organization.

3 The Pharmaceutical Service System is organized in two parallel tracks. One track is a state monopoly where drugs are purchased and distributed. Drugs are sold to Aimak pharmacies and resold to Som pharmacies which sell their drugs to the public. The other track is the hospital system with a pharmacy in each hospital from the central to Som level.

4 The Hygiene Control Center has offices in each Aimak. They are responsible for water supply, sanitation and hygiene as well as inspection and control of food, use of chemicals, occupational health etc.

In the new decentralized health structure, these four institutions should be coordinated and placed under a joint management at Aimak level. To support this new management structure an integrated information system which collects and analyzes information from all the health institutions is needed in each Aimak. The current information systems are extremely fragmented and are not useful in this regard.

The main aim of the present system is to provide the center with information. Local use of information is not an integrated part of the system and the mechanisms of feedback to lower levels are poor. These features of centralization strongly contradict the needs of decentralized administrative institutions, which emphasize local decision making and as a result require local information support. The national health information system can be perceived as consisting of four different vertically organized systems:

1 The main hospital based health statistical system. All Som hospitals have one statistical feltsher who collects data from the Bags and from the Som hospital and reports to the Aimak; both to the central Aimak hospital under which they are organized and to the Infectious Disease Control Center. All Aimak central hospitals have a statistical unit of one statistical doctor, who reports to the director of the hospital, and 3-4 feltshers. This unit is organized under the statistical office in the Ministry of Health, where national reports are produced.

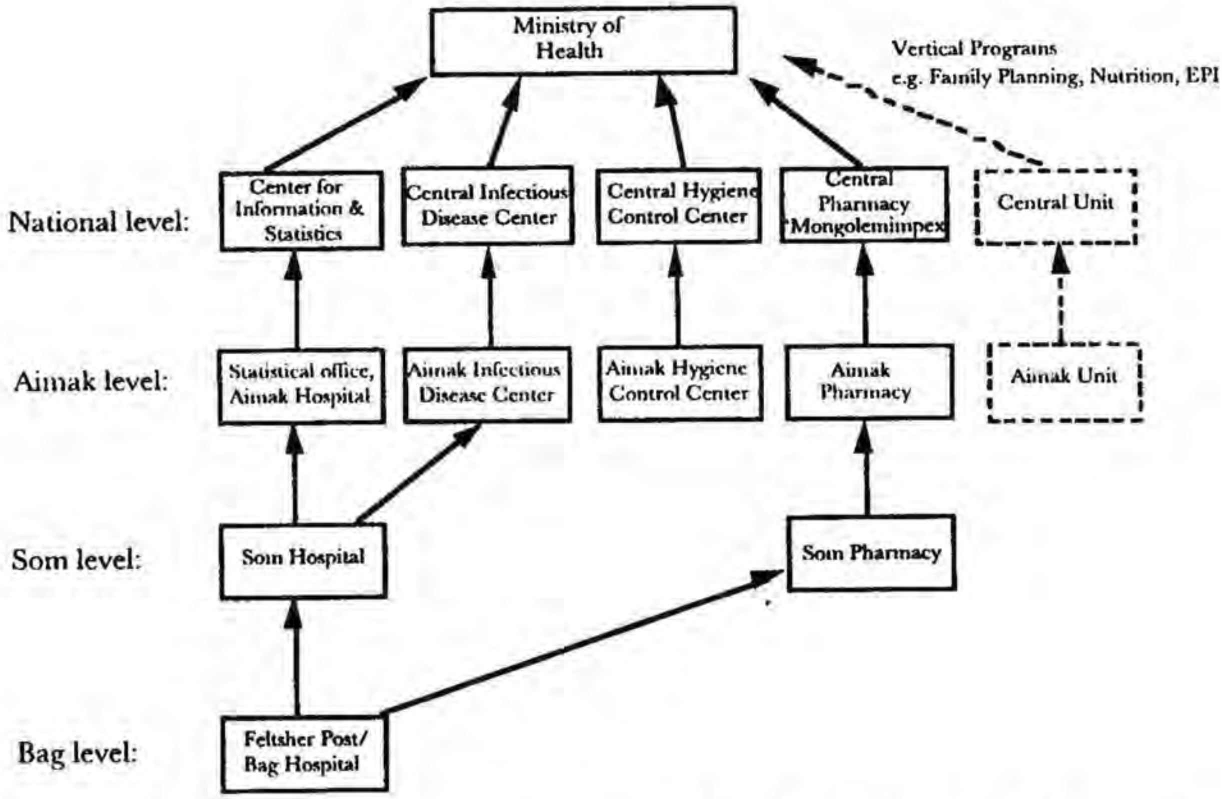

Figure 9.1 Structure and flow of information in Mongolia's health sector

2 Information on infectious diseases and immunization. This information is collected by the Infectious Disease Control Centers in each Aimak. They get routine reports from the Som hospital.

3 Pharmacy and drugs. All pharmacies control their stock against an inventory list and regularly report to the level above. At present a computerized drug invoice and inventory system is being developed, funded by the WHO.

4 The Hygiene Control Centers collect information about sanitation, hygiene and water supply. An improved information system on water sources and quality is given the highest priority

In addition, a number of vertical programs have their own information systems, for example, Family Planning and Extended Program on Immunization. Figure 9.1 provides a visual representation of the flow of information with the health system.

Numerous statistics for measuring the performance of the health care sector are generated by the existing system. The question is whether they provide relevant information. Several example are illustrative.

Due to the economic crisis in the country the number of patients in hospitals has dropped from about 500,000 a few years ago to an estimated 200,000 in 1993. The official statistics show that the number of cases of syphilis and gonorrhea have decreased, whereas surveys indicate that the number has increased. The reason is that the hospital data fails to recognize that people have partly stopped coming to hospitals.

Similarly, despite high female literacy and an extensive network of health care facilities, Mongolia has a higher maternal and infant mortality than countries with similar socio-economic characteristics. Respiratory and diarrheal diseases have been the major killers of infants for the past twenty years. The maternal mortality has increased in recent years. In order to improve mother and child health three major programs have been launched: one against diarrhea, another against respiratory diseases, and a family planning program. Lately there has been a slightly decrease in infant mortality, but nobody knows why. Is it a 'mechanical' result of decreasing fertility, or the result of the program against diarrhea, or the one against respiratory diseases, or is it simply a result of under-reporting deaths as some people claim? Answers to these question are vital to efficient public health care (PHC) management. But as the officers in charge of PHC in the Ministry of Health explained, the present system does not answer any of these questions, it simply reports the number of deaths.

The importance of better information in PHC program management can be illustrated further by an example from Henti Aimak where a five year program against diarrhea has been carried out. In order to ensure the management and continuous evaluation of the campaign, two different kinds of information were prepared. First, surveys of mothers who had been through the campaign's education were compared with surveys of mothers who had not, and second, statistical data at the bag level was analyzed. The director of the former health directorate of Henti Aimak maintained that this information support was a prerequisite for the success of the campaign, and claimed that the campaign was a success. In 1986, just before the implementation of the program, 60—70 per cent of the mortality of children under 3 years was caused by diarrhea, and the child mortality rate was 12.6 percent. By 1993, only 10 per cent of the mortality was caused by diarrhea, and the mortality rate of children under 3 years had fallen to 4.0 percent.

Finally, the situation in the province of the Bayanhongor Aimak of Mongolia illustrates the need for cross-comparisons among local sites. Official statistics report a decreasing infant mortality rate (IMR). This is correct but misses a vital point; namely, that there are huge variations between parts of the province. The IMR in the districts varies between zero and 25 percent. By analyzing the reports from each district and plotting them onto a map of the province, a distinct pattern emerges. In the mountainous northern part of the province, the IMR was dramatically high and increasing. In order to take appropriate action, this information is vital. But it is 'averaged away' in the official statistics. Again, the simple counting of deaths, without any concern for where and why the infants had died, is of little help when trying to cope with the problem of infant mortality. For example, in visiting local hospitals here, we learned that the majority of infant mortality occurred at home, a fact not reported in official statistics.

Telecommunication in Mongolia

Both telephone and postal services are used in order to collect health information in Mongolia. Only urgent information, on which the monthly reports are based is collected by phone. The reporting of paper-based and more comprehensive information is slow and not entirely reliable. Mail from a Som to the Aimak center easily takes two weeks, and from the provinces to the capital at least one week must be added.

Telecommunication from computer to computer is barely developed in Mongolia, but a message handling center based on a PC network will soon be established in each Aimak. These centers will have the capacity of 12 subscribers, but the price will be so high that no public sector organizations, particularly those in the health sector, can afford to use it. In this way the tariff policy of the state-owned Mongolian Telecom, and consequently the Ministry of Transport and Communication, poses a serious obstacle to developing a nation-wide data communication infrastructure in the public sector. Only banks, the Stock Exchange and some private companies will be able to use the data network being implemented.

However, an ad-hoc public sector system of data interchange between computers using modems does exist. The State Statistical Office has established a system connecting their branches in the Aimaks to the center. Several times a month routine data is sent from each Aimak to Ulaanbaatar. The frequency varies according to agricultural seasons, as data on animal breeding and harvesting make up a substantial part of the routine data. The network is operated by making a 'manual' call through a manual exchange, from a telephone connected to a computer to a telephone connected to another computer. Once a connection with the operator at the other end has been established, both operators turn on their modems. The transmission starts and the success of the transmission is displayed on the screen. The software was developed by the State Statistical Office and is also used by (at least) the Stock Exchange and the Railway.

A new digital telephone exchange is being installed in the capital, Ulaanbaatar. In the Statistical Office in Bayanhongor we were told that this had already markedly improved the situation. Before, they could spend a whole day trying to get a connection to Ulaanbaatar, but now it takes no more than 5 minutes. They must still order a line through the manually operated telephone exchange in Bayanhongor, however, the speed of the transmission is normally 1200 baud.

In Tov (the central) Aimak, the Statistical Office plans to establish this kind of network within the Aimak. By providing the Som local governments with computers and modems, and using the Aimak office as a communication center, a public sector network at the Aimak level will be implemented. The idea is that documents, mail, messages and data will be sent between different parties in both Soms and Aimak. From the Aimak local government point of view, these slow lines of communication are a major obstacle to efficient management. The modem and computer network should to improve this situation by speeding up communication within the Aimak. First, they will use the network to collect statistics. Thereafter they will use it to send mail. In the beginning the main users will be the local governments themselves, the health sector and other public sector organizations. Banks at the Som level are interested in using the system to remit money. The Agricultural Exchange wants to use it to send data. Finally, the general public will use the system.

In each Som there is a meteorological station transmitting data to the center several times a day, using a leased line. The director of the Statistical Office in Tov Aimak said that they hope to use the free capacity in this network of leased lines to implement their data network. There are computers in about 10 of a total of 27 Soms, but all of these are owned by private organizations. So far, two modems have been distributed for test purposes. At present there is no money available for the purchase of computers and modems in the Som local governments, so the full implementation of the network must wait.

The knowledge of IT in Mongolia

In general, the IT professionals in Mongolia were in the former Soviet Union or Eastern Europe. Only recently have the university and the technical institution in Ulaanbaatar started programs in computer science. This contrasts with the situation in health care where most professionals are educated in Mongolia. Two institutions have played a major role in the history of informatics in Mongolia: the National Computing Center (NCC) — now reduced to the computing department — of the State Statistical Office, and the computing center of the Academy of Science. NCC was involved in researching the technical aspects of IT and in developing practical solutions. Being the processing unit of the State Statistical Office, NCC was also a dominant user of IT, functioning as the Computer Center, processing data, and making statistics for ministries and other state organizations. Since it conducted research in IT, developed practical solutions and used these solutions, NCC played the key role in adapting IT to Mongolia's conditions. However, it is important to stress that the planned economy's need for statistical information was the driving force behind both IT use and development.

A few years ago about 40 programmers and 30 electronics engineers were among the more than 200 people working in NCC. They formed a true center of IT knowledge. But today there are only 12 IT professionals.

The computer department of the Academy of Science has experienced a similar, dramatic decline over the past few years. For example, Monel was a computer company coming out of the Academy of Science. It had more than 200 employees and produced micro-computers and developed software before it closed in 1993. The decline was due to the changing political and economic situation; the state no longer has money for research and the development of solutions. Adapting to a market economy implies that firms must sell services in order to survive. Unfortunately, due to the economic crisis, there is no market, and hence no investment in system development. At the same time, a market economy does not demand the enormous amount of statistics a centrally planned economy does. Thus, a declining market for NCC. The introduction of micro-computers is also part of the problem, since organizations purchase their own computers and process their own data.

A substantial part of the IT professionals in Mongolia worked in these two institutions. Today some of them work in computer departments of different organization and some have started private companies, but a substantial part of the computer professionals in Mongolia are not employed in IT today. They are either unemployed or working in different businesses in order to survive. A typical private company in the IT sector is a computer repair shop which also repairs televisions and other electronic equipment. Desk-top publishing is another sector with some demand. The typical business for a former computer professional is buying commodities in China and selling them in Russia, and dealing on the black market. For example, the apartment block where one of the authors stayed in Ulaanbaatar had been turned into a company involved in a multitude of small businesses — from running the apartment block to trading sheep hides for cabbage from China. The director of this company was a professor in computing at the Academy of Science who had brought some of his research staff with him. The foreman of the truck is a former researcher in parallel programming. Clearly, the decline of these two institution has resulted in a de-skilling of Mongolia's IT capabilities. Further, no new 'enabling environment' or system of innovation has been developed to take their place.

In an 'ideal world', these IT-professionals would have started companies, made innovations, diffused technology and boosted the economy. But in the real world this is not occurring because there is no sustaining market. By using one of the most successful new computer companies as an example, we will illustrate these problems and also possibilities. Sanchir Technologies was founded 3 years ago. They sell micro-computers, train users, and do some software development. Sanchir employs 12 persons. They work mostly in desk-top publishing, and have adapted a graphical package to Mongolian Cyrillic. They have also developed some small systems based on dBase and spread-sheets. A substantial portion of their activities, and their success, is based on two customers — the WHO and the DANIDA (donor money). Within health and education, desk-top publishing is used to produce publications and books in the Mongolian Cyrillic language. These projects include both development and adaptation of software, technical support, and training of users in three Aimaks.

Sanchir is also working on a third domestic project — software development and the adaptation of a movie animation system for the Mongolian television. Unfortunately, however, the latter does not have the money to engage Sanchir at present. Nevertheless, this example demonstrates that an important side effect of the donor money from WHO and DANIDA, which was used to support publications, has been the creation of a sound computer company, the development of software and knowledge, and the diffusion of technology. The Mongolian television company illustrates that appropriate computer solutions are wanted and needed, but are not affordable in the domestic market. This example supports our main thesis: *a market for domestic IT solutions must be created using public or donor money*. When IT is being developed and put into use, demands arise, and enterprises dealing with technical and software support and system development will emerge.

It is clear from these examples that the software being developed in Mongolia has a technical bias; software for data transmissions using modems, and a keyboard for Mongolian Cyrillic. So far, few end user applications have been developed. One reason is that the use of IT is still quite limited, and when it is used, it is still mostly for word processing. Thus far, software development has focused on overcoming the major obstacles to the use of existing software. However, since the polytechnic universities in the former Soviet Union, where most IT professionals in Mongolia were educated, are biased toward hardware and electronics, the technical knowledge and capabilities of Mongolia's IT professionals is high. This may provide some reasons to be optimistic about future developments.

Communicative infrastructure

Integrated, open systems

In the health care sector, the trend towards open and integrated systems corresponds well with the requirement for developing district health information systems. District systems, in turn, permit aggregation of information at higher (non-local) levels of decision through the National Health Information System. This allows the addition of new services such as electronic referral of patients to central hospitals with confirmed time reservations. The problem, however, is one of 'scalability' — how can systems be designed which are useful at the local level but also permit integration and aggregation to higher levels?

Since a decentralized structure requires the integration of lower levels, the information systems to be developed must solve real problems at the local, program, and organizational levels, and at the same time be able to interchange information across different levels. Such systems operate through the country's 'communicative' infrastructure. The process of decentralization of governmental functions and health administration underway in

Mongolia is typical of many developing countries. In health care, this process is encouraged by WHO as part of the PHC strategy. An important part of this strategy is to strengthen local health management and supporting managerial tools. Local processing of information using micro-computers can play a key role in this regard. In the developing world, the health sector typically consists of vertically organized and independent institutions. Throughout Mongolia the Infectious Disease Centre and the pharmacies are examples of such organizations. The Expanded Program on Immunization as well as the Family Planning Program are examples of centralized organizations difficult to integrate below the top level.

Communications as the 'key technology'

In a sense, IT as a whole is a 'key technology'. We argue, however, that open, integrated systems are of particular importance for the developing countries. We have already explained how economic development has generally occurred by sheltering key technologies. In order to connect this general argument with the discussion of communicative infrastructure, one must recognize (or accept) that the relevant 'key technology' is communication technology itself. Accordingly, the Clinton administration has launched the 'National Information Highway' project which aims at providing the U.S. with a high-speed, flexible communication infrastructure. Despite the fact that the development and establishment of sophisticated communication technology is prohibitivelt costly, the deregulation of telecommunications is believed by some to further monopolize the market (Mulgan 1991, Wilson 1992). The rate of adoption and diffusion is some times greater *outside* the OECD countries.

The pivotal role of key technologies in the techno-economic development paradigm makes leap-frogging (the rapid catching-up of economic growth) theoretically possible (Toussea-Oulai and Ura 1991). A recent OECD report on the subject notes, 'Advanced telecommunications, then, seems to offer the perfect example of a major leap-frogging opportunity...By paving the way for the diffusion of modern information technologies, it can be the key to boosting a county's overall growth rate and competitiveness on world markets.' (Antonelli 1991, p. 11). This occurs because, in advanced telecommunications the '...correlation between innovation capacity and internal diffusion capacity appears to be missing...' (ibid., pg. 47). This, perhaps surprising, empirical fact (see Antonelli 1991) is due to a few crucial characteristics of communication technology. First, communication technology is complex in a quite different manner than other 'self-contained' technologies (Schmidt and Werle 1992). Second, it is 'systemic' as opposed to self-contained — to use Antonelli's terminology. Diffusion presupposes the establishment of a comprehensive technological network which represents an enormous amount of sunk investment in equipment. This makes it extremely difficult for early investors to change rapidly. This is exactly the situation a number of the industrialized nations encountered which invested heavily in telecommunications in the 1960s and 1970s; and it is a situation which developing countries should seek to avoid. In Norway, and other Western countries, for example, the data networks were developed before most target organizations realized they could be of any use. The public sector only slowly learned to use the extensive data networks. In Mongolia, on the other hand, the public sector immediately recognized the advantages of telecommunications as the example of the 'home-made' modem illustrates.

An appropriate data network does not exist in Mongolia due to tariff policy. Due to poorly developed telecommunication facilities and her location in the center of Central Asia, Mongolia is among the most isolated countries in the world. As a result, a communication policy should be encouraged to counteract this isolation by setting the lowest possible tariffs on international calls. Now the policy is quite the opposite: the tariff is put as high as possible, making international calls and other uses of the telecommunications infrastructure affordable only to the richest international organizations.

In this chapter, we have emphasized different aspects of learning in connection with technology. We have also explained how learning about the communicative infrastructure which makes open and integrated systems possible is particularly important for developing countries. Recognizing the importance of creating this kind of knowledge is not the same as actually producing it. There are a number of obstacles, not the least of which is the fact that a communicative infrastructure needs a physical carrier. This would typically be the national telephone network; however, these networks are extremely costly, especially in developing countries where resources are scarce.

There is clearly no easy way out of this dilemma. But by being aware of the problem, one can prioritize investments to support an appropriate (tele)communications strategy. Learning to cope with this technology is, as pointed out earlier, crucial for its successful exploitation. In the case of communication technology this implies that rather than waiting to build an infrastructure of equal quality to those in industrialized countries, developing countries should begin immediately, by making use of whatever is available. There are a number of examples of electronic networks which have been established in such an incremental, bottom-up approach through local initiative (Fredrick 1992, Levinger 1993, Schuler 1994). In fact, Horejs' chapter in this volume provides a detailed description of this process.

Conclusions: Toward a national health information system

The availability of appropriate information is the key to efficient public health care (PHC) management in Mongolia, and, we believe, in developing countries in general. We conclude by way of a handful of policy guidelines which may help Mongolia — and other developing nations — build a national health information system.

First, local use and processing of information is the key to improving the quality of information at both the local and central levels. What should be viewed as relevant information depends on its 'granularity', as the following example shows. In a local community like Shargalzuut in Bayanhongor Aimak (Mongolia), infant mortality is too small make generalizations about its causes. But visiting the neighboring village of Erdenetsog, it appears that the mountainous region of northern Bayanhongor share some common features regarding infant mortality. However, this fact is difficult to see at both the national level — since the data is too aggregated — and the local level — since too little data is available. Thus the Aimak — comparable with what WHO calls a 'district' — is the appropriate level for processing and analyzing this type of data.

Second, the WHO calls for the decentralization of health care services (Mills et al. 1991). This corresponds, in technical terms, to the development of relatively independent, semi-autonomous, local systems which allow integration and communication. In short, open and integrated systems. Communication between the various sub-systems requires a data network. Today such data networks, even ones that are state-owned, are expected to function according to free market principles. But this effectively blocks early use of the system. It also seems unreasonable considering that key technologies in industrialized countries moved from a sheltered environment to the marketplace only after some time.

Third, as the Mongolian case clearly demonstrates, specific institutions can play a key role in receiving, adapting and diffusing IT. In Mongolia, the National Computing Center of the State Statistical Office and the computing center of the Academy of Sciences developed both practical solutions and carried out important research. Institutions like these form part of systems of innovation that are important in all nations. As in Mongolia, such organizations and institutions are most often financed by public funds and are thus sheltered from the market economy. The modem based data network described earlier is an example of one innovation coming out of this system; keyboards and software for Mongolian Cyrillic is another. However, in Mongolia there is very little experience with systems development without a technical bias — outside the laboratories and for end-user organizations. Without this experience, we believe, the effective use of IT will not be possible.

Finally, we recommend the health sector as an area for learning about the use and development of IT, since one can improve PHC delivery while at the same time learning to exploit IT. With the Center for Health Statistics and Information in the Ministry of Health already playing, the WHO has funded a distribution of micro-computers to the health administration in all Aimaks. In order to turn this project into an efficient health administration system, new approaches must be learned and experienced. As stated above, such end user solutions are yet to be widely available in Mongolia. Technical knowledge about IT exists, but local users must learn how to use it efficiently. At the Aimak level, the State Statistical Office already has their branches making appropriate use of modem technology. Together with the central health administration the Aimaks could become an important factor in new systems of innovation which are yet to be developed. This is where efficient use of IT must begin.

10 Health care networks: a hierarchical spider's web model

Andrew Clement, Mike Robinson and Ina Wagner

Introduction

The objective of this chapter is to discuss using computers to support cooperative health networks. We use the example of the Nicaraguan Health Care System, including a brief case study of an urban decentralized health care network (Kohl et. al. 1991). The case is then analyzed from three perspectives relevant to the integration of computer support with concrete medical, para-medical, and administrative practice. First we look at social practices of networking and the dilemmas that arise in an environment characterized by a high degree of risk and instability. Next, the Nicaraguan experience is translated into a 'platform' of technical facilities, general requirements and design principles on which to build adequate communication and cooperation support. Finally, we discuss the importance of fostering local cooperative infrastructures, focusing on the need for and emergence of 'local experts' who use the system as part of their ongoing work, but also assume key technical roles, serving as a vital resource in assisting others. The objective of the chapter is to offer helpful insights derived from use experiences in Western industrialized countries.

Decentralized health care: The case of Nicaragua

The World Health Organisation (WHO) concept of Primary Health Care uses a multi-disciplinary approach based on popular education, broad participation and the cooperation of different communities of practice including health personnel, planners, resource persons from the community, and specialists. Health Care is defined as an answer to the specific living conditions, culture and needs of the population. Various 'principles' have been formulated to characterize this approach. These include: 1)the integration of all health services and institutions relevant for people's health including agriculture, education, public services; 2)the participation of the local community in identifying, defining and remedying health-related problems through the use of local knowledge and resources; 3)the integration and coordination of preventive, curative, rehabilitative and health-promoting measures; and 4)decentralization of all services. After the Sandinista Revolution in 1979, the Nicaraguan government adopted these principles and began building a decentralized health care system. A large part of the budget was used to improve the quality of health care and access to medical and para-medical help.

Since the early 1990s, economic conditions have deteriorated dramatically. The new government has revived the emphasis on a curative approach more in tune with traditional images of medical practice, and has diverted its diminishing resources from local health services to a few, hopelessly under-equipped hospitals. In spite of these more recent developments, we think that Nicaragua provides a stimulating case study which helps to understand some of the preconditions for a functioning, decentralized health care network in an extremely poor country.

Hierarchical spiderwebs: The network organization

Nicaragua's national health system is divided into small territories — the communities (largely identical with existing political boundaries) and *Area de Salud* (health regions) which connect an area with similar social, demographic, and economic conditions. The *Ministerio de Salud* (MINSA) with its offices on the national, regional and community level, together with a variety of people's health commissions and associated mass organizations, from the Nicaraguan Women's Association to the Federation of Health Workers, form a fabric of political decision making and planning bodies. The health services are regionally distributed and hierarchically ordered.

At the bottom is the *Case Base*, normally the home of voluntary workers such as 'brigadistas de salud' or 'parteras' ('empirical' midwives) who help establish a stable relationship between people in their immediate neighborhood and the health system. Their main task is to help implement basic health care measures, such as hygiene, epidemic control, rehabilitation, and mother-child programs. They are supported by professional health workers who offer advice and training and exert some control.

On the next level is the *Puesto de Salud* which is permanently staffed by a nurse and periodically by a medical doctor. This nurse is supposed to carry out a variety of health-promoting and preventive measures according to well-defined priorities and may dispense from a small stock of basic drugs. She should keep in touch with the *Case Base* and *brigadistas* in her area, initiate health-related activities, and refer patients to the next level where they can find a doctor. Given the difficulties of transportation, this often 'empirically' trained nurse is frequently in the position of diagnosing and performing medical interventions.

The doctor who works on the next level — the *Puesto Medico* — is the only medical specialist within a given region. Apart from carrying out a standardized program of medical work which has a strong focus on pregnant women, young children, malaria and tuberculosis patients, doctors engage in educational and administrative activities and take an active part in the development of the community as a whole. One important task at this level is the documentation of the population's health conditions.

On the top of this hierarchy of health services is the *Centro de Salud* which is permanently staffed by medical and nursing personnel — some of them specialists such as dentists, gynecologists, psychiatrists — and includes a pharmacy and small laboratory. There are also a few hospitals with clear priorities, and the hospital and the *Centro de Salud* are responsible for the more severe cases. In addition, a *Centro de Salud* conceptualizes, plans and carries out a vast array of programs, including: epidemiological control, rehabilitation, long term psychiatric care, education of health personnel on all levels, care of chronic patients, and even employment programs.

The purpose of this "hierarchical spider's web"of health services is to create a regionally dispersed network of contact points for patients, and to distribute professional resources. Information about the population's health, specific health-related problems, and various suggestions and requests are supposed to travel from the bottom up, and thus initiate activities on the appropriate level. Priorities, legal measures, specifically designed programs, and resources are expected to come back as an answer to concrete, locally identified problems that have been re-defined and evaluated on the various levels.

When patients travel through this system, it is expected that their problems are treated where it is most appropriate, given the severe constraints of finances and personnel. One example may illustrate the importance of such a feedback system. In the words of one doctor, 'If I have identified such and such number of cases of tuberculosis and want to provide them with proper treatment which is long term and very costly, the therapy has to be programmed in great detail and accuracy. A *Centro de Salud* which does not do good work and does not identify and document its cases of tuberculosis, will not get any medication'.

A fair distribution of scarce resources can only function if individual doctors at the community level create reliable overviews of the health situation in their area. This in turn often requires that they personally reach out to the most distant *comarca* (small settlement), establish relationships with the people who live there, and communicate their experiences effectively to the next level.

One can imagine that this kind of network requires dense communication and cooperation, locally as well as over large distances and across professional boundaries, and involves different institutions. Communication is often disrupted, and mending broken channels costs both effort and time. When frustrated and inactive health personnel at the bottom do not reach out actively to the community or when it does not collect information and communicate it, the design of programs and measures at the higher levels becomes disconnected. When programs are not responsive to local needs, they are not effectively carried out. If the MINSA does not have the money to distribute resources, and patients must travel three days by canoe or horse to the next hospital or *Centro de Salud* only to find that they cannot be treated, they may never return to the health system for help again.

An urban Centro de Salud in Managua

To date, there is no computer-supported health care network in Nicaragua. The central MINSA office in Managua collects and processes health data on a national level. The statistics they currently create are designed as information for the Minister of Health. There is a project underway to develop an information system with the help of foreign aid which will build upon ideas of cost containment. At the same time, there is strong interest on the local level to use computers for supporting and strengthening communication within existing social and networks. These local information systems cover one *Area de Salud.* A project in Leon, for example, plans to place a network of six terminals in the city's Hospital Leondra and in the *Centro de Salud.* Although the following case refers to a single stand-alone PC in an urban *Centro de Salud,* it is intended to provide a general indication of the conditions in resource poor settings and of the kinds of networks required to keep them functioning. This social network consists of two Health Centers, twenty local units — *Puestos Medicos* staffed by one medical doctor, a nurses' aid and an administrative helper — and a substantial number of *Casa Base.*

Social networking builds upon three pillars: 1)a patient 'identification' system (supported by a stand-alone PC), 2)recurrent training for *brigadistas* and *parteras* (midwives), and 3)regular supervision. One main task is to identify high-risk patients such as pregnant women, young children with symptoms of malnutrition, and cases of tuberculosis, so as to integrate them into the network. Those patients are registered and visited at home if they do not stay in touch with their *Puesto Medico.*

This fragile network of cooperative relationships is supported by a modest computer application which consists of a database and a suite of statistical programs. Information provided includes:

1 The staff's scheduled home visits to the *barrio* as part of a pre-designed special program, such as malaria case identification. This is an indicator of the degree of activity of health workers.

2 Data on the health status of children under four, collected in a participatory project with volunteers who visited each home and performed some basic tests in the *barrio,* as part of the yearly vaccination campaign.

3 The number of patients referred to one of the health care units. If mothers avoid their local *Puesto Medico* and come directly to the *Centro de Salud,* it might signal problems at the local level.

4 Data on educational activities and meetings with the *barrio brigadistas* as indicators of community participation. For example, each *Puesto Medico* should visit schools and factories and offer a daily 15 minute talk about health related issues.

5 Epidemiological data.

These 'overviews' are presented in the form of tables, graphs and maps. One table may show the percentage of children who are overweight, normal, at risk or definitely undernourished. A graph may illustrate how many cases of diarrhea have been registered by week in various health care units. A map may reveal the spread of malaria cases in the *barrio*. Another map may show high risk areas in the district. These 'overviews' are discussed and evaluated in meetings with the center's medical, nursing and voluntary workers staff.

A clash of cultures

Our small case shows how computer-supported 'overviews' may act as an important feedback system in an environment characterized by risk and instability. One goal for which local networks are being developed is the use of the computer system to identify risk cases. The system may spot a high risk patient who has not contacted the *Centro de Salud,* immediately schedule a meeting with the responsible *brigadistas* to discuss the case, and eventually generatte a visit to the patient's home. Another objective involves the use of the computer system to provide 'proof' used to back up arguments in a difficult political arena. The system may be able to establish a clear relation between the area in which a person lives and his/her state of health.

Networking is made difficult by social and cultural factors. There are enormous difficulties translating an 'overview' into practical work at all levels. Vital information is often not integrated into everyday social practice. One example is the death of infants under one year. In most such cases, all of the frequently-discussed risk factors are present, including inexperienced mothers and malnutrition, yet no-one has sent the child to the next hospital. In this case, the problem is not the lack of effective information transmission but difficulties taking action in a resource poor setting.

Another crucial problem is the clash between traditional professional cultures and the demands of primary health care. Doctors are still trained according to the curative image of medical practice, which in turn is associated with costly and refined equipment. They expect to become medical specialists who diagnose and cure the medically defined part of a patient's illness. Although university education in Nicaragua tries to change this image and each graduate must spend two years in the countryside, young doctors find it extremely difficult to abandon the specialist image and engage in largely communicative activities. One doctor noted, 'Young people don't reject this kind of community work during their *Servicio Sociál* in the countryside, but they cannot see its scientific aspects; they believe that their work is not so much different from what the *brigadistas* do.' Instead of administering their medical routines, they are expected to talk with people about their everyday habits, participate in community meetings, initiate programs, and conduct large-scale inquiries.

Besides this tension between the curative and the preventive image of medical practice, there is a clash between the ordered communication required in a computer-supported network and the people's basic communicative culture. Most people in poor countries communicate locally and directly. More than in highly technical cultures, exchange of information is tightly connected with meeting personally and having the time to explore situation, context and people. Very often communication is not predominantly verbal, but mixed with dramatic and visual elements. The concept of *Educación Popular* builds on this fact by using pictures, songs, theater, and role playing. A concrete and lively presentation of problems, enriched by visual and playful elements, helps people understand and relate what is communicated to their own life. This culture of communication poses a major challenge for the development of a supporting technological system.

Even so, there are good reasons for introducing technology into health care networks. The first is the notorious lack of transportation facilities in poor countries. Often participation in educational activities fails due to the lack of a car or petrol. As public transport is almost non-existent it becomes difficult for ill people to travel even short distances. A second good reason is the system's high instability due to restricted resources. The limits of what is possible are quickly reached, and good solutions are often difficult to replicate because the means are lacking. Provision of the most basic medication is far from guaranteed, or a hospital may have to close its surgery rooms because of broken equipment. When a mother has asked several times in vain for medication for her child, she will give up. When two doctors fall ill simultaneously, one of the *Puesto Medicos* has to be closed.

We conclude from these observations that computer systems should mainly be developed to compensate for the lack of transportation and resources and to support communication over distances and thereby aid effective planning. Thus, health care networks might benefit from: a real-time overview of regionally dispersed events and activities which helps to locate emerging problems and discuss them; a communication function (such as e-mail) which helps to exchange information, and give immediate feedback; and a planning function which helps to distribute scarce resources to where they are needed and patients to where they can be most efficiently treated.

Technical infrastructures for health care networks

There is no model infrastructure for health care networks. Every organization, large or small, rich or poor, has its own needs and objectives, its own way of working, and its own history, including its investment and experience in computing. The importance of the local and specific in design and implementation of computer systems has been identified by Suchman and Trigg (1991) and Kyng (1995) among others. This section will provide a similarly brief overview of experiences from Europe and North America in computer support for cooperative work (CSCW). The specific focus is on e-mail, data banks, user interface issues, and appropriateness since these topics are particularly relevant to the objectives, structures, resources, and cultural factors in health care. They can be seen as supporting the objectives of integrating health care with other activities relevant to health such as education and agriculture; integrating preventative and curative medicine; decentralization; and involving the local community.

Electronic mail

Electronic mail first appeared in 1966, and its use has been increasing exponentially ever since. One estimate puts the number of host computers on the Internet alone at over 30 million. The number of users is estimated to be more than a billion, and the number of messages flowing is beyond countability. Messaging is a phenomenally successful communications application. There is no definitive explanation of why e-mail is so popular, but it is likely that some of the advantages and pitfalls found in current Western expectations and usages will be repeated in the Latin American context.

Advantages First, members of the same community of practice can keep in touch easily. They can communicate effectively at their own pace, on the basis of their own experiences and sense of relevance (Perin 1991), and can use language in a natural way. Second, a more subtle effect is that e-mail helps redefine the notion of 'local'. It is easy to keep in touch with colleagues, friends, and the latest events irrespective of whether they are in the same building or on the other side of the world. Third, experience shows that e-mail encourages informal communication, running alongside officially designated usages. This can be invaluable in maintaining the cohesion, the day to day functioning, and the diffusion of new, relevant information, especially in under-resourced and fragile networks.

Disadvantages First, e-mail is used despite technical difficulties, and despite user unfriendly interfaces. The latter are often little more than raw UNIX, which Don Norman remarked in *The Trouble with UNIX* was '...a disaster for the casual user. It fails both on the scientific principles of human engineering, and even in just plain common sense.' After more than 25 years, the first cheap, user-friendly e-mail interface — EUDORA — has been launched. Second, many expensive software packages have been marketed

(The Coordinator, Higgins, Profs) that take advantage of and build on e-mail, but these are not widely used or liked. Studies suggest that '...messaging overshadows other system based functions ....electronic messaging support is what is most needed.' (Bullen and Bennett 1990). Failure to use functions such as electronic calendars, project tracking, reminders, directories, and expense tracking, is explained by many factors. Some tools require users to spend time on activities they do not normally carry out; some tools benefit mainly those who do not have to use them (Grudin 1989); there can be lack of commitment from management; unclear expectations; lack of 'what keys to push' training; etc. A simple moral is that expensive and sophisticated packages may not give better value than straightforward mail programs. Third, experience shows that formal communication (such as regular placing of orders for supplies) is an area where e-mail has an unimpressive track-record, especially if the organization cannot enforce procedures, or is fragile in other ways. E-mail is a good way to access databases, but a bad medium for the bureaucratic sides of organization such as accounting or database maintenance and updating.

Pilot studies and evaluation In the Nicaraguan case, it would be superficially desirable to network all the *Puestos Medicos* — but this is unrealistic since many of them will be closed due to lack of funds for doctors, nurses, and basic medicines. A sudden deluge of technology, without specific local demand or previous experience, training, and backup is a classic mistake. Pilot studies will be needed to determine the local usefulness of e-mail, and to see whether experiences from other countries are applicable. One starting point would be e-mail for regional communication — networking some regional offices of MINSA, some major hospitals and *Centros de Salud*. It might be possible to link a few, carefully selected *Puestos Medicos* to the pilot network. The justification for funding could be distributing 'official' data, communicating new treatments, warning about newly discovered side effects, requesting information on emergencies of all sorts, participating in joint planning such as for a vaccination campaign, sending emergency orders for drugs, and so on.

Evaluation of a pilot network should look at the strengths and weaknesses of both formal and ad hoc uses in the local context. It should look at specific issues such as how the text/typing skill fits cultural practices that are primarily verbal with handwritten notes. It should look at how skills and experiences gained could support an extension of the network, and how 'local experts' arise. Further developments and new features should, as much as possible, be guided by local need and demand. The expectation is that e-mail consolidates fruitful relations between those with 'something in common'; has a role in the development of skilled local practices; and increases competence in day-to-day management of unpredictable disruptions. On the other hand, it is important that expectations are realistic and grounded in local use and experience.

Databases and planning

A discussion of databases and planning must first address the questions: 'what for?' and 'who for?' It is quite a different matter to establish a system for local use than for organizational use. Local planning can mix the formal and informal. Information gaps can be filled with informed guesses, decisions can be subject to ongoing revision. Support for, and constraints on such processes can come from regulations and directives, knowledge of available resources, and previous training and experience. Communication need not be textual, and may not even be predominantly verbal. It may be mixed with dramatic and visual elements. The formalism and algorithms of computing can be subordinated to the needs of practice, not the other way round, in a technique known as 'Participatory Design'. This approach involves users and their specific work situations in the construction of systems. It utilizes a range of techniques, including: prototypes and cardboard mock-ups (Kyng 1988); Future Workshops (Jungk 1986); games (Ehn and Sjögren 1991); and working scenarios (Bødker 1993). Such methods can result in tools such as the hospital system illustrated in Figure 10.1 which resembles a map of the ward with patient information stored 'in the patient's bed' (Bjerknes and Bratteteig 1988). In this context, it does not matter whether a database is 'formally correct'.[1] What matters is whether it is useful and supports the activities at hand. For instance, it may be easier to utilize a word processor, spreadsheet, or graphics format than some cumbersome, hard to access, and difficult to print database program.

Organizational databases need to operate on a strict formalism. Those who enter, retrieve, or interpret information in MINSA, usually do not have contact with those who originated it. Ambiguity and difficulties cannot be resolved easily, and updating may hit the wrong fields. In organizational systems, these problems arise because information is flowing between communities of practice. Information must therefore 'follow the rules'. Even with a formal system, careful design is necessary, taking into account how the system will be used and how data will be entered. While the more informal types of databases are particularly suitable for 'local' and participatory activities, more formal ones are necessary to manage global organizational resources, keep track of epidemiological developments, or conduct regional and national planning.

User interface issues

One important issue for developing countries is Graphical User Interfaces (GUIs). Usability, ease of use, and ease of learning are vastly increased by GUIs. The term 'WIMPS' summarizes these concepts: 'Windows' for seeing different documents at the same time; 'Icons' for easy recognition; 'Mouse' for pointing and taking action; and 'Pull down menus' for seeing and choosing appropriate actions. GUIs were pioneered on the Xerox Star, popularized by the Apple Macintosh, and are now embedded in Microsoft Windows. GUIs are essential for those involved in health care, but who do

Room 507-1	Room 508	Room 510	Room 512-1
<patient name> Diagnosis: Hospital History: IV doses: Inv: electro car- diogram info	<patient name> Diagnosis: Hospital History: IV doses: Inv: electro car- diogram info	<patient name> Diagnosis: Hospital History: IV doses: Inv: electro car- diogram info	<patient name> Diagnosis: Hospital History: IV doses: Inv: electro car- diogram info
Room 507-2 <patient name> Diagnosis: Hospital History: IV doses: Inv: electro car- diogram info	WORK TEAM HEART MONI- TORING AREA	WORK TASKS	Room 512-2 <patient name> Diagnosis: Hospital History: IV doses: Inv: electro car- diogram info

Figure 10.1 System for storage and access of patient information (Computer screen layout matches actual room layout)

not have the time or inclination to learn operating systems such as DOS or UNIX. Without GUIs, many of the things the computers and networks can do technically are not available in practice. GUIs are more expensive and require faster machines which are also expensive. Cost increases directly with usability; and as a result users in developing countries are least likely to get them.

Appropriate systems

Appropriate interfaces or systems do not have the same financial problems. A multi-million dollar system can be a miserable failure, a cheap and cheerful hack can be just what is needed (Robinson and Paton 1983, Kyng 1988, Robinson 1991b). Appropriate systems depend on an appropriate understanding of organization and work-process. The danger with computerization is that it can put too much info the computer,[2] and in so doing, disrupt important but 'invisible' social processes that have been taken-for-granted. The main achievement of computer support for cooperative work (CSCW) has been to recognize the importance of mundane, everyday interactions, and to indicate what to look for in system design, use, and evaluation. For example, drawing on the last decade of work in Europe and the U.S.A., Robinson (1993) identifies peripheral awareness; implicit communication; double level language; and overview. He stresses that any successful computer use for collective support, no matter how rudimentary, will impact all these phenomena. Space precludes an examination of each category, but two are discussed below.

Peripheral awareness: This means that workers have a background awareness of the activities of others around them. This facilitates coordination, cooperative intervention, misunderstanding avoidance, etc. if and when these become necessary (Suchman 1987, Robinson 1991a, Kasbi and de Montmollin 1991, Heath and Luff 1992). For instance, clinics and their administrations in any country generate 'paperwork' — appointment cards and books, case notes, statistics, address files, correspondences, budgets, purchase orders, and so on. When actual paper is used, it is often coded by color. This approach is cheap and enables workers to immediately identify a specific item, while the size of a stack and its color gives information without explicit questions, or interruptions. This raises questions since there may be a danger in substituting screen-based for paper documents. The very artifacts that make cooperative work possible may disappear from sight and be 'swallowed up' by the computer. Even if only one simple machine is involved, the general visibility and accessibility of records, and easy knowledge of who is making changes, for example, to patient notes, may be impeded. Work can be disrupted because people no longer know what others are doing. Alternatively, workers may not use the system or may continue to use paper. Time and money are wasted because the workers have lost peripheral awareness even if they cannot say explicitly what it is. This is not an argument against computer support, but for being careful about how it used.

Overview It is always worth asking whether an application provides an overview on the field of work that would not otherwise be available. Useful artifacts that afford overviews have a long history and include maps, photographs from the air, watchtowers, exploded diagrams. Computer graphics are a powerful way of gaining overview on medical trends and incipient epidemics that might otherwise be mere numbers to health workers. The patient information system considered earlier (Figure 1) provided the nurses — and later the doctors — with an overview of the ward that was not otherwise available. However, computer supported overview does not have to be graphical. For example, the *Puestos de Salud* and *Puestos Medicos* have difficulties ordering equipment due to scarce resources. Drawing on the work of Kreifelts et al. (1991) equipment ordering using e-mail messages could provide an effective solution. Read-only access to the order database could provide a useful overview. It would show when an order had been placed or received and could provide an alternative means of communication between individuals and locations. As a result, an overview that would not otherwise be available could be provided at very little extra cost and with possible savings in bureaucratic time and goodwill.

Conclusions

CSCW has labeled some essentially human processes, such as peripheral awareness and overview, that are indispensable for effective office work. Any and all of these processes may be dramatically supported or disrupted by the introduction of computers. What actually happens is a function of how far developers are able to involve user experience in the design and modification of interfaces, applications, and systems. It is likely that e-mail will be appropriated by users to support their work, even if the interface is not wonderful. Applications to support team work in a clinic need to take account of how the work is actually done. People often need to be aware of what others are doing. Where possible, computer support should not impede peripheral awareness, and where possible, should provide overview. Even at higher administrative levels, applications such as order databases should attempt to minimize abstraction, involve users in design and, as Henderson and Kyng (1991) point out, 'design for redesign' in use.

Social infrastructures for computer support

The need for social support

In addition to the technical aspects of the information/communications infrastructure discussed in the previous section, we must pay attention to social aspects. We are concerned with the ways people interact to share and develop knowledge vital for the ongoing operation of the computer systems used for cooperation and coordination. The focus here is on fostering the cooperative social networks necessary for supporting the technical facilities which in turn support the health care networks. Posed recursively, this suggests that the two social networks — the primary one health-oriented, the second, information technology-oriented — share some important characteristics.

Principles corresponding to the WHO model for health care are likely relevant for supporting computing facilities, especially in resource poor countries such as Nicaragua. Both networks have to address tradeoffs involved in responding to local needs arising out of situations of everyday life in which scarce, technically sophisticated expertise and resources are sometimes vital. The aim is to maintain robust functioning at basic levels for as many people as possible. Detecting problems early and dealing with them promptly in situ reduces the need for much more expensive intervention later once they become urgent.

Investigations of social infrastructures of computer support in industrialized countries are quite underdeveloped in comparison to the enormous attention accorded the technical facilities themselves. A widespread expectation is that once suitably powerful, 'user-friendly' computing facilities have been selected and installed, appropriate usage will automatically follow. While there have been notable accomplishments, the process of achieving them is not always smooth. There are chronic complaints about breakdowns of various kinds, incompatibilities between components at all systems levels, inabilities to exploit powerful features, delays in getting work out, lost documents, inconsistencies in file management schemes, inscrutable interfaces, inexplicable errors, etc. Any positive results have to be seen not simply as flowing from the technologies involved, but also from the much less well recognized accomplishments of skilled and dedicated users who have knit together heterogeneous collections of complex information artifacts into productive systems.

There are several reasons for the problematic character of desktop computerization. Partly it is a result of technical deficiencies — primitive interfaces, complexity of operational features, lack of standardization, technological flux, etc. as well as poor management including lack of planning, training, and technical support. Most fundamentally it has to do with the situated nature of the work and its transformation which requires dealing locally with contingencies that arise in the course of the work (Suchman 1987). No devices by themselves exactly fit the task requirements, and some customization and fitting must always be done. The need for this articulation work (Gasser 1986) is especially clear in the case of desktop computing, where it is necessary to bridge the gap between the generic capabilities of common software packages and locally specific task requirements.

Local experts and support webs

The most visible response to these difficulties is the continuing demand for more training and technical support. It is now becoming widely recognized that ongoing training is a requirement as long as the technological infrastructure is in flux. Complementing this is a growing range of support services, notably internal and vendor hotlines, that users can call upon. However, there are indications that even where such facilities exist, the problems persist (George et al. 1990). Local collaboration and problem solving plays a critical role in supporting computer use (Bannon 1986, Clement 1991, Gantt and Nardi 1992, Nardi and Miller 1991, Mackay 1990). Furthermore, a UK research firm found that an overwhelming proportion — 91 per cent — of the expense of PC systems is in such 'invisible support costs' (Child and Dubash,1993).

There is a recurring discovery of the importance of 'local experts'[3] — people whose primary expertise is in the local task domain but who help others in the work setting with their computer use. They assist in answering questions, customizing applications, dealing with breakdowns of various kinds, suggesting improved methods and otherwise resolving difficulties in the use of computerized information systems. Several studies have found that users find their colleagues, principally these local experts, actually more helpful than officially designated technical support personnel (Bannon 1986, Clement 1991, George et al. 1990). It is not by coincidence that this role of passing on to co-workers information from outside a work group is very similar to the gatekeeper role identified in diffusion of innovation literature. Indeed, the cumulative effect of colleagues helping each other over the many hurdles of everyday computer use is the development of an innovative, locally adapted work practice.

Having identified local experts as vital, however, does not mean that they can be relied upon exclusively. Many people who assume this role are self-taught, and so by lacking formal training run a greater risk of making basic errors or overlooking important opportunities. Furthermore, when they have to juggle the demands of their official work with the pressing requests for assistance from others, these individuals may 'burn out'. To avoid these potential problems, their important role needs some formal recognition. They need to be given additional time and resources (Gantt and Nardi 1991).

While often a single person emerges from a group to become the pivotal resource, there are other social processes at work. If other members of a work group simply depend on the local expert to provide all the answers, the overall capabilities of the group are likely to stagnate, and even regress if the local expert withdraws to avoid being overloaded. It is important that requests for assistance be seen as learning opportunities so that expertise is passed on and people become more capable of dealing with problematic situations in the future. Furthermore, as packages and applications proliferate making it impossible for one person to handle all inquiries, it becomes important that others in the group take on their own specialized responsibilities. To some extent this process can occur on its own, but in general, it needs active encouragement. A significant benefit is that it can help relieve some of the problems of overload and role conflict which come with local experts. The emergence of such webs of learning and mutual support help us to see workgroups not just as collections of individual computer users but rather as evolving communities of use, in which there is specialization of the role and regular patterns of communications and assistance focused on computer use.

Problems that give rise to the need for the invisible networks of social support are likely to be more severe in developing countries. The technologies are generally more primitive, users less experienced and trained, technical expertise and spare parts not so readily available, and so on. The communicative culture — 'the exchange of information is tightly connected with meeting personally and having the time to explore situation, context and people' (p.181) — may be an important resource in fostering support networks. There is a small but growing recognition that the qualities of personal interaction focused on concrete, rather than abstract, information handling practices are often neglected in conventional systems development activities (Greenbaum and Kyng 1991). The informal networks of support which appear to be a vital aspect of the effective functioning of computing technologies in industrial countries will not only be *more* necessary in developing countries, but might also work better in these settings since they may be part of normal work practices. Perhaps too, they will not have to compete as much with the presumptions of technological primacy which afflict so many technology promoters, managers, specialists and, in turn, users?

Hypothetical support networks in the health service

With these general observations about the social practices of computer use and support in mind, we are in a position to explore the possibilities of a hypothetical support structure for computer based networking in settings similar to the *Centro de Salud* case. The following discussion elaborates what a "hierarchical spider's web" for supporting computer work might look like. It focuses on four main sets of connections. The primary one is in the local unit, the point closest to the provision of service and furthest from any centralized technical expertise. The local unit is where the smooth integration of computing facilities into the on-going work is most critical. The second focus will be on the vertical relationship within the Health Service, between the local unit and the technical specialists at higher levels in the organization. Third, we look at how local units may communicate among themselves to share computer information and resources. Finally, we explore how the support web may be extended beyond the health service, both in the local area of the centers as well as globally. In each case we will look at the principal actors involved and their roles. 'Local experts' reappear throughout.

Local internal webs Within the work group, primary relations of support, centered on the local experts, must be established. These relations are general to computer support, not particular to computer networking applications, although they add the complexity of dealing with people not physically present. Although the person who uses the computer most often becomes the local expert, this is not necessarily the overriding factor. Other important factors include an interest in technical aspects, a willingness to experiment and study manuals, and a desire to offer assistance. Since effective local experts provide their co-workers with information helpful in specific situations, they need to combine familiarity in work tasks with a strong aptitude in technical matters and good social skills. Local experts cannot be picked based on formal qualifications alone, but will often be identified implicitly as the group's patterns of support emerge. Once it becomes clear who is most suitable, relief from a portion of their regular duties should be given to avoid 'burn out'. Solving problems and customizing configurations can be quite time consuming, and this needs to be recognized as a legitimate part of the job.

Vertical internal webs An important connection will be between local experts and technical specialists higher up in the organization who have formal training in hardware and software and are familiar with the main applications in their region. Part of the regular responsibilities of these specialists will be to provide assistance to local groups. Much like their medical coworkers, they could make periodic tours of sites, offering focused training sessions, encouraging good data hygiene (backups), passing on tips from other sites, answering questions and assisting local experts. On occasion technical specialists may become involved in solving problems that the local expert is unable to handle. Between visits, contacts can be maintained via e-mail.

Horizontal internal web Local experts will have much in common across the various work groups and hence have a basis for sharing information and experience. Like vertical connections, these contacts could be conducted in parallel with the exchange of health related information between the various health care sites in a region. In this case keeping in touch might involve identifying recurrent problems, sharing tips or getting help with questions about supporting computer use. An important advantage could come from not having to 'reinvent the wheel' in each of the sites. This communication would generally be fairly informal and take place between local experts. E-mail and bulletin boards are promising in this regard.

External webs Local experts will also find they can gain useful information from others in their immediate vicinity about dealing with hardware and software packages not highly specific to health care. Here the emphasis is on being able to meet other local experts in person to talk about and inspect hardware and software. Since the health centers are ideally, according to WHO principles, in touch with other agencies in the immediate locale who also are computer users, this may provide a starting point for technical exchanges. A rather different possibility for external contact through computer networking facilities is access to technical experts around the globe. On the Internet (via the NICARAO listserver operated in Central America by the Association for Progressive Communications) there are several Listservs (e.g. DEVEL-L) which enable people in developing countries to pose questions to other subscribers. This is perhaps more relevant to questions of computer support than health care because access to electronic networks is much more a part of the working experience of computer specialists than medical personnel.

These social support networks cannot be 'installed' in the same way that devices and wires can. Since these webs depend heavily on existing patterns of work, they must be encouraged to 'grow' out of immediate conditions. Developing these networks will be an obvious concomitant to the participatory approach to systems development. When the people most heavily affected by the system play an active role in discussions about its intended use, selection of relevant features, and even design of the application, it will not only improve the chances of developing a system appropriate to their needs, it will also put in place an invisible social infrastructure that will enable the system to be used in a continuing and reliable fashion.

Conclusions—the Cooperative Support Model

This chapter has outlined an approach to supporting health care networks which adopts an hierarchical spider's web view of health services. Our main concern is that special attention be given to integrating the information system into existing social and organizational networks. The system should be designed with a particular local community of practice in focus. Is structures and functionalities should be based on close collaboration with this community and a careful analysis of work practices. Such an approach requires those responsible for the design and implementation of a computer system to engage in field research based on ethnographic and observational techniques together with interviews. These research methods help identify the problems inherent in 'specifying' the activities in which people engage as individuals, when collaborating in groups, or over professional and space-time boundaries. They help to make more visible, for the purposes of systems design, the particular social and organizational fabric in which particular activities are embedded. The need for this approach is based on the observation that it contrasts with current practices of simply 'exporting' products and technical 'solutions' to developing countries; or even worse, of using these nations as a dumping ground for out-of-date, unsuitable hardware and software.

Although we are not in a position to give detailed 'recommendations' to project teams intending to develop a small sized, local health care network when facing a situation similar to the Nicaraguan case discussed above, we do feel that some conclusions are warranted. These conclusions are based on the results summarized in Table 10.1. It compares the 'cooperative support' model we advocate with a more conventional centralized approach, contrasting each of the three main areas discussed in the chapter: health practices, technical infrastructure, and social infrastructure.

A closer look at health practice in a country like Nicaragua shows that the main reasons for promoting a 'cooperative support model' of technology design are rooted in the way health care is structured. The preventative approach involves a different set of practices and social relations than the curative approach common in the developed world. Its main pillars are the integration of health care with community development; a high degree of participation of the local community in planning and organizing health services; a proactive attitude based on the necessity to anticipate problems; and an active outreach to patients who would otherwise not be in touch with the health system. The focus is less on highly sophisticated and highly diversified medical technologies and services than on a narrow repertoire of standardized medical programs and on dense cooperation across (professional) boundaries. Another main characteristic is the importance of decentralized, local services which need to be networked rather than centralized services found in hospital centered health systems.

This particular social and organizational fabric, together with insight from research on computer support for cooperative work (CSCW), suggests a specific set of features for appropriate supporting technology. In situations similar to Nicaragua, computerization in the sense of automating work flow or expert decision-support systems appears even less meaningful than it does in a highly centralized and specialized world. There is a need for distributed and inter-operable systems. CSCW research has stressed the importance of open and flexible technical platforms which can accommodate a variety of local practices. One of the pillars of such platforms is a reliable, easy-to-use communication function based on e-mail. E-mail seems particularly suited to support reciprocal informal interaction — especially between actors with shared concerns and common ground developed in local contexts. E-mail makes local actors more accessible and responsive, and strengthens the visibility of activities and concerns within regionally dispersed communities of actors.

Another major task is to carefully analyze the information needs of local actors and to spend some creative energy on developing 'overviews' that effectively support decision-making, stimulate discussion, and help clarify ambiguity. These overviews can be quite simple and are often an unanticipated by-product of a system which has been primarily designed for other functionalities. Certainly for people with a culture of representing and communicating based on concrete, narrative, and often pictorial information, computer graphics provide particularly powerful tools for expressing ideas.

Finally, it seems necessary to develop a counter strategy to the prevailing top down approach of administrators and donor agencies whose main concern is to create a database for national statistics, budgeting, and cost containment. In contrast, a local health care network should emphasize a more informal database approach flexible enough to be adapted to a variety of possibly unforeseen applications.

In light of findings that local collaborations and artful problem solving play a critical role in computer use, we argue that great care should be taken in exploring and defining the role of local experts, including the training and organizational support they need. The role of such invisible networks of social support is to sustain the robust functioning of the technical infrastructure and to help customize and fit it to the specific context in which it operates. This latter task is even more important when off-the-shelf generic software is used. In developing countries there is likely to be less specialized technical expertise available, as well as fewer resources for recurrent training and continuous maintenance of hardware and software. This makes the practice-based, rather than system-focused, expertise of local actors particularly valuable. They are familiar with the work tasks, have access to resources and knowledge, and have experience in getting around constraints. While formal technical training has much value, we stress the importance of a wider spectrum of practice-related knowledges and skills.

The Nicaraguan case suggests the importance of basing system design on an understanding and respect for the work practices of local communities, and on their needs for networking. This requires an approach based on a

Table 10.1
Summary of alternate models

HEALTH PRACTICE

MAINSTREAM MODEL	COOPERATIVE SUPPORT MODEL
Curative Approach	Preventative Approach
Stand-alone medical services	Integration of health care with community development
Centralized Services (hospital centered)	Decentralized, local services
Expert (physician) based	Participation of local community
Reactive	Proactive — anticipating problems, outreach to patients

TECHNICAL INFRASTRUCTURE

MAINSTREAM MODEL	COOPERATIVE SUPPORT MODEL
Computerization	Computer support
Centralized and top-down	Distributed and integrated
Aggregated, vertical statistical reporting	Intense mutual monitoring — Overviews — Reciprocal informal communication (e-mail)
Formalized organizational databases	Informal local databases
Abstract information handling	Concrete information handling

SOCIAL INFRASTRUCTURE

MAINSTREAM MODEL	COOPERATIVE SUPPORT MODEL
Technical support and formal training	Recognition and fostering of local experts
System-focused	Practice-based
Hot-lines, standard user manuals	Building support webs — local internal — vertical internal — horizontal internal — local external — wider international

cooperative support paradigm and the desire for administrative control of regionally distributed heterogeneous operations.

Notes

1 By 'formally correct', we mean a relational database in 3rd normal form, whereby the formal procedures of checking atomicity, non-dependence, and non-redundancy have been rigorously observed (Maier 1983). It goes without saying there are limits to possible incorrectness in a looser sense — we are not asserting that bad programs work!

2 Artificial Intelligence, and its twin, the 'Expert System' have *not* provided any solution to this. The theoretical foundations of AI have been devastated both by one of its main founders (Winograd and Flores 1986) and by powerful critics, e.g. (Dreyfus and Dreyfus 1986, Suchman 1987). More telling, after decades of very expensive research, there are almost no 'expert systems' in practical use — a very good example of multi-million dollar failure.

3 There are many different terms used to describe the local expert role. Here are just a few: 'local supporter' (Henderson and Kyng 1991); 'gardener' and 'guru' (Gantt and Nardi 1992); 'translator' (Mackay 1990); 'tinkerer' (Maclean et al. 1990). 'Local expert' is used by Bannon (1986) among others.

11 IT in rural development planning: the case of Nicaragua

Irene Horejs

Introduction

This chapter analyzes the role of information technology in rural development planning. The first section gives a short introduction into the theoretical debate about regional planning for rural development and the role of information technology in this process. Viewing rural development as a process of socioeconomic change aimed at reducing poverty and inequalities among the population of rural areas, regional development planning is defined as a decentralized, participatory decision making process. The main potential benefit of information technologies (IT) is its potential to enable not only better informed decision making but also organizational change and improved working procedures.

The second section contains a description and analysis of the concrete experience of establishing a computer supported information system as part of a regional planning system for rural development in a Northern Nicaraguan region between 1988 and 1990.[1] The author, who participated in this experience, describes the concept and procedures of establishing the system and critically analyzes its successes and failures. The final section employs this case to draw some general lessons about IS development and design and to identify some critical factors concerning implementation.

IT in regional planning for rural development: some conceptual issues[2]

Toward an operational definition of rural development

For the purpose of this article, rural development may be defined broadly as, 'Improving the living standards of the mass of low income population residing in rural areas and making the process of their development self-sustaining' (Lele 1975, p. 20). Uma Lele's broad definition is useful because it emphasizes that:

1 the ultimate goal of development is to reduce poverty and inequalities,[3]

2 rural development goes beyond agricultural development and involves natural resource utilization and conservation, rural industry, health, education transportation and so on,

3 rural development refers to a socioeconomic and political process within a certain area which has to rely on local capacities; any development activity has to strive to strengthen these capacities.

Defined in this way, rural development appears to be a process of rural change which requires some sort of intended and planned intervention[4] in the form of policies, programs and projects. Ideally, such interventions should be based on reasonably accurate information, target relevant needs and constraints of the rural population, comprise multisectoral and integrated activities and mobilize local knowledge and resources. This definition implies that effective development calls for a planning approach radically different from blueprints conceived at the commanding heights of the state. According to Conyers (1985, p. 60), '...regional development planning means managing socioeconomic change at a decentralized sub-national level involving many decision makers and actors of which the state is but one.' Thus, development planning goes beyond the formulation of plans and programs.

To some extent, development planning may be considered a decision making process involving six basic steps: 1)information collection and analysis, 2)goal formulation, 3)designing alternative courses of action, 4)choosing among these alternatives, 5)implementing the decision, and 6)control and feedback. Each step is briefly discussed below.

Information collection and analysis This refers to the collection and processing of relevant data and information in order to identify potentials and constraints for the socioeconomic development of a particular area.

Goal formulation Given the previously identified potentials and constraints, broad development objectives are defined and broken down into more concrete targets.

Designing alternative courses of action This refers to the design of several different programs or projects to achieve the specific targets and development objectives.

Choice Using a broad range of relevant criteria, one of the alternative actions is selected. Ideally this decision should be based on the economic, financial, institutional and environmental evaluations of the different project or program proposals.

Implementation Implementing the selected project or program often involves another entire (operational) planning and management process.

Control and feedback The final step consists of monitoring the results and effects of the implemented activities as well as other factors in the economic environment which may influence the development process in the area.

This decision making process is, of course, not a linear one. It is iterative and its steps may overlap. Control and feedback, for example, is strongly related to the first step — information collection and analysis — since new information about problems and potentials may lead to necessary changes in the course of action.

The steps in this planning process have many similarities with corporate strategic planning (Bryson and Roering 1987). Two factors add to the complexity of the regional development planning process. First, socioeconomic regions are highly open systems whereas business organizations are relatively closed systems in which substantial control of the planning unit's resources is assumed. In contrast, most regions do not control their economic resources and the actual scope of their decision making is usually constrained by a substantial dependence on the national government for financial transfers. In addition, local development efforts may be in conflict with national policies and programs which are frequently designed without regard to the interests of a smaller region. Therefore, regional development planning requires, among other things, strengthening the negotiating position of the regional unit *vis-à-vis* the national administrative unit (Boisier 1978).

Second, regional planning requires the systematic inclusion of stakeholders at different levels — be they sectoral field staff, local governments, private organizations or simply the population of the concerned rural communities — in virtually all six steps of the planning process. Not only is this necessary to ensure the effectiveness of a particular project, since people are providers of information and resources and the main actors in the development process; local participation is also an essential component of a democratic society and a basic requirement for the well being of the individual and the community. As such, people's participation is a development goal in itself.[5]

To ensure a planning process that actually contributes to attain the goal of rural development, organizational and procedural factors are crucial. Therefore, Conyers (1985) calls for an operational rather than a substantial theory of regional planning. According to Conyers, subnational or 'regional' development planning has to facilitate four outcomes:

1 popular participation as an end in itself and as a means for improving the quality and relevance of plans as well as their implementation and acceptance (including the contribution of local resources of finance and labor);

2 multi-disciplinary 'horizontal' coordination among the different (usually hierarchically organized) sectors at the local level;[6]

3 the 'vertical' integration of local plans and activities into national policies and programs in order to ensure the consistency of regional and national development activities;

4 translating macroeconomic policies and targets into detailed programs and projects which can actually be implemented.[7]

This implies that regional planning include the socioeconomic and land use and management dimensions of planning and should seek to integrate a number of different levels of planning paying particular attention to lower (local) levels. What is required is a decentralized approach to planning, in which 'the main responsibility for making and implementing decisions rests with people in the regions and planning becomes an extension of the exercise of decentralized political and administrative power' (Conyers 1985, p. 46). Planning procedures must therefore be relatively simple and allow for the active participation of governmental field staff, popular organization and the people themselves.

IT in regional planning: the importance of an 'IS' approach

The definition of regional development planning as an iterative decision making process somehow similar to business strategic planning suggests an enormous potential for the application of IT to support one or several steps of the decision making process. Indeed, computers may facilitate the storage and presentation of data, increase processing capacities, facilitate the evaluation of alternative investment projects or other specific parts of the planning process, such as land use planning. The technical options range from these relatively simple applications to far more complex Decision Support Systems and Expert Systems (Sprague and Carlson 1982, Guariso and Werthner 1989). The technical possibilities of IT have raised high expectations in developing countries and among development agencies since IT provides a means to increase productivity and transparency in public administration, a substantial number of World Bank financed development projects are concerned with the development of computer applications for and within public administration. Madon (1994, pg. 2) reports several developing countries plan to introduce large scale computer based information systems in their regional or district development planning and administration systems. Yet, while high expectations have led to considerable investments of scarce development funds, the results of such projects have, so far, been ambiguous. Institutional weaknesses, the lack of acceptance and of trained people, as well as poorly suited and unreliable communication infrastructures are said to be the most important limitations in the above mentioned World Bank projects.

Avgerou and Mulira (1994) define the problem as a conceptual one and criticize the technology centered approach of many IT projects and research. They note, 'To apply modern IT with the aim to speed up existing procedures and to save labor costs in the context of a developing country misses the potential benefit of IT' (p. 16). They advocate a clear distinction between computer applications and information systems (IS) in a much broader sense, independent from a particular means of technology and including the organizational context.

Our considerations from the previous section underline this point of view. The substantial and procedural characteristics and requirements of a rural development process imply somehow the need for a concept of IS that goes beyond the pure computerization of a decision making process. One constraint for computer centered solutions — the development of more complex computer applications — results from the complexity and openness of the socioeconomic system as such. Rural change is determined by multiple and interrelated factors within and outside the scope of regional decision making. Any attempt to model these systems will constitute an unsatisfying simplification and therefore be of little practical use. Hence, the application of modern IT must be necessarily be part of man-machine systems and use to support very specific parts of the planning process.

The shortcomings of a technology centered approach appear even more clearly if one takes into account the complex but indispensable organizational and procedural requirements for a participatory multi-level planning process which incorporates information and communication are essential components. Multiple problems arise from dysfunctional information flows. Policy and program decisions suffer from inaccurate and unreliable primary data due to the lack of an institutional registration capacity and 'registration culture'. Rather than use information and 'rational' decision making procedures, investment decisions are often based on informal cultural values, power and/or kinship relations. Informal information flows and power structures coexist with formal ones and influence decisively the actual behavior and activities of people. In addition, top down procedures and hierarchical decision making structures are much more common than participatory approaches. And even if there is an opportunity for people to express their opinion, their effective participation is heavily constrained by their lack of (access to) information.

Therefore, it might be of little use to computerize existing information procedures. According to Avgerou & Mulira (1994, p. 16), this would 'even bear the risk of rigidifying or worsening the existing limitations by destroying the flexibility of the manual and often informal handling procedures'. The obvious necessity of improving development planning and procedures requires 'a much broader approach and a concept of information systems which includes the people who take part in information handling, both the formal and informal information and communication processes and considers not only computer technology but any kinds of technology which assists in information recording, processing and communication such as office equipment and others' (Ibid, p. 15). Computers are tools for information systems which attempt to improve the functioning of an organization and whose ultimate success is measured in terms of the achievement of the mission of the organization. It is in the potential to enable organizational change, to support new forms of organization, new working procedures, where the most significant benefit of IT are found.

Research on the impact of information systems on the internal organization of firms and on relationships among firms supports this view. Gurbaxani and Whang (1991) have examined the influence of IT on organizations and markets and confirm that the use of IT may effectively induce a change in the firm's internal and external structures and relations. They note, 'Whether the use of information technology supports a trend towards centralization or decentralization of decision making power within a firm, depends on other organizational and environmental factors, such as the role of information systems in the firm, characteristics of the information flows, and organization culture' (1991, p. 71). In contrast, concerning the firm's external relationships (the relationships between organizations), it seems that the use of information systems favors a trend toward decentralization and market relations rather than centralization and hierarchies. The authors argue that information systems may reduce transaction costs and facilitate the access to information also for smaller units. By providing considerable external economies, information technology may stimulate a tendency towards a decrease in firm size as it strengthens the position of smaller units.

As in firm and market relations, the use of information technology may promote organizational change in multi-level planning systems. Madon (1994), in her study on the CRISP[8] Project in India, found that one of the most important effects of the information system several years after its implementation was a trend toward the empowerment of decentralized units *vis-a-vis* the central state government. However, it had been critical to improve the training of people at the district level to enable them to actively participate and to perceive their own interests and opportunities in the information system.

Considering the benefits of IT to enable organizational change and viewing information systems as more than new technology applications has far reaching consequences for the requirements of IS design and development.

An IS for regional development planning is a project of social and political dimensions and is an essential component of the planning process itself. Thus, on one hand strategy formation has to depart from an analysis of the functionality of the existing information flows within the regional decision making procedures. This analysis has to include the organizational context with its formal and informal power relations, the role and behavior of the different key actors and interest groups, and the sources of power and the way decisions are made and conflicts resolved. On the other hand, strategy formation for an IS needs the formulation of a vision of the role and functioning of the different organizations in an improved regional planning process which can then be translated into organizational arrangements, new working procedures, and instruments, including the potential function and conception of computer applications within this future planning process.

An IS for regional development planning: the case of Nicaragua

The following case is an example of an information system designed and implemented with the broad 'organization driven' approach discussed above. It refers to a computer supported regional information system striving to increase the effectiveness and efficiency of local and regional development planning by strengthening the position and capacity of community organizations and local governments. The experience was carried out by the regional planning department of 'Las Segovias', a predominantly rural region in the north of Nicaragua (350,000 inhabitants; 9,000 km^2) between 1988 and 1990. (The effort ended abruptly due to the change of government and the virtual dissolution of regional governments). As a member of the regional planning department during this period, the author of this paper was directly involved in the experience.

Background

Until 1986, 'Las Segovias' had been one of the principal scenes of the civil war against the Sandinista government. In the period examined in this paper, military activities had decreased. However, definite pacification required urgent development efforts to satisfy the basic needs of the impoverished population. As a response to politically popular claims on the one hand and to the many problems and failures of centrally planned development programs on the other, the Sandinista government implemented administrative decentralization thereby strengthening regional and local governments. In 1988, the region was administratively organized into 26 municipalities, each including 10 to 40 communities. While regional and local governments were given more authority for local development planning and implementation, their actual implementation capacity was rather limited. For the most part, the different sectors had remained vertically organized, responsive to national ministry levels rather than to regional or local governments. National resource allocation occurred mainly at the national level along sectoral lines and priorities. Hence, the implementation capacity of local and regional development activities relied on the local and regional government's capacity to coordinate the different sectors by mobilizing local resources and the financial support of external donors.

The development efforts of the regional government consisted mainly of five foreign-financed rural development projects implemented by the regional planning department and local governments. In addition, different sectoral programs steered from the central government level were carried out by the local staff of each ministry. Common to all projects and programs was the claim for participatory approaches and for the mobilization of local resources (mainly labor).

Although multi-sector development plans were regularly elaborated at both regional and local levels, the lack of a consistent development strategy and an institutionalized planning system was clearly felt. Regional planning and decision making lacked relevant and opportune information. Although sectoral staff at all levels spent several days per month writing reports, information was compartmentalized and dispersed, and rarely used for decision making. Monitoring the activities of regional development programs and projects consisted mainly of the registration of the delivery of data.. Evaluation was carried out by external units whose reports were rarely communicated to the regional project management where they made little impact on decision making. Regional management's feedback was mainly based on close contact with local governments and the rural population. This feedback was good enough to report problems associated with programs and projects.

Objectives of the regional information system

In 1987, the regional planning department proposed that an information system be established to generate a regional information base containing basic data on population, production, health, education, etc. based on the traditional territorial organization of communities and municipalities. The data base would substitute for sectoral data collection and allow for the monitoring and evaluation of project interventions (especially in integrated rural development projects), the development of a more consistent development strategy, and the planning of programs and projects. Initially, the principal users of this information were to be the regional government and sectoral institutions at the regional level.

By establishing an intersectoral information base at the community, municipal and regional level, the information system sought to:

1 strengthen horizontal (territorial) coordination *vis-á-vis* the vertical hierarchy by inducing a sequence of intersectoral planning, implementation and evaluation of activities spanning different territorial levels;

2 be part of a 'bottom up' planning process by increasing people's knowledge and allowing common interests and solutions to be

identified, thus enabling effective participation in territorial development planning;

3 increase community mobilization and improve the responsiveness of public institutions as well as the region's bargaining position *vis-á-vis* the central government.

Design of the information system

Upon approval of the regional government, a small team of two social scientists from the regional planning department was charged with the design and further development of the system. This included defining the structure and particular content of the information base as well as the procedures and instruments of data collection, processing and planning.

The point of departure for IS design was determined by the existing administrative divisions and traditional social units (region, municipality, community and family), the potential role of each level in an improved bottom-up planning process, and the requirements of information to adequately fulfill this role (see Table 1). Based on the organizational goals mentioned in the previous section, the IS structure sought to strengthen the position of municipalities.

In order to define the concrete data to be included in the information base, the team made various inquiries among and analysis sessions with all potential users and stakeholders, in particular regional and local sectoral staff as well as local governments. This process of consultation resulted in a range of required data classified by sources of information in 'Basic Data' — those available at family level — and 'Complementary Data' — those available at institutional levels. Basic Data included:

Population data: age, sex, profession, occupation.
Education: educational levels, demand for education, problems in service delivery, felt needs.
Health: morbidity patterns, housing conditions, sanitary conditions, water supply, hygienic and curative habits etc.
Production: natural resources, land ownership, cultivation patterns, agricultural techniques, provision of inputs and marketing of output etc.
Family income: non-farm economic activities, occupation and status of women etc.

Complementary Data included:

Social and production infrastructure and services.
Main enterprises and employment figures.
Recreational facilities and cultural activities.
Popular organizations and social movements.
Development efforts in implementation.
Foreign aid contacts (city sisterships etc.).

Table 11.1
Description of the information base

Level of institution	*Participation in planning/ potential use of information*	*Activities for the production of information*	*Form of information available*
Family	Participates in community decisions.	Provides information about basic data; participates in aggregation at community level.	Family Information Form (hand written).
Community	Plans and negotiates community projects and communal services with municipal authorities.	Team of community leaders collects basic data at family level and carries out the first aggregation. Provides communal complementary data.	Community Basic Data Form and Community Complementary Data Form (hand written)
Municipal (Local government)	Planning for local development and provision of social services. Negotiation with higher levels of government as well as donors.	Organizes and supervises data collection and aggregation. Elaborates municipal aggregates and municipal complementary information.	Municipal Data Base (contains basic data and complementary communal data organized by communities). Municipal Complementary Data Form. (hand written)
Region	Elaborates regional development strategy. Planning for regional and local development and provision of social services. Monitoring of development programs effects and impacts.	Organizes and supervises data collection. Establish computer supported information base (LOTUS™) and carries out data processing	Computer supported information base organized by municipalities and communities (LOTUS™ spreadsheets). Regional complementary data.

The procedures for data collection and processing as well as the different instruments for information handling were designed on the basis of the already-defined structure and content of the information base and with an explicit participatory approach in mind. They were, however, also determined by the existing limitations of technical knowledge and financial resources. As shown in Table 11.1, Basic Data were to be collected at the family level and aggregated at the community, municipal and regional levels. At each level, Complementary Data not available at the lower level was included. Hence, the information base at each level of aggregation consisted of the same structure of basic data items (the aggregate of the family information) and complementary information items, filled in accordingly by communal, municipal and regional entities.

Data processing was to be done mainly by the regional information center which utilized three microcomputers. After designing the structure of the future information base on LOTUS™ spreadsheets, the regional teams elaborated the paper forms for data collection, aggregation and representation (municipal, communal and family information forms) using this structure and tested instruments and procedures in a pilot community. Table 11.1 provides further information on the data base.

Data collection and processing

The process of data collection was carried out simultaneously in 13 municipalities within a two week period and involved the voluntary mobilization of more than one thousand persons. Based on a kind of 'research-action' methodology, it was designed as a huge multi-level learning experience. A critical element in this process was the quality of training events at the different levels. This training ensured that people internalized the purpose and functions of the IS; managed the procedures and instruments of data collection, aggregation, and basic interpretation; and were able to conduct a high quality training event at the next lower level (see Figure 11.1). Data collection and the first aggregation and analysis were done by previously trained community teams comprised of community leaders, teachers, community health workers, and also primary school students. Emphasis was placed on widespread understanding of the purpose of the process, and on the discussion of communal data in community assemblies.

The first processing step was done by the communal team which was also responsible for the first communal aggregate and for providing complementary communal information. This step was performed in an open assembly in every community. Municipal staff was responsible for municipal aggregates and complementary information. Supported by regional staff, analysis of critical indicators was also carried out. Up to this level, no computer support was provided. At the regional level, in contrast, LOTUS™ spreadsheets for every main item were established and organized by municipalities, maintaining communal information. Complementary regional information was added. An additional data base with information provided by the public sectors was established in order to allow cross-check analysis. In the first processing step, these information bases were used to calculate basic development indicators — mainly percentages and basic statistical figures. The collection of renewable information was to be repeated annually by communal and municipal leaders.

During 1988 and 1989, for most regionally controlled project funds, decisions about social service provisions and support to peasant agriculture and small scale industry were delegated to the municipal level. This allowed a kind of bottom-up planning process to be established in which the information base was used by local governments and community leaders as a tool for development planning — although in a rather rudimentary way.

The establishment of the annual plan of a large Integrated Rural Development Project (IRDP) served as a pilot project for a consistent bottom-up regional planning process to be institutionalized later. As shown in Table 11.2, this planning process was organized in four main steps which involved 'learning by doing' in workshops, assemblies and practical field work. Immediately after the termination of data collection and aggregation at the municipal level, local governments, sectoral field staff, and their regional counterparts met in a session to analyze this data and to calculate basic development indicators for their territory. On the basis of these indicators, development problems and goals were defined in more accurate quantitative terms.

The subsequent discussion of municipal and communal leadership about 'their' individual development indicators gave rise to an array of project proposals. In a follow-up training session, an appraisal of the feasibility of these proposals was carried out by the communal and municipal leaders themselves. A questionnaire referring to the most common organizational and technical problems experienced in similar projects, elaborated by the regional planning department for this purpose, turned out to be very useful. Moreover, a very simple project planning format designed to guide people's thinking, as well as a list of prices for the most commonly used construction materials and services allowed communal and municipal leaders to approximately calculate the costs of each project and also the financial value of their local contributions (in kind and labor). Since planners knew the amount of development funds destined for their municipality at this point, the next step involved a round of negotiations between community and municipality which yielded a second prioritization and a definite list of community projects to be executed that year.

This list of projects at the communal and municipal level was the basis for the municipal development plans which also included the program activities of the different sectors. A more detailed planning format was used to present this plan in operational terms, specifying the 'who makes what when and with what resources' of every activity. Finally municipal plans were integrated into regional IRDP plans which constituted the basis for the disbursement of donor funds on the one hand and for the regional operational annual plan on the other.

Municipal development funds were transferred directly to local governments for the first time. Assisted by the regional planning department, local governments took over the responsibility for project implementation, administration and monitoring. A few months after the process of data collection and planning, local governments indicated they were using the information base above their periodic reporting to higher level authorities and donors. Having readily available data greatly facilitated these tasks. In addition, the use of concrete data in their funding applications and project reports strengthened their positions in negotiations with donors and higher levels of government.

At the regional level, however, less information was used, because of inadequate regional processing capacities. Data processing was too slow and produced unsatisfying results. The sectoral bureaucracy continued their own information flows. Based on existing information, the planning department of the regional government initiated a process of regional analysis and long term development planning. At the same time, the information system was to be revised and improved. In February 1990, the experience was suddenly stopped, as regional governments were largely stripped of power after the change of government in Nicaragua.

Evaluating the experience

For a team of social scientists working several years in the regional planning department, it became obvious that the only way to achieve effective rural development was to realize fundamental changes in the regional decision making structures and procedures. The organization-driven approach of the IS was not the result of choice, as there was never any other option but to view the IS as an opportunity to induce organizational change. In practice the goal of building a comprehensive information system for monitoring, evaluating and planning purposes from scratch, given the conditions of underdevelopment existing in Northern Nicaragua (lack of trained people, infrastructure, communication and financial resources etc.) turned out to be too ambitious, although the methodology was consistent. It was based on the existing capacity for the voluntary mobilization of people whose involvement was, in any case, the only feasible and affordable way to ensure more or less reliable data.

It was perhaps even more ambitious to launch a project for organizational change with far-reaching political implications from the position of a relatively weak regional planning department, counting only on the political will of a regional government, which in turn was involved in an implicit power struggle with regional ministries and national centers. Although the formal process of decentralization actually provided the basic conditions for the functioning of an improved regional information and planning system, its effective implementation would have taken a long time and caused continuous tensions with those who had to release power and functions. It seems appropriate, therefore, to also consider successes and failures of this experience as an expression of this power struggle.

The greatest success of this experience was its mobilizing effect at the community and municipal levels. Community projects were identified and discussed as the resulting increase in the share of local resources in the form of materials and voluntary work considerably reduced the cost of commu-

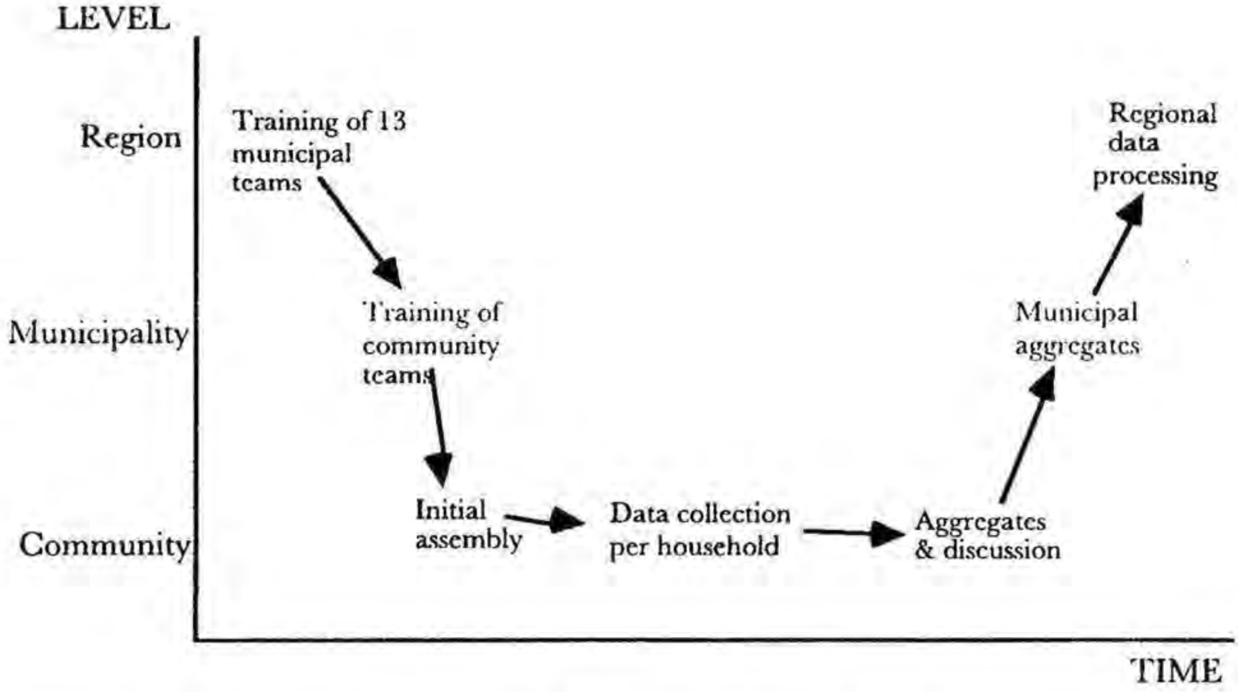

Figure 11.1 The process of data collection and processing

nity projects. To some extent, this success may be considered a result of a consistent participatory methodology not only in data collection, but also throughout the entire planning process. Within this collective learning process, it was critical that all people involved were clear about their respective roles and responsibilities. On the other hand, people had to perceive their own interests and opportunities in the system. A crucial aspect in this regard was the structured use of training to ensure the effective conceptual and technical learning of a large number of persons.

A further achievement was the instrument used for data collection which had to respond to a complexity of information and computer processing while being manageable by people with very low educational levels. Similarly, the instruments elaborated to support development planning at lower levels turned out to facilitate the process a great deal. However, the most important reason — and at the same time critical condition — for the success of the system at lower levels was that the information system was part of a process of decentralizing decision making power and resource allocation to lower levels.

At the regional level, however, the IS failed to achieve the desired objectives. Data processing was far too slow and results too unsatisfying to respond to the needs of potential users. While certainly a welcome pretext for the sectoral hierarchy to resist organizational change, the inability to deliver satisfying results in a reasonable period of time reflects severe errors in IS design, particularly the inopportune selection of the data for the information base and inadequate technical choice for data processing.

In the first case, the objective to establish a 'unique' regional data base that could rationalize data collection efforts and satisfy sectoral information needs turned out to be too ambitious. The involvement of the different stakeholders in the design of the system, while ensuring their participation in the process, greatly complicated the selection of data to be included. Decision makers were unclear about their actual needs for information. Hence, a disproportionate quantity of data was collected which clearly exceeded the processing capacities at the regional level. In addition, the system did not supply relevant information for monitoring development interventions. Therefore, information at the regional level had to be supplemented by adding institutional information and a sample survey.

Regarding the technical choice for data processing, the structure of the system, as well as the choice of the LOTUS-123™ application program turned out to be fairly well suited to represent data but not to calculate indicators. The lack of more sophisticated technical knowledge and the failure to begin system design from the actual use of information and the indicators to be calculated turned out to be crucial. Moreover, the bulky representation of data in a number of different spreadsheets turned out to be an obstacle to the use of data in decision making, particularly at lower levels where people were not accustomed to handling large amounts of paper. Finally, data collection by poorly educated community teams led to a considerable amount of errors. At the community and municipal levels, the fact that the people were involved in aggregating allowed common sense and local knowledge to act as an effective control mechanism. At the regional level, however, the aggregation of errors in some cases negatively affected the usefulness of the resulting information.

The sustainability of the IS with its participatory procedures was, in any case, questionable. Data collection had required a huge voluntary mobilization of people, which had been possible due to the enthusiasm and high degree of political organization of people — both factors subject to change. To maintain the integrity of data without increasing the professional data collection capacity, it would be necessary to reduce the quantity of data collected so that collection could be handled by a few people at the community and municipal levels without involving the families themselves. The frequency of the large mobilizations must be reduced to once in every 5 to 10 years. On the other hand, mobilizing the population depends on the extent to which people perceive their own interests in the system, which in turn, depends on the effective scope of their participation in local and regional decision making.

Conclusions and lessons from the case

Like any socioeconomic management system, an information system for rural development planning must be seen as part of an organizational and thus political process that builds on and influences existing organizational structures and the human interactions within and among these structures. Therefore, its design has to depart from an analysis of the organizational structure, procedures and culture and explicitly include organizational objectives according to the wider aims and actual potentials of the regional organization. Within an IS in this broad sense, computer applications consti-

Table 11.2
Steps in the 'bottom-up' planning process in 'Las Segovias'

Participants	*Activities*	*Inputs provided by regional planning department*
Regional planning dept. + Local government + Sectoral staff	Data analysis Problem definition Goal formulation (key indicators)	Municipal information base
Local government + Communal leaders + (supported by reg. planning dept)	Identification of projects Institutional and technical appraisal First Prioritization Calculation of project costs (and local contribution) Second Prioritization	Questionnaire for technical and institutional feasibility appraisal Project planning format List of costs per unit
Local government + Sector staff (supported by regular planning department)	Elaboration of municipal development plan (operational)	Planning format
Regional planning dept + Regional sectors	Integrated rural developments plans Operational plans for implementation	
	Transfer of project funds (lump sum) to local government	Assistance in administration and monitoring

tute a versatile tool in a more general effort to improve regional decision making and management.[9]

Such an IS must provide accurate and relevant data for regional development decision making in a timely and opportune manner. Given the complexity of the subject of rural development, any information base will necessarily be complex and must contain multisectoral information. In procedural terms, an IS for rural development planning has to fulfill the same requirements as the planning process in which it is an essential component. These include:

1 popular participation,

2 multi-disciplinary 'horizontal' integration among the different sectors, and

3 a twofold appropriate mix between 'bottom up' and 'top down' approaches.

These conceptual and procedural requirements imply particular consequences for IS development and design. Our experience suggests the following conclusions and lessons:

1 The development and implementation of an IS for regional development planning constitutes a huge organizational learning process and it seems obvious that rather than focus on expensive imported hardware,[10] the investments for a regional information system should prioritize software issues. As the Nicaraguan case shows, large scale and qualitatively valuable training programs, as well as opportunities for information and discussion with local stakeholders, are critical investments for improving the effectiveness of rural development activities.

2 To ensure the success and sustainability of the system, the overall responsibility of IS development and design should be assigned to one central person who is equipped with sufficient power and resources — as well as political support — to undertake far reaching organizational decisions. Moreover, it is essential that an initial agreement with regional and external decision makers is reached regarding the assumptions, expectations and broad objectives of IS development, and on the participants, and the form, timing and logistical requirements of the process. Decision makers should also be conscious of the possibilities and constraints of IT for the development planning process and the need to invest in software use and the institutional learning process.

3 The selection of data to be included in a regional information base constitutes an ambiguous issue. In this particular case, the most important failure involved this point. On the one hand, any information for rural development planning decisions is necessarily complex and has to include an array of data responding to different sectors. On the other hand, data cease to be relevant for planning purposes *if they cannot readily be processed and handled by their users,* or if the scope of decision making does not permit adequate responses. The challenge in the selection of data is to find the appropriate mix between the minimum quantity and the maximum relevance. Participation of potential users

of the information base in the selection of data is crucial to ensure their support throughout the entire IS development process. It may, however, lead to inopportune choices. Thus, it seems necessary to expand the initial analysis sessions with all potential stakeholders and to critically question the information requirements put forward by decision makers given their actual scope of decision making and existing information processing and reporting procedures. The outcome of this initial step should be a consensus on a minimum but sufficient information base for planning and monitoring development interventions.

4 To guarantee both 'horizontal' and 'vertical' integration implies that the information system includes all levels involved. Given the often required emphasis on 'horizontal' coordination, it is necessary that the system be 'consciously biased' and offer particular advantages to those institutions and persons whose position should be strengthened without completely neglecting others.

5 The system must be functional at each level in terms of the interests and the decisions to be taken by different users. Both the information provided at each level and its presentation must be suited for its particular use. In addition, it is important to remember that particularly at lower levels, people's participation and interests require feedback in relatively short periods of time. Hence, data processing must be fast, so that the link between the collection and the use of information becomes obvious. People should spend their time interpreting information rather than processing it.

6 Since requirements and use of information differ, the system must be manageable and accessible at each level. Provision of computers at lower planning levels (in this case local governments) could be an enormous step forward. Requirements of accessibility and manageability imply that procedures must be simple, taking into account the capacities of the different users, especially those of lower levels. In addition, the system should show users only the particular information they really need without being confronted with the entire range of data.

7 As a precondition for the above mentioned points, an adequate design of the system requires the participation of *all* potential stakeholders not only in the choice of the type of information to be included but also in the technical design of the system.

8 The collection of data by the (rural) people themselves poses some technical problems. On the one hand, their low educational levels lead to a number of errors in the information base. While at lower levels, local knowledge and common sense may act as a kind of self

control, at higher levels automatic control parameters to signal significant errors must be built into processing mechanisms. On the other hand, some information may be culturally bounded and people will not be willing to provide it. Profound local and cultural knowledge in the design of instruments and procedures for information collection will therefore be crucial to avoid such errors.

9 In our case the system was designed by social scientists with local knowledge and the capacity to analyze the organizational problems but with very few technical criteria. The many errors and problems in our results speak for themselves. Technicians would probably have done things differently but not necessarily any better. The evidence suggests that the design of such systems requires a multi-disciplinary professional team which allows social scientists, methodologists and technicians to bring in their respective knowledge and criteria to the process.

Finally, we want to underline a point that seems obvious, but unfortunately is not: Effective rural development requires improved planning procedures and the use of information technologies may play an important role to facilitate the task. Nevertheless, such procedural and technical advances resolve only part of the problem. The ultimate success of any planning system will depend on the political will to effectively transfer power and resources to lower administrative levels and to effectively address the problems of the poor.

Notes

1 An experience of the regional government 'Las Segovias', Estelí, Nicaragua, 1988-1990.

2 The term region is used here in a relatively broad sense to refer to any form of subnational geographic area. In the present context, it does not include multinational regions.

3 The concern with inequalities, although today somehow 'out of fashion' has been also underlined by the often quoted declaration of Dudely Seers which marked development thinking during the past decades: 'The questions to ask about a country's development are therefore: What has been happening to poverty? What has been happening to unemployment? What has been happening to inequality? If one or two of these central problems have been growing worse, especially if all three have, it would be strange to call the result 'development', even if per capita income has doubled' (Seers, 1969, p. 3).

4 It seems to be largely proven that the adoption of a laissez faire offers little hope for the majority of rural population in most developing countries. Eg Fields, in a study of the relationship between economic growth and equality in six countries concluded that: 'in the absence of a firm commitment to developing for the poor and the courage to act on that commitment, it seems only natural that economic systems will perpetuate the flow of resources to the haves with at best some trickle downs to the have nots. More may trickle downs in some cases than others. Commitment to developing to help the poor does not guarantee progress, but it helps a great deal.' (Fields, 1980, p. 242).

5 Participation in local decision making constitutes an essential component of the 'basic needs' approach to development, initiated by the ILO in the 1970s.

6 Despite the fact, that the 'Integrated Rural Development' (IRD) approach has largely been abandoned at project implementation level, some sort of intersectoral planning is likely to remain an important requirement for regional development planning, if it is to effectively tackle rural poverty. As Chambers (1983) says, the problem of underdevelopment and poverty is an 'integrated' one and both its analysis and solutions require an integrated and differentiated picture of reality.

7 According to Rondinelli and Cheema (1983, p. 14) 'the delegation of greater authority for development planning and management to officials who are working in the field, closer to problems allows to ensure that national plans are based on reasonably accurate information about existing activities and needs and to disaggregate and taylor development plans and programmes to the needs of heterogeneous regions and groups.'

8 'Computerized Rural Information System Project'.

9 In our concrete case, computer support was limited to the establishment of an information base to support the very first step of regional planning. Nevertheless, just the storage and availability of structured data was perceived as a major improvement for the entire planning process.

10 Unfortunately, there is a widespread preference for western skills and products reflecting an implicit belief that sophisticated hardware might be the key to development. (If in our particular case, the role of computers in our information system was very limited, this did not reflect an exceptional consciousness of regional decision makers but rather the desastrous shortage of foreign currency in Nicaragua in the 1980's !).

12 A study of a university admission system in Uganda

Chrisanthi Avgerou and Nora Mulira

Introduction

The concept of 'information system' is often used to mean computer applications despite efforts to define the former in more than strictly technical terms. Certainly, information handling in organizations involves much more than the engineering and use of new technology applications. Even in the most extensively computerized corporation there are other aspects of information that matter at least as much as the technology. Communication and use of information to serve a company's purposes depend on appropriate organizational structures and effective team work as well as an efficient technical infrastructure. Indeed, the study of information systems constitutes a discipline distinct from computer science and information technology (IT) engineering.

This paper elaborates on our current understanding about the potential of applying information technology in an organizational context. The first part of the paper presents the 'information systems perspective' for the study of issues related to the application and management of new technology in organizations. The second part of the paper presents a case study of a computer based information system and analyzes its effects from a broad information systems (IS) perspective. The final section provides some general conclusions.

The difference between information systems and computer systems

The concept of 'information system' is significantly different from that of 'computer system'. A computer system is an assembly of hardware, software and telecommunications technologies. Computer systems can exist without an organizational context, for example, they can be bought ready made as combinations of machines and software packages from computer vendors. In contrast, information systems are meaningless without an organizational context and they are independent from particular means or technology. The concept of information system is much broader than that of computer system and includes: the people who take part in both the formal and informal information handling processes of an organization; and not only computer technologies, but *any* technology which assists information recording, processing, and communication (such as manual records, and office equipment).

The social context within which information systems are developed and operate is of paramount importance. Crucial for the success of an IS are: the social relations between the participants involved with the information system, the infrastructure available for its support, and the prior history of developing and operating such information systems. Kling's influential work on 'web models' offers particularly valuable help in understanding such a social context (Kling and Scacchi 1982, Kling 1987). Web models have been applied in many cases to analyze the process of implementing new information technology in organizations, deciding on appropriate actions, and predicting the consequences of computerization projects (Walsham 1993).

The term 'information system' is often used in the literature in a narrower sense to denote the means for processing data. This reflects the origins and bias of IS research towards study of the utilization of new technologies. However, this is an impoverished view of information systems, because it leaves out the most central players in information handling activities — people. When people are considered, they are often referred to as 'users'. Although this is perfectly valid when a study concentrates on the design of particular means of data processing, such as a database management system, people should be considered as participants in information systems and not just 'users'.

Consequently, the development of information systems is a distinctly different process from the development of 'computer systems'. The main objective of a computer system development project is to build a reliable and efficient application of technology in the most cost-effective way. The functions of the computer system are clearly defined and permanently built into the system. The practices of building such systems should follow good engineering principles by applying appropriate engineering methodologies. Indeed, software engineering has emerged as the branch of engineering that studies the production of software.

In contrast, the development of 'information systems' is a process of organizational intervention (Checkland and Scholes 1992). It may involve the development or acquisition of computer software and the acquisition and installation of computers or telecommunication networks, but the main effort is not technology centered, it is organization centered. The objectives of an IS development project are determined by the requirements of a specific organization to achieve its mission, and to survive or grow in a changing national and international environment. Thus, the development of an information system also involves the development of information resources and the creation of organizational procedures for effective information handling. The full process of information systems development includes the following elements:

Planning the information system This step is closely related to planning the organization's business. Information acquired great significance in contemporary organizations (Scott Morton 1990). In addition to the potentially significant productivity gains in information processing that can be achieved with information technology, information systems are now seen as means for achieving a variety of organizational goals, such as maintaining competitiveness in the market, improving the quality of products, launching new services, empowering managers in their decision making, or working out more effective organizational structures. Thus planning for the development of new information systems matches organizational aspirations with the potential of new technology, and balances organizational conditions against the costs and effort required to implement these technologies.

Analysis of the organizational context This analysis attempts to identify what changes need to be made in order to achieve new information systems procedures. Having established the desirability and feasibility of a new information system given the organization's broad missions and objectives, it is necessary to determine the scale and kind of changes required. The changes may go far beyond the simple substitution of one information processing routine with another. They may involve significant organizational changes such as learning new ways of doing business, or taking action to correct inefficiencies of structure, work procedures, communication and collaboration among departments or groups of employees.

Designing new work procedures and organizational arrangements Any new information system is likely to require changes in the organization of work procedures, which should be designed to fit the skills and satisfy the job requirements of the organization's employees (Mumford and Weir 1979). Moreover, in many cases, the main objective of the development of new information systems is to redesign the organization's structure. New technologies provide opportunities for new ways of communicating among the different parts of an organization and redistributing responsibilities and control functions. Organizational design is increasingly becoming a key part of the information system's development process (Hammer and Champy 1993).

Introducing new technical components These may include software, hardware, telecommunication equipment, and paper forms. Some of these components may be tailored to fit the IS under development, while others can be bought ready made, providing standard information processing procedures.

Implementing the new system This step involves preparations for the operation of the new system, and replacement of existing information handling procedures. The most important aspects of this task involve managing change, addressing people's requirements and attitudes, and developing strategies for enhancing participation and interest.

System evaluation Evaluation should address the effects an information system has on the organization rather than merely its technical efficiency and cost effectiveness. The broad question that needs to be considered is whether the new systems has contributed to the main objectives of the organization, such as improving the competitiveness of a business organization in its market, improving the services provided by a government institution, or enabling desirable organizational changes. Thus, evaluation of information systems must be seen as part of organizational change.

Symons (1991) provided a valuable framework for understanding information systems evaluation in terms of the system's contents, context, and process. Content refers to the criteria used to assess a proposed or implemented change in an information system. Efficiency and effectiveness measures have been the most frequently applied criteria, although they are not the only ones. Other criteria include systems utilization, user satisfaction, and strategic value. Context refers to the organizational and broader socioeconomic environment and includes aspects such as the history of the organization, infrastructure, management procedures, business goals or organizational mission, and its social structure. Finally, process refers to the actions, reactions and interactions of parties involved in the information systems evaluation.

The evaluation process is part of systems planning and implementation. It is also part of the on-going process of organizational learning. Thus, the evaluation process can only be partly formal. People also evaluate information systems changes informally, and their opinions affect the success of present and future systems changes.

Information systems in developing countries

It is well documented that the diffusion of IT in many regions of the world, such as Africa, parts of Asia and Latin America, is very low (Rigg and Goodman 1992, Odedra et al. 1993). Less visible are the poor results often achieved by applying much sought after computer and telecommunications technology. Odedra's (1990) research in Africa, in the mid-1980s suggested that many computerization projects fail, and a number of those that succeed in delivering a technical system do not have a significant positive impact on the performance of the organization or their equipment is under-utilized.

The literature tends to support Odedra's findings. Many ambitious projects in terms of technology and objectives are announced and sometimes described in detail (see for example Salih 1981, Han and Render 1989), but implementation and post-implementation studies are rather rare, and reveal discrepancies between the results achieved and the improvements expected in the organization's performance (Madon 1991). Typical problems quoted are an inadequate supporting environment in maintenance and operation skills, and an organizational culture which does not permit the technology-based system to be utilized as initially specified.

It is often said that developing countries can avoid costly and frustrating experiences regarding the exploitation of new IT by learning from the mistakes of industrialized countries. Each society has a distinct socio-economic context for the application of new technology and needs to follow its own learning process. It must learn through its own experience what this new technology can offer its members, what risks it involves, and how to deal with them. Developing countries must enhance their capacity to judge what can be effective in their particular conditions. This is why the information systems perspective is valuable for developing countries. It encourages those responsible for introducing IT to consider what innovation will mean for the organization and how to manage the resulting organizational change, rather than merely to construct a technical application. While we should be cautious about trying to transfer the experiences of organizations in one particular context to another, there is a great deal to gain from sharing insights about the nature and potential of IT. Organizations in developing countries can benefit from the efforts made thus far to understand the potential of these new technologies and the processes that may take place when we introduce new information systems into organizations.

Organizations in developing countries, faced with powerful but costly and risky new technologies, have to learn to address themselves to broader information systems questions. To mechanistically apply modern technology in an attempt to speed up existing procedures or to reduce labor costs misses the most significant potential benefits. Computerization of existing information processing bears the risk of worsening the situation by destroying the flexibility of manual or informal information handling procedures. When, however, new technology is introduced as part of a process of information systems change which addresses the organization's needs, it can be the vehicle for substantial improvements.

Organizations in developing countries may find that the suggestions and methods that have been proposed in the discipline of information systems are inapplicable or inappropriate for their contexts as they often lack the business plans and planning procedures needed to begin the information systems development process. Formal planning practices may be alien and unsustainable in the prevailing culture. Still, a manager responsible for information systems development must make long-term decisions regarding the value of information systems for the organization before allocating substantial resources to development of infrastructure. The significance of the information systems perspective is not so much in the methods it suggests as in the insights in provides, directing attention to organizational needs rather than technological determinism.

The case study

Uganda's education system

Uganda is a landlocked country in the Eastern part of Africa with a population of 17 million people. Agriculture accounts for the bulk of its Gross Domestic Product with export earnings dependent on coffee. Small scale farmers form the backbone of the economy. The industrial sector, although small, has experienced some growth. Electricity and telecommunications infrastructure have been gradually upgraded. Uganda gained independence from Britain in 1962, but suffered oppression and political uncertainty until 1978.

Makerere University is the most prestigious institution of higher learning in Uganda. It has grown from 1,500 students between 1966-7, to 3,427 in 1972-3, 3,913 in 1980 and 5,200 in 1990. Makerere was the only degree awarding institution in Uganda until 1987 when the Islamic University and Mbarara University for Science and Technology were established. The impact of these new universities is yet to be felt; since the former has only graduated a small number of classes, while the latter graduated its first class in 1994.

Makerere University closely follows the pattern of English universities, with a council consisting of law and academic members as the governing body, and a senate responsible for all academic matters. It is organized into 13 faculties, institutes and schools. There are 22 undergraduate degree courses, 2 undergraduate diplomas and 1 undergraduate certificate course. Higher degree courses are also offered in some disciplines, with post graduate diploma in education, statistics and adult education. It has also resumed its exchange program under the Inter-University Council for East Africa with neighboring Tanzania at the University of Dar-es-Salaam.

There are three main avenues of entry into the university: direct entry, mature entry, and the diploma avenue. Direct entry is usually referred to as the 'A' level leavers avenue. The minimum admission requirements under this avenue are: a)an O-level certificate; Uganda certificate of education (UCE) or its equivalent; and b)at least two principal passes at A level (UACE) or its equivalent obtained at one sitting in the current year of admission or at most two years previously. Mature entry is for candidates who wish to study for a degree/diploma but do not qualify for admission under the direct entry scheme. Such candidates take the mature age entry examination set by the university. They should at least be 25 years of age and should have completed formal education at least 5 years before the date of application. Up to 5 per cent of the year's intake may be admitted through this avenue. Finally, the university recently agreed that a few candidates who performed very well in the diploma courses may be admitted into degree courses. This form of entry is called the diploma route.

During the 1991-2 academic year the university also agreed that graduates may be admitted to other undergraduate courses and such candidates are to be privately sponsored at the university. Foreign candidates may also be admitted to all courses at the university .

The computerization of admissions

Computerized admissions in Makerere date back to the mid-seventies when computer programs were designed by personnel at the computer center, assisted by a United Nations consultant from the Institute of Statistics and Applied Economics. Responsibilities for maintaining computerized admissions has traditionally been given to the computer center in close cooperation with the Academic Registrar's office, which specifies system requirements and changes depending on university policy. At present, admissions are processed by four officers including the deputy academic registrar, two secretaries and six record clerks all working closely with the academic registrar. There are two people who do the computer work.

Briefly, the admission system consists of the following stages.

1 The cycle starts in October when application materials (forms and faculty course regulations) are distributed and coordinated from the university to A-level schools across the country. Students fill out their application to tertiary institutions including Makerere University in which they indicate their choices. Forms must be returned by December.

2 The graduate office cross checks the information on the forms before sending them to the Uganda Education Board (UNEB). Information on the coding sheet is entered into the UNEB computer where university admissions are processed by university officials.

3 Each faculty then proposes to the senate the number of students to be admitted each year, and the senate makes a recommendation to the university council which finally decides on the intake figures.

4 Selection procedure follows. With the use of the UNEB computer 'A' level applicants in the direct entry category are listed in merit order per course of first choice. The applicants' subsequent course choices with their corresponding weights (points) are also indicated. The points are a combination of O-level and A-level points.

5 The ministry of education is represented at the admissions board meetings which are held in August/ September each year.

The admissions office accepts only 2,500of the 6,500 applications of the direct entry candidates and applicants for the recently introduced diploma avenue. Codes for the courses for which candidates wish to be considered are indicated on the coding sheets. The order of choices of the courses is very important at the selection time, since candidates are advised that it is not possible to change their course choices.

At this point, it is important to analyze the role of the computer within the admission system.

The evolution of the computerized system

The system has changed over the years. Significant changes have been made to both the format of the application forms and the coding process. In the beginning, applications from schools (corresponding to UNEB examination centers) first had to be coded and the information transferred to coding sheets. These were transcribed them onto punched cards. After the punching of all centers, they were fed through a card reader and a computer tape file was created. This file was verified and sorted by center and a hard copy of error entries was printed out for correction. It was not unusual to have a number of iterations through the correct, re-punch, re-read cycle. That coding process and the punched cards have now been phased out all together. This was achieved by designing a pre-coded application form which requires only minor editing once it is returned from the school. Head teachers have more work to do than before, indeed they actually complete the forms taking the input of course choices from the candidates. At the university, many manual errors from the schools are detected and eliminated. Certain fields (such as the applicant's names), though present on the application forms, no longer need to be entered at the data entry stage as these can be picked up during later stages of processing from the UNEB results file. Data are then keyed in at the UNEB's computer terminals.

The new coding sheets can be scanned at the data entry stage and have helped to reduce the duration of the data entry process. Duration could be reduced further if the processing were done locally at the university in the academic registrar's office which has IBM computers. This has not yet been possible because UNEB is using an ICL ME29 minicomputer which can not (in its present form) provide the university with IBM compatible results file. Accordingly, it is likely that all computer processing will continue to take place at UNEB's computer installation. The analyst in charge of the system acknowledges that this problem, although solvable, is constrained by the model of the computer used. The ICL ME29's main advantage is its vast storage capacity but it requires special cabling, and lacks an operating system compatible with MS-DOS, graphics, word processor and spreadsheets.

Finally, the selected applicants are entered into a nominal roll which is used to locate index numbers and halls of residence. Although this is currently not part of the computer admission system, if there was a compatible computer file from the admission list file, this could form the basis for the nominal roll, and automated index number and hall allocation. Since admission is the first contact point with the student, information about the student can be used to generate databases for all sectors of the university such as the library, residence, finance department and other departments which need to monitor the students progress.

Another significant change that has taken place during the life of the computerized admissions system is the implementation of weightings in admissions, a process which is controversial from a social point of view, and therefore raises interesting questions from an information systems perspective. Each undergraduate course and the M.D.D diploma course at the university has a set of prerequisite A-level subjects. For example, for admission to the Bachelor of Medicine and Bachelor of Surgery degree course, a candidate must have taken the following subjects at A-level: Biology, Chemistry and Physics (BCP); or Biology, Chemistry and Mathematics (BCM). To be eligible for admission, the candidate must have passed Biology and Chemistry with principle level passes and at least a subsidiary pass in Physics or Mathematics. The subjects that must be passed at principle level are the essential subjects and they are given a weight of 3. If however the candidate for Medicine obtains a subsidiary pass in Chemistry, with very good passes in Biology and Physics, they can not be admitted to the course. Subjects which may be passed at subsidiary level are referred to as 'relevant' and are given a weight of 2 points. 'Desirable' subjects are given 1 point.

Applicants are first considered for admission to their first choice courses. The selection of an applicant for a given course depends upon the candidate's position in the merit ordering, the combined weight of the applicants to the course, and the intake capacity for the course. If for example, the intake figure for Medicine was 90, and the 90th candidate on the merit list with Medicine as a first choice had a weight of 32.5, then 32.5 would be the cut-off point for the course in that specific year. An applicant with a weight of 32.3 for Medicine would not qualify for the course but would be considered for their second choice, together with other applicants who selected that course as their first choice. This process continues until the applicant is admitted to one of the subsequent courses or is left out altogether. However, this policy has often been undermined. To candidates who happen to be at the fringes of a cut-off point, this system is certainly not logical, systematic or fair. As a result, the admissions office is sometimes forced to compromise on this procedure.

Weighting is also used as a means of improving women's chances to enter the University. Like most African societies, in Uganda, traditional values dictate that the man is the provider and therefore more deserving in employment. Although attitudes are gradually changing, women's education and careers are generally regarded as less important in the long run. Research on factors hindering women's education in Uganda have identified three broad categories: family, societal and institutional. Since primary education is not free, parents with a low income would rather educate their sons rather than daughters. The assumption is that girls do not need education because they end up being supported by their husbands.

This cultural bias has not been eradicated despite the government's effort to promote women.

Evaluation of the admission system as an information system

To analyze the effects of the changes of the admission system of Makerere university from an information systems perspective it is useful to identify the key participants and outside stakeholders in the university admission system (Waema and Rodrigues 1991). The government through the Ministry of Education is a key stakeholder of the university admission system. Broad government policy objectives in education are influential in the stand taken by educational institutions. Most countries seek an education system that produces individuals who are properly socialized and possess the necessary knowledge, skills, attitudes and values to enable them to effectively participate in national development. The government will also receive public criticism if the education system does not adequately meet the demands of employers, as this is a direct reflection on the quality of graduates.

A second group of key participants is the academic staff. This comprises the Deans of faculties and the university admission staff. Their perceptions are mainly based on the requirement of specialized faculty degree programs and the need to maintain certain minimum academic standards. Each faculty is interested in getting the best people into their degree programs. There are other considerations besides quality, like funding, university resources and special candidate cases. The admission staff would like to perceive their system as being fair, logical and systematic, able to admit well rounded, capable students.

Another group of stakeholders comprises the analysts and programmers who develop and operate the computer system for admission. Their work usually depends on the demands generated by the university admission staff. The main task here is to advise the admission board about the 'implementability' of certain principles. Finally, schools, candidates and parents are other stakeholders of the system. Their participation is vital but passive. A-level schools have the responsibility of conducting examinations and ensuring that the candidates are well advised. It is important that students, with the guidance of their career teachers and parents, chose what they want and have all relevant information regarding their alternatives.

In such a complex social context, the criteria used to assess the computerized admissions system in terms of the Symons (1991) framework should be broadly defined. Does the system improve the efficiency of the admissions procedure? Does it contribute to the improvement of higher education in Uganda? Does it contribute to government targets and people's aspirations for social development? Does it contribute to the combat of corruption?

For the Ministry of Education and the university staff the admission system is a means for selecting suitable candidates in a systematic and fair way. In an environment where corruption is rife and competition high, combat-ing corruption is a priority. As seen in the case of Makerere University, the computerized admission system appears fair to the majority of candidates.

However, the Makerere University admissions system is using a computer system to simulate complex social systems which transform many qualitative observations into quantitative form. The old admissions system, which used application forms, provided more information about the candidates and gave more scope to the student, career teachers and head teachers to influence the admissions process. Evidence of the quality of the old system can be seen in the quality of graduates from the 1950's to the early 1970's. These include some of the old statesmen of sub-Saharan Africa — like Mwalimu Julius Nyerere the first President of Tanzania, leading academics and clergy. While the present shortcomings of education at Makerere could be attributed to the social and political turmoil that prevailed in Uganda over the past decade, it can also be argued that the current admissions system — which totally excludes judgment of general qualities of the candidates — has contributed to the questionable quality of university students. With the aim of eradicating tedious manual entries, the coding sheets for the computer based admissions system were designed with only one entry provision for academic qualification. There is no entry for the candidate's general academic performance from the head teacher or career guidance teacher. Indeed, the university Vice Chancellor is concerned about the kind of students that are admitted to Makerere. He cites the deteriorating sanitation conditions in some men's residence halls as an example of the declining student quality.

In an effort to enhance the education of women, especially in science and technical fields, Makerere has taken steps to increase the numbers of women admitted. In 1990, the university decided that 1.5 points should be added to the weights of female applicants per course. Although the percentage of women admitted has gone up from 23 per cent in 1988, 25 per cent in 1989 to 30 per cent in 1990, the number of eligible female candidates is still very low. The 1.5 points bonus for women applicants is in line with government broad policy but has raised the question of whether women are the only disadvantaged class. Are women more deserving than boys from peasant backgrounds whose only chance to overcome their station is through higher education? Since the bonus does not take into consideration the candidate's social circumstances, such a policy only affects a small percentage of girls on the margin. There is nothing outside O/A-level grades considered to throw some light on the candidate's capabilities or character, or her/his circumstances, misfortune or disabilities.

Thus, for the government and the university authorities, it is perhaps ironic that the same system that combats corruption perpetuates another evil — bureaucratic inertia — which has been instrumental in Africa's economic stagnation. Education, especially at the top level, plays a role in overcoming this hurdle but if the quality of candidates admitted through this system is questionable, then it is likely they are ill equipped for the task.

The centralized, rigid and inflexible system used for university admissions is insufficient to guarantee ethical, human choice; and such 'rationalism' as the university goal impedes the development of compelling, philosophically sound objectives. The system does not take into account the effect of the cut-off points which usually create spill overs into non professional courses like BA and BSc., nor does it consider the government's desire to increase the student intake at the university. This continues to put considerable strain on resources and further compromises academic standards. In order to deal with this situation the university has increased the number of self-sponsored students and cut student allowances. This policy has encountered resistance from both parents and students.

As far as the university administration is concerned, the computerized coding sheets were intended to eliminate tedious work and increase productivity. Information on the coding sheets was manually entered into the computer by data entry clerks and proof read to eliminate man-made errors, a laborious and time consuming process. Although the coding sheets require less processing time, their use eliminates valuable information about candidates. Moreover, realization of the potential efficiency gains of the system have been hindered by technical limitations. The number of applicants is overloading the modest capacity of the computer. Scanning all the coding sheets still takes considerable time and some have to be re-entered several times. The admissions office still has to call upon colleagues in other departments to help with admissions work.

Another limitation of the university's administration is that computer processing stops after printing out an admission selection list. The system cannot generate a nominal roll which can be used for index numbers and the allocation of residence halls. Since admissions is the first contact point, various databases for other departments like the library, bookshop and finance could be generated if the system were better.

Another handicap is that the computer facilities are not on the university premises where they could be better managed and the university would have greater control over the results if this were not the case.

From the point of view of technical experts, the system can be evaluated in a different light. IT clearly has technical limitations. Some of them, such as the restrictions of the operating system are consequences of the British colonial legacy. More important, however, is the role that technical experts play in developing systems with such far-reaching effects. Although the terms of reference for computer experts is narrow, engineering of a technical system often makes *de facto* social policy. By introducing the weighting system, the analysts defined policy for regional and female advancement. Similarly, the introduction of new coding sheets fundamentally changed the entire university admission system.

Several criticisms can be made to the system from the point of view of the teachers, the candidates and their parents. The application fee per candidate has been increased to Shs. 3,000 ($10) to help defray the cost of the computer system. This receipt must be presented to the admissions office which then issues the corresponding number of coding sheets. Increasing the application fee is a financial burden especially for poor parents for whom school fees are already a struggle.

Another problem involves filling in the coding sheets. This requires extra care and is typically done by teachers to minimize errors. Guidelines stipulate the use of lead pencils, with all information in capital letters using only one letter per box, without full stops, commas, hyphens or apostrophes. All candidates must complete these forms in one day under the careful supervision of their teachers. Notes on completion further state that 'the computerized coding sheet MUST NOT BE FOLDED OR GREASED OR WRINKLED OR MADE DIRTY in any way otherwise it may be rejected by the computer'. Since each candidate is entitled to only one sheet, extra care must be exercised. Clearly, it is difficult to ensure the accurate completion of these forms; and when problems arise, the inevitable inquiries are dealt with only by the admissions office. This is particularly burdensome for schools located far from the capital due to the unreliable communication infrastructure, and teachers often find it frustrating to have these problems sorted out. Finally, schools are informed of the closing dates for admissions through radio announcements and through the ministry of education; however, because of Uganda's poor communication system some head teachers collect their coding sheets as late as February (closing date is October the previous year) and return them a month after the closing date.

Conclusions for Developing Countries

Today IT combined with communication technology allows much greater flexibility. Technologies tend to be more compatible with each other and user-friendly. They can support centralized as well as decentralized tasks; they can process structured data and numbers as well as symbols, text, images and sound. As a result, they can be used in many different ways to support various changes in addition to efficiency of administration. Very often, however, the limited uses of computer technology that can be found in many organizations in developing countries are not a consequence of technical limitations only, but of an impoverished perspective of the role of the new technology. Computers are usually seen as machines capable of quickly and reliably processing large quantities of data, rather than as components of dynamic information systems which enable the realization of an organization's mission. This former approach is what we call the 'computer systems perspective' — viewing the utilization of new technology as a technical fix to a particular 'problem'.

While the potential benefits of new information and communication technologies are enormous, the risks are equally significant. In an era when IT is used world-wide as an 'enabler' of far-reaching organizational, economic, and social change, using technology in a limited administrative support capacity both wastes opportunities and frustrates development efforts. On the other hand, organizations that attempt to exploit the developmental capacity of new technology to support policy objectives often end up with misconceived or badly implemented systems. This is why the use of IT should be part of a broader effort to consider what changes are desirable and feasible and to organize their implementation. In other words, *the devel-*

Table 12.1
Information Systems Development at Makerere University, Uganda

Traditional Systems Development Model	*What Actually Happened at Makerere University*
Planning	Done with the aid of a U.N. Consultant brought in from outside Uganda.
Analysis of Organizational Context	System did not consider human and cultural 'web' in the surrounding social space.
Designing New Work Procedures and Organizational Arrangements	Designed by the Computer Center with the cooperation of the Academic Registrar's Offie. Registrar's office took lead in specification of system requirements.
Introduction of New Technical Components	Legacy of Colonialism influenced selection of hardware — did not use open operating system, resulting in lack of compatibility and difficulty with future upgrades.
Implementing the New System	Required use of paper forms and manual data and key entry of information.
System Evaluation	System works as defined narrowly, but there are problems with use because of external constraints e.g. poor telecommunications in Uganda; difficulty of communication with remote locations. Result was introduction of rigidity into the process.

Note: This table was inserted by the editors.

opment and implementation of a computer application should be part of a broader information systems analysis which considers organizational and social, as well as technical issues.

Unfortunately, few systems developers are able to manage such a process of investigation and change. Most systems analysts have an engineering background which is at best suitable for managing the software development project; they rarely possess adequate knowledge to sustain an intervention that enables organizational improvements. Therefore, managers and directors have a much more significant role to play in the development of information systems than merely authorizing the necessary financial resources. They need to decide how new information systems can serve the organization's strategies, policies or mission, and what organizational changes are required. They also need to assess the feasibility of such changes within the context of their organization and manage the implementation process. Finally, they must seek the involvement of those groups that will be affected by the changes.

From a broad information systems perspective, the study of an admissions system should not be limited to the technical aspects of computer processing of candidate forms. Instead, it should consider the manual, organizational and social procedures which constitute the whole process of admissions. Moreover, it should not confine itself to who is eligible to be admitted, but should include the dissemination of information on higher education, decisions on admissions, and the fundamental rules and norms of the process.

Makerere University in Uganda has used computers in admissions mainly as a means of expediting a tedious manual procedure that could not cope with the growing number of students. However the computerized system is integrated into the wider context of the university and the country's higher education system, and has far reaching effects. Efficiency goals impeded the effectiveness of the admissions process. Although the computerized system has to some extent increased efficiency, it has done so by eliminating certain vital information which could be helpful to the selectors. The computerized system has evidently made an already rigid procedure, even *more* rigid.

To a large extent, the rigidities of the computerized admissions system — such as the centralization of data processing and over-simplification of the information handled — stemmed from the limited nature of earlier generations of computer technology. Technical limitations of information technology have been more severe in developing countries. Organizations have little choice regarding computer systems either because of a lack of resources — a large number of systems were donated in tied aid schemes — or a lack of knowledge about technical complexities. Such experiences with computers are not unusual in developing countries — indeed several African countries have developed similar systems for their university admissions. In attempting to achieve apparently straightforward efficiency gains, efforts are made to acquire the computers, develop software, and transfer some manual data processing tasks onto the system. This is a demanding process in its own right; but it is far from adequate.

As indicated above, there is a well developed literature on information systems, ranging from philosophical sttudies of the nature of information systems development interventions to the normative and prescriptive (methods for successful exploitation of technology and organizational change). It is unlikely that the knowledge accumulated thus far — particularly the normative guidance to practitioners — is directly transferable to organizations in developing countries such as the Makerere University. Information systems requirements and the actions needed to implement them are highly contextual, yet most information systems research has been done in the context of a few western industrialized countries.

Understanding that the effective utilization of information and communication technologies needs to be explicitly linked to organizational objectives is particularly relevant to developing countries. It must take into account the social environment and organizational changes. Developing countries need to develop their own capacity to assess the opportunities new technologies provide, the magnitude and nature of the changes involved in the development of new information systems, and the risks they entail. They also need to work out more carefully methodical activities for organizational change and systems development which are appropriate for their organizational culture. To that end, information systems research programs are as critical as efforts for the development of the necessary technical skills.

13 Impact of an imported IT sector: lessons from Ireland

Eileen Trauth

Introduction

As technology-based information processing becomes an increasingly important success factor in organizational endeavors, those engaged in information processing and communication activities account for an increasingly large portion of the global labor force. This shift in employment toward knowledge and information processing activities is variously referred to as the movement to a 'post-industrial' society, an information society, or the information age. All these terms signify the same fact: that a substantial segment of a nation's labor force is employed in information technology production and information processing industries. Taken together, these industries — computer and telecommunication hardware manufacture; computer software and system development; and information processing and services provision — comprise what can be called the information technology (IT) sector.[1] In recent years, many newly industrializing countries (NICs)[2] have begun to look to the information sector as a key to their economic growth.

There are two significant differences, however, between the path which newly industrializing countries are taking to the information age and the route followed by advanced industrialized countries. Whereas countries such as the United States moved from an agrarian phase through a period of traditional industrialization which lasted over one hundred years and then into a knowledge-intensive society, NICs are proceeding directly from a traditional, agrarian society to a modern society with employment in the IT sector being a key component of this transition. In so doing, they are bypassing the lengthy period of industrialization which developed countries experienced as they moved toward the information age. The second difference between advanced and newly industrializing countries is that the latter endeavor to accomplish this rapid economic transition by importing both IT jobs and IT expertise through inward investment by multinational IT firms.

A series of societal issues are raised by this approach to economic development. This chapter addresses some of these issues using Ireland as a case in point. Interviews with IT workers in multinational firms are used to provide an insider's perspective on the nation's information economy. The experiences of Ireland can be generalized to broader themes regarding the challenges facing developing and newly industrializing countries who are following a similar path.

Background

Ireland's independence in 1922 marked the end of eight hundred years of British control. The price it paid for independence, however, was partition, the separation of the island into two nations: the twenty-six county, independent Republic of Ireland and the six county Northern Ireland which remained part of the United Kingdom. In addition to dividing the nation, partition also eliminated from the Republic what little industrial base it had since the North contained Ireland's incipient industrial sector at the turn of the twentieth century. The new republic then entered a period of economic isolationism and protectionism for the purpose of reestablishing an Irish identity within the context of political and cultural sovereignty. By the 1950s, however, this inward focus with its attempt to achieve complete self sufficiency was found to be wanting. As a result of policy changes beginning with the Programme for Economic Expansion in 1958, Ireland moved toward an aggressively outward orientation. In order to develop its industrial sector, Ireland's industrial policy was directed at 'importing' high tech industrialization via three sectors: pharmaceuticals, chemicals, and electronics.[3]

Methodology

This chapter is part of an ethnographic study of Ireland's emerging information sector. The purpose of the research is to consider the role of societal context in the evolution of an information economy. Figure 13.1 shows the underlying model that has been developed to frame this and related research.[4] According to this model there are two forms of interaction between society and the information economy. First, societal context exerts an *influence* on the way in which the emerging information sector develops. Second, there is the subsequent *impact* that the information sector has on society. This interaction is not linear, however. There is a constant interplay between society and the IT sector. In this research model societal context is comprised of culture, economy and public policy. The research hypothesis is that societal context plays a significant role in shaping the information economy of a nation. Therefore, societal data was collected to provide evidence to support this thesis. The shaded portions of the model indicate the

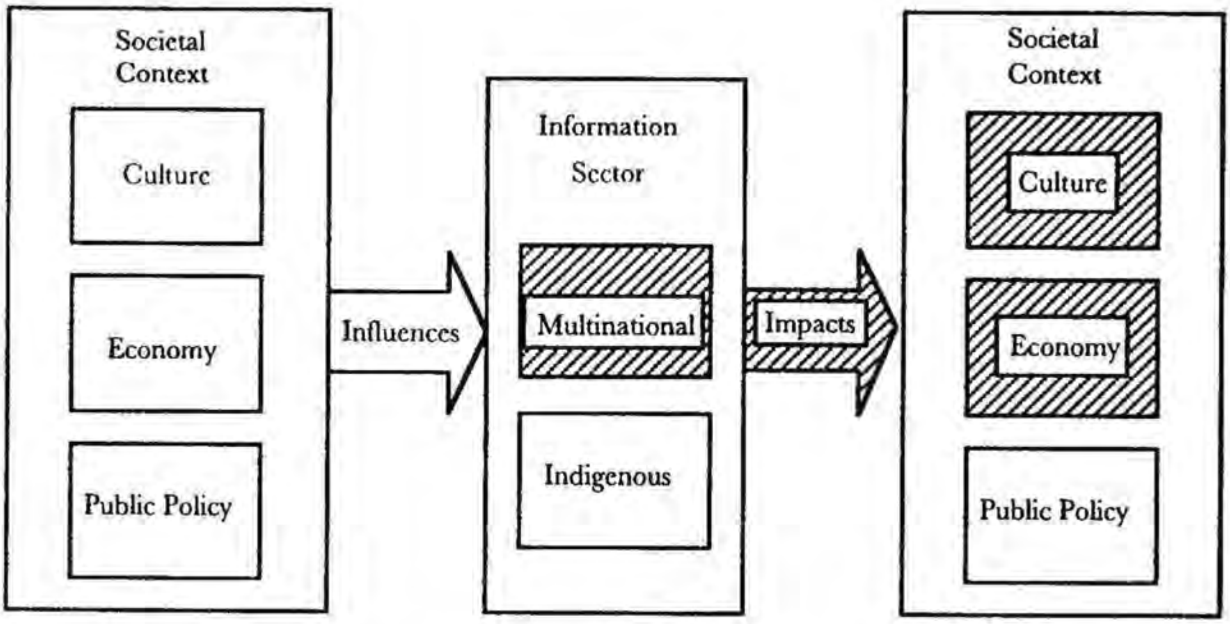

Figure 13.1 Influence-impact model of societal effect of IT

focus of this chapter: the impact of multinational firms in Ireland's information sector on cultural and economic aspects of society.

The majority of the data used in this research comes from semi-structured interviews (which typically lasted one and a half hours) with information sector workers. Supplemental interviews were also conducted with selected individuals outside the IT sector.[5] Additional sources of data collected for the purpose of triangulation (Jick 1979) were participant observation and document analysis. Transcripts of the interviews were coded by the researcher based on a content analysis schema developed in grounded fashion (Strauss 1987). A database of respondent characteristics and comments was then created to facilitate retrieval and systematic analysis of this data. Further details on the research methodology are provided in Trauth and O'Connor (1991). Summary information about the respondents and the IT firms appears in Tables 13.1 and 13.2 respectively.

The economic impact of an imported IT sector

Employment

The primary intention of Ireland's shift in industrial policy was to create new employment opportunities. From the outset, the information technology sector contributed significantly to this goal. Because the IT sector is an evolving category which also cuts across existing employment categories, a definitive measure of the size of this sector is not available. Nevertheless, a sampling of representative statistics gives some indication of the contribution of the IT sector to employment in Ireland. In 1971, 'Metals', which contained electronics and computer manufacturing (the IT sector at that time) accounted for 26 per cent of foreign investment in Ireland (Buckley 1974, p. 307). The portion of the Irish labor force accounted for by the three categories that contained the IT sector — 'Manufacturing,' 'Commerce' and 'Transport/Communications' — went from 45.37 per cent in 1988 to 46.94 per cent in 1993 (Central Statistics Office 1992, p.24; Central Statistics Office 1995, p.24). Recent studies of the hardware and software sectors indicate that employment in computer hardware in 1994 accounted for 0.6 per cent of the labor force (Coopers and Lybrand Corporate Finance 1994, p.5—6) while employment in the software industry in Ireland accounted for 0.7 per cent of the labor force in 1992. For the software industry most of this growth has been in recent years. The number of people employed in multinational software firms nearly tripled from 1987 to 1992 (Central Statistics Office 1995, p.24, National Software Directorate 1992, p.1—1)

Table 13.1
Respondent characteristics of Survey in Ireland (n=84)

Nationality	*Gender*	*US Firm*	*Irish Firm*	*No Firm*	*Total*
Irish	Male	24 (28%)	15 (18%)	10 (12%)	49 (58%)
	Female	10 (12%)	9 (10%)	2 (2%)	21 (25%)
American	Male	10 (12%)	0	0	10 (12%)
	Female	0	0	4 (5%)	4 (5%)
Total		44 (52%)	24 (28%)	16 (19%)	84 (100%)

Table 13.2
Firm characteristics of Survey in Ireland (n=14)

Nationality	*Hardware*	*Software*	*Services*	*Total*
Irish	2 (14%)	3 (21%)	2 (14%)	7 (50%)
American	6 (42%)	1 (7%)	0	7 (50%)
Total	8 (58%)	4 (28%)	2 (14%)	14 (100%)

In commenting on employment options in the IT sector, some respondents cited sources who suggested there might be a shortage of trained IT professionals in the future. Throughout the decades of the 1970s and 1980s, they said, there was a widespread feeling this was a growth industry. Firms came to the colleges looking for recruits, and new graduates typically had several job offers from which to choose.

In addition to the direct employment effect of more jobs for Irish workers, several indirect employment benefits resulted as well. The multinational IT firms also provided employees with the opportunity to acquire new technical skills and to gain valuable work experience which gave IT workers a level of job mobility. One young man who now works for an Irish IT firm, explained his own career strategy:

> My first company was an American company... I worked with them for a little over a year. I had made a conscious decision going into them knowing the technology they had. I felt myself as a technician, I would know the product within a year, and there was no point in staying any longer. So I used it as a stepping stone to get into computers and keep an eye on the market, what was going on at that point in time, and I would get the experience.

The growth experienced by the multinational IT firms during the 1970s and 1980s also gave IT workers greater opportunity to rise through the ranks to management positions than did the more traditional work sectors which were not experiencing such dramatic growth.

While actual jobs and increased career opportunities were seen as the positive impacts of the imported IT sector, respondents raised some concerns as well. They noted increased urbanization; specifically, the effect of the IT sector on the growth of Dublin. This is because much of the hardware manufacturing and nearly all of the software and services sectors are located in the capital city which currently contains a third of the country's population. Data for 1992 show that 76 per cent of multinational software firms and 71 per cent of indigenous software firms are located in Dublin County (National Software Directorate 1992, p.2—2, 2—5).

IT workers in Dublin have already experienced such quality of life effects as overloaded transportation and utilities infrastructures, and a lengthening of the work day because of the increased distance that one must travel to work. Respondents also noted the decline of the extended family. As young people leave the rural areas of the country for IT work in Dublin, families are becoming separated. Further, some engineers observed that since most research and development for American multinational firms is carried out in the US rather than in peripheral sites such as Ireland, there is a limit to how far they can develop their potential. Finally, some managers in Irish firms noted that since the multinationals can pay higher wage rates the indigenous IT sector is not able to compete in recruiting the best workers.

But the most common concern about IT employment in the multinational firms centers around the vulnerability workers feel as employees of internationally mobile firms which could abruptly leave Ireland at any time... and have. The following respondent provided a dramatic example:

> We've had a couple [multinational firms] here that locked the door and vanished. There was one company that at noontime management went out to lunch and didn't come back. It wasn't really funny, but I could imagine someone looking for whomever and the receptionist saying, "She'll be back, she'll be back."... At [another company] peo-

ple came to work in the morning and were simply told the plant was closed.

The global downturn in the computer industry has resulted in downsizing and plant closings in Ireland as elsewhere, IT workers have become much more concerned about job security in the 1990s than they were twenty years ago. When the topic of loyalty to the firm arose, respondents noted the importance of loyalty in general but also recognized the need to look out for one's own interests. Loyalty to one's employer had always been seen as an important workplace value, but that attitude has begun to change. Loyalty has become eroded as people no longer think in terms of having the same job forever. The 'permanent and pensionable' positions that had been so highly sought after in Ireland are no longer seen as possible in the IT sector.

Consequently, employees of the multinationals communicated a feeling of powerlessness at not having control over their destinies. They expressed a fear that some faceless manager at corporate headquarters halfway around the world might make a decision that would have grave consequences for them and their families. If the multinational firm is located in Dublin then other employment opportunities might exist. But if the firm is in Cork, Galway or Limerick or in some small village, then one might not have other IT options nearby. In fact, one respondent commented about some multinational firms purposely establishing subsidiaries in locations remote from other IT firms in order to minimize the opportunity for 'job hopping' — a widespread phenomenon that occurred in the US IT sector during the 1980s.

Emigration

Emigration has always been a part of Ireland's history. During the nineteenth and early twentieth centuries, those who emigrated were the sons and daughters who did not inherit the family farm, become a priest or nun, or join the civil service. Given few other options, they emigrated to America, England, Canada, or Australia. In the early years of the new Irish nation the emigration rates were particularly high. In the decade 1951 to 1961, the emigration rate rose from 0.82 per cent to 1.48 per cent of the population. The new industrial policy was directed, in large part, at stemming this tide of emigration by providing industrial work at home. This indeed occurred as the emigration rate slowed to a rate of 0.42 per cent by 1971 (Buckley 1974, p. 302.) In fact, because of the marked decline in the emigration rate during the 1970s, more young people remained in Ireland to marry and have families and to produce a baby boom that has given Ireland the youngest population in Europe.

One unintended impact of the industrial policy, however, has been the new wave of emigration which began in the 1980s. During the period 1986 to 1991 Ireland experienced a 5 per cent decrease in its population (Central Statistics Office 1991, p. 11). This new breed of emigrant has a totally different profile. He or she is a young and highly educated member of the information technology sector. This new form of emigration is occurring for a simple reason: it is difficult for the Irish economy to absorb the large number of young people entering the labor force. At the same time the quality of their education makes them a desired resource in other countries which have an older and/or less qualified labor force. Consequently, many well educated Irish graduates are being recruited by foreign firms while still attending university. From Ireland's perspective, the preferred alternative would be to have the multinational firm employ the Irish workers on home soil, rather than taking them abroad. The comments of one respondent clearly reflect this perspective:

> It's raw material, almost sitting here waiting to be employed. And the way it's employed is in two ways. Either by locating here or by coming here on very heavy recruitment contacts. Philips, for example, in the Netherlands, are renowned for coming over recruiting fifty to eighty technically qualified graduates in one swoop... So the way those of us who live here would like to see it developing is that more by investment, actually come and locate here. Leave these people in good living environments, good work environments. In doing so contribute to the economy's growth rather than seeing them do the same jobs effectively overseas.

Despite the claims of more jobs than applicants, there is sometimes a mismatch between skills and needs. As noted earlier, since research and development functions are rarely brought to Ireland, those wishing to pursue that line of work must often emigrate. Additionally, employers in Ireland increasingly expect experience along with a relevant university or technical degree. Consequently, some Irish graduates work abroad for awhile, returning home after they have some experience and want to settle down and raise families.

But coming full circle, a positive impact of this new wave of emigration, driven in part by the information sector, is the changed perspective these émigrés have when they return. One manager in an indigenous firm believes that when these émigrés eventually return, they will bring back with them what they have learned about different cultures and ways of operating. In an increasingly global industry, he believes this wider exposure will be a definite benefit to Ireland.

Dependence

The most immediate and observable benefit of the presence of multinational IT firms is the direct and indirect employment that has resulted. Direct employment is the actual job in the multinational firm. Indirect employment arises from multinational firms which source from indigenous suppliers. Another indirect benefit to employment is the role multinational firms play in stimulating the growth of the indigenous IT sector. This has been the case in key regions of America such as 'Silicon Valley' in California and 'Route 128' in Massachusetts. Just as a few core companies spawned an entire sector in these locations, many Irish entrepreneurs have learned about the IT field through working with multinational companies and have then gone on to establish their own firms.

The major drawback of this industrial policy, however, is its dependence on overseas investment which makes Ireland more vulnerable to fluctuations in the world economy. This economic dependence is felt at both the national and the personal levels. The departure of a multinational firm can devastate an entire region of the country. At the personal level, there is the constant fear of arbitrary job reductions (redundancies) occurring at any moment. An American manager recalling his earliest impressions about Ireland noted the role that employment security plays in decisions about job changes or career moves. When doing initial hiring for his firm in Ireland, he was struck by the number of resumes which reflected recent redundancies. This nervousness was demonstrated when the president made a visit to the Irish plant. Although the real reason was to observe operations because the plant had been so productive, workers were convinced he was coming to deliver bad news.

Cultural impact of an imported IT sector

Against the backdrop of the economic benefit of foreign investment in the forms of increased employment and reduced emigration must be seen the impact of 'imported culture.' This term refers to the introduction of a foreign culture when a multinational firm establishes a remote site. This impact occurs through the medium of corporate culture. A firm's corporate culture embodies its values, management style, method of operations and work environment. While these are, to a certain extent, unique to each particular firm, it is also the case that they reflect the national culture in which the firm developed. Thus, the corporate culture of an American firm brings to Ireland not only its own unique values but also some of the values present in the American culture. Of interest here is what happens when two different cultures come into contact.

According to the Irish respondents the American culture is characterized by an open, entrepreneurial, risk taking attitude toward work and life. American respondents who were asked about American culture being imported along with employment opportunities when multinational firms come to Ireland were quick to downplay any influence of (American) national culture. Instead, they emphasized the uniqueness of each of their corporate cultures and attributed any aspects of work culture at their (American) firms to a difference of *corporate* culture rather than *national* culture. However, when this researcher compared the cultures of the seven American multinational firms to those of the civil service, the professions, and traditional industries in Ireland, American firms appeared to be quite similar.

On one level, many Irish workers *wanted* to absorb the American culture. Several aspired to become 'yuppies'.[6] Others saw becoming more like America as the inevitable result of an improved standard of living. But an unexpected finding in this research was that the majority of respondents who embraced the American culture said they did so mostly for another reason. They saw a strong similarity between the American culture and what they perceived to be the *essential* Irish culture. By 'essential Irish culture' they were referring to patterns of thought, feeling, and behavior that reflect their Celtic origins. They contrast this with those essentially British modes of thought, feeling and behavior which were adopted while Ireland was a British colony.

It is ironic that the American firms reflect the open and easygoing style which respondents associate with their essential culture. To them, the American IT firms represent the Irish ideal of openness typical of the native culture. In contrast, indigenous firms in Ireland reflect the rigid, hierarchical atmosphere typical of a foreign (British) management style. The reason is that until the industrial policy of the past thirty years, Ireland looked to England for its model for business practices and management. One Irish worker noted:

> It's a very open style which is becoming more evident in Ireland. Right from the day I joined or anyone joined it's much more the American process of 'John' and 'Jim.' There's none of this 'Mister' or 'Miss' that, you're still getting in many Irish indigenous organizations.

Domination

In direct contrast to viewpoints which welcomed the American culture, were others which felt the foreign culture was being imposed. Strong views on both sides of the issue surfaced during the interviews. At one extreme was the view that multinationals *ought* to have a significant cultural impact. One American thought, for example, that Americans ought to retain management control until its home culture was firmly in place. The rationale was that if a firm is successful it is in part because of its corporate culture. Therefore, that same 'successful' corporate culture ought to be in place in the same way at all locations of a multinational firm.

The opposite view argues for tailoring the corporate culture of a multinational firm to the specific context. The example used to illustrate this point was one firm's affirmative action program. An Irish human resources director believed that a corporate policy to actively encourage the hiring and promotion of women at the Irish site similar to the one used in America would be culturally inappropriate. Another Irish respondent recommended that when American companies are setting up operations they should use Irish managers who know the local environment.

Not surprisingly, one American firm had difficulties getting Irish workers to adopt the values and processes inherent in it's corporate culture. Despite offering a course on those values twice, the outcome was disappointing. The third time, an Irish human resources manager co-taught the course with American management and it was more successful. The managing director of this firm shared a telling experience about a meeting with local politicians and business leaders:

> I said [our firm] would have an impact on the town and the culture. I commented on conflicts that I saw [between the cultures] and said I thought the [firm's] culture would diffuse into the local society. But one man from the residence council said, "The Vikings and the British tried that before and it didn't work!"

Peaceful coexistence

While some respondents did not care that Ireland was once again being 'invaded' — this time not by Vikings or imperialistic countries but by multinational companies with foreign corporate cultures, most expressed some concern about the impact this foreign influence would have on the indigenous culture. Respondents were asked about the wisdom of inviting a new wave of foreigners in the form of multinational firms into a nation which struggled during so many years of colonial rule to establish its own national identity. They were asked if Ireland was, perhaps, replacing one form of imperialism with another.

By and large, the Irish respondents both expected and welcomed new cultural influences. However, they also believed that the Irish culture should leave its imprint on the multinational firms as well. One individual acknowledged the irony of Ireland's position, yet didn't see any alternative. He wanted Ireland to be able to retain its cultural identity without returning to isolationism, and wanted to see cultural influences flow in both directions. In this way, he thought Ireland could absorb the best of outside influences and reject the worst.

Another respondent provided an example from a Japanese firm where he had worked. In his view, this firm believed that if the Irish wanted to become successful they would have to adopt the Japanese style of management and work. The firm left no room for mutual adaptation. He then explained what happened:

> I'll tell you this, I saw more Japanese taking an interest in the Irish culture than I saw Irish people taking an interest in the Japanese culture... In fact, it was a problem for some of the Japanese within their own family scenes. The Japanese men didn't like the Japanese women adopting the Irish ways. They didn't like to see their Japanese children running out to do Irish traditional dancing! In fact, some of them wanted to go back to Japan because of that. But also, where the Japanese men tended to adapt or adopt some of the Irish ways, they were often taken back to Japan as well. I think it was nicely summed up by a man that I worked with. After I left [the firm], I went back and met one of the guys three or four years later, and he looked tired

and worn. And he was a man in his mid-forties at the time, but literally he looked sixty. He was grey and his skin was dry and he looked very tired. And I said, "John, how are things going?" and he said, "Ah, tough going." I said, "As bad as how it was?" and he said, "Worse." He said, "Just when we had them all nicely educated they sent them all back to Japan!" So the crowd that had learned the Irish ways and had mellowed from some of the Japanese ways were taken out of the situation and put back to Japan.

Work style

According to the respondents, a noticeable positive impact of importing American corporate culture has been on the work ethic. Like other newly industrializing countries, Ireland did not have an industrial work ethic much less a post-industrial one. By bringing in multinational firms in the information industry, Ireland has been able to import and implant a work ethic that would have taken considerably longer to develop. Another positive effect has been the introduction of an entrepreneurial spirit, something needed to motivate new ventures. And as a result, the IT sector is establishing a pioneering identity. As one individual observed:

> ... there is a corps of people coming out right now that have this 'get up and go' and the work thing is there, it's instilled in them. They can see it, that they can go out and get it. It has to be influenced from outside. Those things have changed. American companies definitely would have an influence on it. You see very small industries setting up. Like that. You would hear, if you got the redundancy, a lot of people would talk about setting up their own small business whereas before, it would be more of, "Can I get another job, put the money away and if I can get a decent job, will I have the house paid off?" or whatever. More and more people are looking at the alternative of investment and maybe you wouldn't have that fifteen years ago.

Part of the reason these American attitudes toward work have been able to penetrate the IT work sector to such a large extent is that for many of the workers, a multinational work environment is the only setting they have known.

Quality of life

While the American zeal for achievement has helped foster an entrepreneurial spirit in Ireland, some wonder about the effect on the Irish quality of life. Quality of life in Ireland means a strong emphasis on the family and social interaction, and sufficient free time to enjoy oneself outside work. While high tech employment brings financial rewards and contributes to quality of life in the form of an improved standard of living, it also frequently takes the worker away from the family. For example, it is traditional in Ireland for workers to have time off during the week between Christmas and New Years. But for production-oriented companies like computer manufacturers, the last week of the quarter and of the calendar year is an important time. Consequently, numerous stories were related about having to give up holiday time with family because of the demands of work. The respondents worry that what they perceive as the American attitude of 'live to work' will replace the Irish attitude of 'work to live.' The desire to maintain a balanced life was emphasized by Irish respondents across all managerial levels.

Lessons from Ireland

The lessons from Ireland are applicable to other countries that are in the process of rapidly establishing information economies through inward investment. As a newly industrializing country in the late twentieth century, Ireland shares certain characteristics with developing, post colonial, and post communist countries. It only achieved its independence from a colonial power in the middle of this century. Like many former colonies and communist countries, its industrial base and national infrastructure are underdeveloped. Until the establishment of its current industrial policy it was a traditional, agrarian society. It has few natural resources. Finally, it is on the periphery of a powerful economic regime — the European Union. So, what can countries learn from Ireland's experience? Four general lessons emerge.

Consider tradeoffs

The first lesson is that inward investment is not an economic panacea. It should be viewed as an option which requires a serious cost-benefit analysis. Significant tradeoffs are implied in the decision to base economic development on outside interests. These tradeoffs should be evaluated before a decision is made to pursue this sort of industrial policy. Ireland has had to come to terms with two significant tradeoffs: economic vulnerability and proper allocation of financial resources.

In the early years of its industrial policy, Ireland promoted itself, in part, based upon its relatively low wage rates compared to other locations in Europe. While this may have been true at the time, some unintended negative effects also resulted. Ireland learned that firms whose only commitment is to the location with the cheapest labor and the best incentive program[7] would also quickly leave to pursue a cheaper workforce. As other parts of Western Europe, the Pacific Rim, the Caribbean and Eastern Europe have begun to compete for mobile foreign investment, there have been some abrupt departures from Ireland and a concomitant sense of vulnerability on the part of the Irish labor force.

The other tradeoff involves the allocation of financial resources. To the extent that grants and tax relief are given to foreign firms, there are fewer resources available for indigenous firms in that industry. Thus, the tradeoff becomes one of short-term versus long-term gain. The short-term gain in specific jobs for the present may be at the cost of investment capital available to indigenous firms which will remain in Ireland permanently.

Throughout the period of this industrial policy, Ireland has had an ongoing process of policy analysis. The issue of Ireland's economic vulnerability was first raised in the early 1980s (Telesis 1982). As a result of more extensive assessment in the 1990s (*Overseas Industry in Ireland*, 1991, *A Time for Change* 1992), a substantial shift has occurred. Ireland now places much more emphasis on developing indigenous firms and it is much more selective with regard to the type of multinational firm it wants to attract.

Consider opportunities in context

The second lesson is that the solutions must make sense for the particular context in which they will be implemented. When the information sector was emerging as a key target area of Ireland's industrial policy during the 1970s, there was a clear expectation about the payoff for the financial incentives given to the multinational computer companies. It was expected that a 'spillover' effect would result. This 'spillover' would include the creation of new indigenous firms. Some of these firms would be suppliers to the multinational IT companies, others would be IT companies themselves. This expectation was based on the experience of the high technology region in the Boston area during the 1960s and 1970s where such a phenomenon did, indeed, occur.

However, in the thirty years since the industrial policy was enacted, Ireland has learned that the 'spillover' effect is neither automatic nor monolithic. Multinational firms are not inherently motivated to source locally. Further, the placement of a single high tech firm in a particular location is not sufficient to stimulate the development of an industry in that region. There must also be a market, a sufficient number of qualified personnel, an infrastructure, and an entrepreneurial presence in order for an IT region to develop.

Interestingly, derivative employment did develop, though not in the intended form. In the 1970s Ireland did not think in terms of an *information technology* sector. Rather, it envisioned the development of an *electronics* industry with computer manufacturing as the main type of employment. However, in order to attract and retain multinational firms in the 1970s Ireland had to significantly upgrade it's telecommunications infrastructure, particularly in western Ireland. Once the telecommunications infrastructure was in place, multinational firms began to see Ireland not just as a location for hardware manufacture, but also as a location for 'offshore' data processing[8] and software development. Irish policy makers recognized this opportunity, and gradually began to promote Ireland as a site for a full range of information technology activities including data processing and software development in addition to hardware manufacture. The recently constructed Financial Services Center in Dublin targets the information processing needs of the European financial services industry.

Coordinate educational and employment policy

A third lesson concerns the development of human resources. There should be coordination between the employment objectives of the policy makers and the educational plans of the universities. There is much irony in the fact that an industrial policy intended to stem the tide of emigration has resulted in some of the best and brightest leaving a country. Ireland made a concerted (and impressive) effort to reorient its educational system to make it compatible with its industrial policy. This involved the rapid creation of two new universities with a strong orientation toward business, and science and technology.

The industrial policy also resulted in the creation of government schemes for worker training and retraining. An unexpected outcome, however, was producing graduates who were educated for jobs that didn't exist or were in small supply in Ireland. As a result of the new wave of emigration in the 1980s, recent industrial policy assessments have recommended a closer match between the educational plans of the universities and the employment opportunities available in the country (*A Time for Change* 1992).

Another part of the educational issue is the need to make it widely available. Because particular skills are required for employment in the information sector, education is the key to economic and employment opportunity for people in countries which emphasize this sector. In order to ensure that all citizens are able to avail themselves of the *economic opportunities* present in the information sector, it is important that they have equal *educational opportunity*. In Ireland and elsewhere gender and class barriers may inhibit full and equal participation in the emerging information society (Clancy 1988, Trauth 1993 and 1995). Addressing this issue might require a reexamination of the entire spectrum of educational content and processes.

Recognize the special concerns of later entrants

The final lesson relates to the ability of Ireland or any latecomer to compete in the international information technology arena, particularly in the face of a general trend toward privatization and unfettered competition. Several recent studies on Ireland have pointed out the difficulties associated with unrestricted free trade and capitalism (see Jackson & Barry 1989, O'Hearn 1989). O'Malley (1989) identifies three significant barriers to entry late industrializing countries like Ireland encounter:

1. advanced industrialized countries can offer products and services at lower costs because of economies of scale,
2. and they have already achieved product differentiation and recognition, and
3. newly industrializing countries must cope with the capital expenditures necessary to enter an industry.

Singer (1970), frames this issue as one of dualism, the growing disparity between the 'haves' and the 'have nots' in the global arena.

The lesson for Ireland and other later entrants into the information age is that what worked for the first wave of post-industrial societies like the United States may not work for succeeding waves. Whereas a high level of competition and privatization may have worked for the first entrants, later entrants may require government stimulation programs or other policy interventions (see Trauth and Pitt 1992 for an elaboration of this argument for the case of the telecommunications industry). Finally, it is important to differentiate between means and goals. While later entrants may share the same goals as early entrants, the means by which they achieve these goals may be different because of the changed circumstances in which they operate.

Conclusion and Recommendations

The research described in this chapter attempts to achieve a better understanding of the complex interaction between the IT sector and societal context. It focuses on the cultural, economic and policy issues that can arise in the establishment of an information sector. It also endeavors to identify some of the unintended consequences that can accompany the development of an information sector in a newly industrializing country. An examination of the impact of the IT sector on the Irish economy and culture yields some general lessons applicable to other nations traveling a similar path into the post-industrial world. The experiences of another country can help policy makers address societal issues that challenge the successful development of an information sector in their own nations. Likewise, they can suggest to multinational managers some of the impacts their decisions may have. In this spirit the following recommendations are offered to policy makers and multinational managers.

Policy makers

Policy makers need to be cognizant of the economic tradeoffs associated with developing an IT sector through inward investment. Where possible they should attempt to minimize their economic vulnerability by developing indigenous firms as well. However, it is important that aspects of the IT industry targeted for development be suited to the circumstances of the country. For example, Ireland's industrial policy for indigenous IT firms increasingly focuses on the software rather than the hardware sector because fewer capital costs are involved. In addition, Ireland's abundance of well educated young IT professionals means it has the proper natural resource — people — necessary for the software sector.

It is also necessary to have the societal infrastructures in place to support the people engaged in IT work. These infrastructures include education, telecommunications, transportation and sufficient housing in regions experiencing population growth. With regard to education, it is important to monitor the skills and knowledge being acquired by students and compare them with expected employment trends.

The overriding recommendation to policy makers is to acknowledge that both intended and unintended consequences will result from policy decisions. To recognize this is to build into the policy making process mechanisms for ongoing assessment of the path toward the information society. (See Trauth 1979 for an example of this.) As the example of Ireland illustrates, these unintended consequences can be both positive and negative. Finally, it is important to remember that the objective is not to simply emulate what another successful country has done, but to develop strategies and policies that make sense within the context of one's own country .

Multinational managers

The economic vulnerability which policy makers see on a macro level, are experienced at a very personal level by IT workers. While managers in host countries may not be able to control the decisions made at headquarters, they can employ communication to help minimize worker fears about redundancies. Depending upon their past experiences with multinational firms, workers may need assurance about their job security. Where assurances are not possible, then at least open communication is needed. Clearly, fear of an abrupt departure of a foreign firm does nothing to enhance worker loyalty and productivity.

But a more overriding recommendation to multinational managers regards something over which they do have control. By recognizing that there is more than one path to excellence, multinational managers can develop procedures and management approaches that exploit the best features of the host country. For example, several American managers noted a feature of Irish culture that they use in resolving human relations issues. This cultural feature is the emphasis placed on social interaction. This cultural trait is manifested in the workplace by the norm of having drinks after work in the local pub. American managers noted that sometimes a potentially significant human relations situation could be diffused by employing the mechanism of meeting in the pub to discuss it. Clearly, this management approach fits well with Irish culture but may not suit other cultural contexts.

Likewise, the way that works best in Japan or in America may not be the way that works best in Ireland. One phrase repeatedly surfaced during discussions about cultural differences. Both this researcher and other Americans in Ireland were often told, 'Well, this is Ireland; things are different in Ireland.' or 'You don't do that. This is Ireland.'

One interpretation of this phrase could be resistance to change. Another interpretation, however, would be that this is an expression of the desire of Irish people to retain their national and cultural identity. Both interviews and participant observation concur that the Irish do not want to sacrifice their identity in order to have employment in multinational firms. Rather, they want to retain what is unique and special about the Irish character in the face of the homogenization of cultures.

It is natural that the home culture of the multinational IT firm will influence the society it enters. But it is also natural that the workers will want to tailor the corporate culture to make it compatible with their own culture. By building a permeable wall through the open exchange of values and norms both cultures can be enriched.

Notes

1 Following Porat (1977), the *information sector* or *information economy* in this study refers to the employment sectors engaged in the manufacture of computer and telecommunications technology, the development of software and systems, and the provision of information services.

2 This research is concerned with those countries which are developing their IT sectors in the 1990s. They include nations that have been traditionally described as developing countries as well as countries with a partially developed industrial sector and/or a partially developed national infrastructure compatible with IT work. These later countries would include post-colonial nations such as Ireland as well as post-communist nations. The term being used in this chapter to describe all of the above countries is *newly industrializing*.

3 While Irish policy makers today would say that information technology was one of the chosen industrial sectors, during the 1960s and 1970s electronics was simply viewed as a type of manufacturing. It was not until firms began to employ high speed telecommunications for remote software development and 'off shore' data processing that industrial policy makers came to use the term 'information sector' (see Note 8).

4 See, for example, Trauth et al. (1993) for an application of this model to a different country context.

5 These individuals are spouses of multinational executives, governmental officials and their spouses and individuals working in other industries in Ireland. They were added to the sample to provide background information about public policy and to provide a counterpoint to the economic and cultural observations made by the IT workers.

6 At the time these interviews were conducted the term 'yuppie' (Young Urban Professional) was meant as a positive reflection on one's lifestyle.

7 Multinational firms in Ireland have been given financial incentives in the forms of equipment and training grants as well as tax relief.

8 This term refers to data processing activities being carried out in foreign locations. The west of Ireland, for example, has become a remote site for claims processing by American insurance firms.

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