Implications of Information Technology in Developing Countries and Its Impact in Organizational Change

Bahar Kenaroğlu
Turkish Aerospace Industry (TAI)
Istanbul yolu 30.km
06936 Akıncılar
Ankara TURKEY
bkenaroglu@yahoo.com

STPS – WP – 0302

ABSTRACT

The survival and growth of organizations in an increasingly turbulent environment would depend upon effective utilization of information technology for aligning the organizational structure with environmental preferences and for creating symbiotic interorganizational structures. How can IT help the organizations in responding to the challenges of an increasingly complex and uncertain environment? How can IT help the organizations achieve the "flexible" organization structure? These are the topics that remains to be a matter of question for many developing countries. Although Information technology is still a "black box " technology for developing countries, it is largely applied in industrialised countries to the disadvantage of the majority of developing countries. This paper will try to illuminate the aspects and the impact of Information Technology in managing organizational change and its implications for developing countries.

Keywords : IT, Organizational Change, Developing Countries

JEL Codes : L86, M54, 033

1. Introduction

> *The rate and magnitude of change are rapidly outpacing the complex of theories—economic, social, and philosophical—on which public and private decisions are based. To the extent that we continue to view the world from the perspective of an earlier, vanishing age, we will continue to misunderstand the developments surrounding the transition to an information society, be unable to realize the full economic and social potential of this revolutionary technology, and risk making some very serious mistakes as reality and the theories we use to interpret it continue to diverge."-Arthur Cordell(1987)*
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> *We have modified our environment so radically that we must modify ourselves in order to exist in this new environment.—Norbert Wiener(1957)*

The survival and growth of organizations in an increasingly turbulent environment would depend upon effective utilization of information technology for aligning the organizational structure with environmental preferences and for creating symbiotic interorganizational structures. How can IT help the organizations in responding to the challenges of an increasingly complex and uncertain environment? How can IT help the organizations achieve the "flexible" organization structure? These are the topics that remains to be a matter of question for many developing countries. This study will try to illuminate the aspects and the impact of Information Technology in managing organizational change and its implications for developing countries.

2. Aspects of Information Technology

Information technology (IT) may be defined as the convergence of electronics, computing, and telecommunications. It has unleashed a tidal wave of technological innovation in the collecting, storing, processing, transmission, and presentation of information that has not only transformed the information technology sector itself into a highly dynamic and expanding field of activity - creating new markets and generating new investment, income, and jobs- but also provided other sectors with more rapid and efficient mechanisms for responding to shifts in demand patterns and changes in international comparative advantages, through more efficient production processes and new and improved products and services (e.g. replacing mechanical and electromechanical components, upgrading traditional products by creating new product functions, incorporating skills and functions into equipment, automating routine work, making technical, professional, or financial services more transportable).

The development of IT is intimately associated with the overwhelming advances recently accomplished in microelectronics. Based on scientific and technological breakthroughs in transistors, semiconductors, and integrated circuits ("chips"), micro-electronics is affecting every other branch of the economy, in terms of both its present and future employment and skill requirements and its future market prospects. Its introduction has resulted in a drastic fall in costs as well as dramatically improved technical performance both within the electronics industry and outside it (Malone and Rockart, 1993). The continuous rise in the number of features on a single micro-electronic chip has permitted lower assembly costs for electronic equipment (each chip replacing many discrete components), faster switching speeds (thus faster and more powerful computers), and more reliable, smaller, and lighter equipment (fewer interconnections, less power and material). Similar dramatic falls in costs occurred in the transport and steel industries in the nineteenth century and in energy in the twentieth, associated with the emergence of the third and fourth Kondratiev cycles, respectively. The potential effects of microelectronics are thus very far-reaching, for its use in production saves on virtually all inputs, ranging from skilled and unskilled labor to energy, materials, and capital.

All sectors of the economy have been influenced by the development of IT applications: information technology opens up greater opportunities for the exploitation of economies of scale and scope, allows the more flexible production and use of labor and equipment, promotes the internationalization of production and markets, offers greater mobility and flexibility in capital and financial flows and services, and is frequently the precondition for the creation of innovative financial instruments. Information system developments are constantly being applied to increase the productivity, quality, and efficiency of finance, banking, business management, and public administration. In manufacturing, and to some extent in agriculture, many processes have been automated, some requiring highly flexible, self-regulating machines, or robots. The engineering industry has been transformed by computer-aided design and three-dimensional computerized screen displays.

The pace of technological change in IT will most likely accelerate the already observable growth in the interdependence of international relations not just economic or financial, but also political and cultural. National economies have become more susceptible to the effects of policy decisions taken at the international level, and domestic economic measures are having increased impacts on economic policies of other countries. World markets for the consumption of similar goods are growing, and so are common lifestyles across national

borders. The advance of telecommunications and computerization has recently enabled large companies to use information systems to transmit technical and economic information among numerous computer systems at different geographical locations, subjecting widely dispersed industrial plants to direct managerial control from a central location; this affects the international division of labor and production and international trade, changing the patterns of industrial ownership and control, altering the competitive standing of individual countries, and creating new trading partners.

It is the integration of functions that confers on information technology its real economic and social significance. More than just a gradual and incremental technological evolution leading to improved ways of carrying out traditional manufacturing processes (i.e. simply the substitution of new technologies for existing systems and the rationalization of standard activities), IT offers the opportunity for completely new ways of working through systems integration. Rather than applying one item of new technology to each of the production functions now performed at distinct stages of the production process, i.e. design, production, marketing, and distribution (in what could be called "stand-alone" improvements or "island automation"), having evolved in to new technologies, i.e. Enterprise Resource Planning systems, IT offers the possibility of linking design to production (e.g. through programmable manufacturing, measuring, and testing equipment responding to the codification of design), planning and design to marketing and distribution (e.g. through a variety of computer aids and databases that sense and collect changing market trends), production to distribution (e.g. by automatically incorporating orders and commissions by customers and suppliers into the production process), etc. The complete integration of all these production subsystems in a synergistic ensemble is still more a long-term trend than a reality, but use of automated equipment to link together individual items of equipment belonging to hitherto discrete manufacturing operations has already made IT a strategic issue for industry.

More technical advances are expected soon in the automation of telecommunications and the linkage of computers by data transmission that will enhance the possibilities of systems integration. Such "programmable automation," or computer-integrated manufacturing (CIM), has the capability of integrating information processing with physical tasks performed by programmable machine tools or robots. CIM offers radical improvements in traditional problem areas confronting manufacturers, such as:

- reduced lead time for existing and new products;
- reduced inventories;
- more accurate control over production and better quality production management information;
- increased utilization of expensive equipment;
- reduced overhead costs;
- improved and consistent quality;
- more accurate forecasting;
- improved delivery performance (Miles et al., 1988).

These features characterize information technology as a new technological system, in which far-reaching changes in the trajectories of electronic, computer, and telecommunication technologies converge and offer a range of new technological options to virtually all branches of the economy. Moreover, IT forms the basis for a reorganization of industrial society and the core of the emerging techno-economic paradigm.

The reason for the pre-eminence of the new technological system clustered around information technology over the equally new technological systems clustered around new materials and biotechnology is the fact that information activities of one kind or another are a part of every activity within an industrial or commercial sector, as well as in our working and domestic lives. Almost all productive activities have high information intensity (some involve little else, such as banking or education). Further more, along with the premier of internet technology and e-business architectures; powerful concepts like inventory control, supply chain management, customer relationship/service management, and management resource planning through the internet under the name of Enterprise Resource Planning have enabled IT to be capable of offering "strategic" improvements in the productivity and competitiveness of virtually any socio-economic activity. Other than industrial or commercial sectors, information technology is also applicable in education sector and in public institutions. Thus, Information Technology is universally applicable.

Probably only a fraction of the benefits derived from information technology-based innovations have so far been reaped and the rest remain to be acquired in the next decades. The shift towards systems integration to capitalize the full potential benefits of IT requires considerable adaptations, learning processes, and structural changes in existing socio-economic institutions and organizational systems. The tradition in most current organizations

is still to operate in a largely "disintegrated" fashion, reminiscent of the Ford-Taylorist management approaches that dominated the fourth Kondratiev cycle: high division of labor, increasing functional specialization/differentiation and de-skilling of many tasks, rigid manufacturing procedures and controls, long management hierarchies with bureaucratic decision-making procedures and a "mechanistic" approach to performance. Under these conditions, use of IT is restricted to piecemeal technology improvements. By contrast, information technology-based systems offer organizations the opportunity of functional integration, multi-skilled staff, rapid and flexible decision-making structures with greater delegation of responsibilities and greater autonomy of operating units, a more flexible and "organic" approach enabling a quick adjustment to changing environmental conditions. (Piore and Sabel, 1984.)

But this means that information management skills require the ability to make choices about the optimal arrangements for particular situations: unlike earlier generations of technology, IT offers not a single "best" way of organization but a set of more or less appropriate alternative organizing, staffing, and managing options that may be adopted in different organizational contexts. There is no "determinism" in the way information technology influences the socio-institutional framework. Therefore, organizational innovation is a crucial part of the requirement for firms to adapt to survive (Miles, 1988).

Unfortunately, this is true for all the institutions as well. Further, it is even more dramatic for the organizations in developing countries because of not being able to properly adapt to this so-called “black-box” technology. No matter how frustrating it is interpreted for these countries, IT still has significant impact on their development. Although socio-economic structure of these countries resists organizational or institutional changes, the complex interrelations between these changes and information technologies have significant implications for the way IT does and will affect the societies and economies of developing countries. As a matter of fact, the negative and positive potential impacts of IT on these countries are a matter of great controversy among economists and politicians. The main short-term issues usually discussed are the potential erosion of the comparative advantages of low labor costs, particularly in relation to assembly facilities, and the effects of automation, particularly on internal markets and international competitiveness. Implications of information technology for those countries hold great importance.

3. Implications for Developing Countries

The first direct effect of the "micro-electronics revolution" was the location of production for export in third world countries. While production of mainframe computers continued to be located largely in industrialized countries, production of smaller computers and of micro-electronic devices, more subject to price competition, was shifted to low-wage locations, mainly in East Asia, where countries presented low wage costs as well as political stability, a docile labor force, and government incentives. Location of production for local and regional consumption followed, but the countries concerned were mainly middle income: three-quarters of US investment in third world micro-electronic industries was concentrated in 11 countries, namely the four Asian "dragons," India, Thailand, Malaysia, the Philippines, Brazil, Mexico, and Colombia (Steward, 1991). Export-oriented investments in these countries were associated more with direct foreign investment from larger firms in industrialized countries than with firms producing for the local market; on the other hand, licensing was more associated with smaller firms (Tigre, 1995).

The automation of production decreases the relative importance of labor-intensive manufacturing and cost of labor, thereby eroding the competitiveness of low labor costs. For instance, automation led to a sharp decrease in the difference between manufacturing costs of electronic devices between the United States and Hong Kong: in manual processes, manufacturing costs were three times higher in the United States, and the introduction of semi-automatic processes made the difference practically disappear (Sagasti, 1994). Equally, the expansion of automation in Japan has contributed to a reduction of Japanese investments in the Asia/Pacific region involving firms in electronics, assembly parts, and textiles (Sagasti, 1994).

The trend to increasing systems optimization and integration is most likely to induce large producers in industrialized countries to bring back a significant share of their production located in developing countries (offshore production). This movement has been called "comparative advantage reversal." As integration increases, with functions previously obtained by assembling pieces being incorporated in the electronic components, value-added is pushed out of assembly processes into the components themselves and upwards towards servicing. In addition, the growing technological complexity of electronic devices increases the value of the parts manufactured by firms located in industrialized countries The amount of value-added obtained in offshore assembly has thus been constantly decreasing (Sagasti,

1994). Global factories constructed in locations of least cost, often at a considerable distance from final markets, were economically worthwhile because labor was one of the major determinants of costs. Technology and rapid responsiveness to volatile local markets are becoming more important components of competitiveness. The reduction of product cycles due to the growing resistance to obsolescence of programmable machines and equipment has led to a concentration of manufacturing investment in capital-intensive flexible manufacturing, further adding to the erosion of the comparative advantages of developing countries.

The assembly of systems will probably continue in some developing countries that have adopted protective legislation for local production targeted at particular market segments (e.g. Brazil), although this is changing very rapidly (Steward, 1991). The types of equipment produced under these circumstances are used largely in internal markets and are hardly competitive on the international level; they tend to be far more expensive than comparable equipment available abroad, and often their installation and use are also more costly because of expensive auxiliary installations, under-use, and lack of management skills. Nevertheless, they may at least provide the country with the capacity to follow the development of information technologies more closely. In other countries, assembly of equipment is taking place from components bought practically off the shelf, but as the level of hardware integration and the amount of software incorporated into the chips (firmware) grow, value-added will be taken away from the assembly process, reducing or eliminating its economic advantages.

The introduction of microelectronics requires certain new skills of design, maintenance, and management, as well as complementary infrastructural facilities such as reliable telephone systems and power supplies. Deficiencies in these factors prevent the widespread adoption of information technology in developing countries (Munasinghe et al., 1985). The more advanced developing countries, with a wider basis of skills and infrastructure and a more flexible labor force, may be in a better position to adopt IT and to increase their productivity and their international competitiveness. But the less developed countries, with inadequate skills and infrastructure, low labor productivity, and lack of capital resources, will find it difficult to adopt the new technologies; they are likely to suffer a deterioration in international competitiveness *vis-à-vis* both industrialized and the more advanced developing countries (Stewart et al., 1991).

Quality, too, requires an adequate level of skills, infrastructure, and managerial know-how that is generally lacking in developing countries. This greatly reduces the synergies, number of options, faster responses, and more informed decisions that can be implemented in the firm by the optimization of the systems performance. In turn, the composition of the labor force existing within firms located in industrialized countries will further improve their systems performance and further reinforce the advantages derived from automation. The proportion of the labor force employed in production is constantly decreasing in the industrialized countries, implying that performances at the systems level and innovation, not manufacturing, are becoming the key to profit, growth, and survival (Sagasti, 1994).

Like biotechnology, information technology is a proprietary technology, vital technical information regarding design engineering specification, process know-how, testing procedures, etc., being covered by patents or copyrights or closely held as trade secrets within various electronic firms from industrialized countries. Many companies in the software area do not patent or copyright their products because it entails disclosing valuable information, and firms are generally reluctant to license the more recent and advanced technologies. Therefore, technology transfer takes place mainly among established or important producers, hindering the access to developing countries. Moreover, the main issue facing developing countries is not so much the access to a particular technology but to the process of technological change, because of the dynamism of this process. Sagasti implies this issue in the book *The Uncertain Guest: science, technology and development (1994)* that recent trends in inter-firm relationships seem to indicate that this access takes place essentially through the participation in the equity of the company holding the technology. The possibility of firms from developing countries doing this is small. He also adds:

> "The general tendency thus points to a widening of the information technology gap, both between industrialized and developing countries and within developing countries. From a purely quantitative standpoint, there remain large gaps in the access to information in the world, showing that the diffusion of information technology in developing countries is still in an embryonic stage. In 1985, only 5.7 per cent of the total number of computers in the world were located in developing countries, which have so far mainly used computers for more standard functions, such as inventory control, accounting, and payroll. There are some significant exceptions: during 1981-1986, the Brazilian electronics market grew to about US$8 billion, becoming the tenth largest in the world, slightly larger than that of the Republic of Korea. Brazilian controlled firms have rapidly expanded their production of computers, and India has been particularly successful in software, having achieved a niche in the international software market through its government policies of tax breaks and liberal foreign exchange regulations for this sector. In 1985, Brazil was by far the largest user in computers in the developing world, with about 10,000, followed by India with around 1,000.
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> The value of data processing equipment (excluding micros) existing in developed countries was 4.5 times greater than in developing countries (including centrally planned economies) in 1983. On

> the other hand, the market for telecommunications equipment (i.e. telephone, telegraph, telex, data and satellite communications, mobile radio and radio telephone, radio paging, and cable TV) in industrialized countries in 1985 was 8 times greater than in developing countries. Increasingly severe financial problems facing the developing countries are most likely to lead to a quantitative increase in the gap.
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> The situation is not very different from the qualitative standpoint. The process of "informatization" of society is one in which greater amounts of knowledge and information are incorporated into goods and services. Knowledge and information are sources of wealth creation and value-added in their own right: as their amount increases, the amount of energy, materials, labor, and capital decreases. The concentration of knowledge and information-intensive services in industrialized countries is *per se* a further barrier to efforts to reduce the information technology gap between industrialized and developing countries." (Sagasti, 1994)

Moreover, since systems integration and disembodied technologies are the essential locations of competitive innovation, the advantages of technology transfer by reverse engineering and technological "unpacking" are more difficult to capture (Kaplinsky, 1989). For instance, even in Taiwan and Korea, all numerically controlled mechanisms are made under license; in Brazil and Argentina, computerized numerically controlled devices and motors are imported (Jacobsson, 1985). India and China produce numerically controlled and computerized machine tools under license, utilizing imported control units and motors.

There is, however, an alternative "reading" of the evidence presented above. Some commentators mentioned previously see IT as a powerful new opportunity for at least some developing countries to improve their competitive position in certain fields and to foster their development precisely because of their relative lack of established industrial infrastructure. Meaning that there are fewer institutional barriers to the adoption of advanced systems based on information technology. Problems related to the reluctance to discard previous generations of equipment, for instance in telecommunications (i.e. outdated electromechanical and copper-wire based infrastructure), are less important in developing countries, and replacement costs are lower, allowing them to jump directly to "best practice."

Evidently this thought minimizes the fact that in practice, information technology is still a "black box" technology for most users in developing countries, requiring new skills to operate, to repair, and even to purchase, particularly in its integrated form, where its full benefits emerge. It is therefore most likely that information technology will be largely applied in industrialized countries to the disadvantage of the majority of developing countries, the latter remaining heavily dependent on advanced technology-based products designed in the former.

4. The Impact of IT in Organizational Change and Human Resources

As mentioned previously, the increasing global interdependencies and the accelerating pace of change demand more flexible and adaptive organizations (Malone and Crowston, 1991). Malone (1991) has defined organizational flexibility in terms of "vulnerability" and "adaptability." Effective implementation of IT would decrease vulnerability by reducing the cost of expected failures and enhance adaptability by reducing the cost of adjustment. Rockart and Short (1989) attribute the ever-increasing need for managing interdependence to competitive pressures that included globalization, time-based competition, increased market risk, and a greater emphasis on customer service and cost reduction. Bennis (1974) notes that "the organization's response to the environment will continue to be the crucial determinant for its effectiveness." Since postindustrial organizations will be faced with increasing environmental complexity and turbulence, organizations' needs to process information and make decisions will be substantially increased (Huber, 1981). The capabilities and flexibilities of computer-communication systems make them increasingly relevant to organizations by being able to respond to any specific information or communication requirement (Holt, 1992).

The cost of IT has plunged since the 1960s resulting in enormous investments in IT applications that have stimulated increasingly complex organizational change (Benjamin and Levinson, 1993). Benjamin and Blunt (1992) anticipate that technology cost-performance improvements will sustain this trend over the next decade. Presently, IT amounts to nearly one-half of US firms' annual capital expenditures and increasingly affects how firms organize, do business, and compete (Keen, 1991).

IT may be considered as comprising of five basic components - computers, communications technology, work stations, robotics, and computer chips (Morton, 1988). In this article, "IT" is considered to be synonymous with the definition of *"advanced information technologies"* provided by Huber (1990):

> "(a)devices that transmit, manipulate, analyze, or exploit information;
> (b) in which a digital computer processes information integral to the user's communication or decision task; and
> (c) that have made their appearance since 1970 or exist in a

> form that aids in communication or decision tasks to a significantly greater degree than did pre-1971 forms."

IT is becoming all-pervasive and is having impact on all industries -- in service as well as in manufacturing. It is affecting workers at all levels of organizations (Daft, 1992) -- from the executives to assembly hands and clerks. IT is increasingly becoming an integral component of all types of technologies -- craft, engineering, routine, and non routine (Daft, 1992). Drucker (1985) has very rightly defined organization as "a structure in which information serves as the axis and as the central structural support."

Benjamin and Levinson (1993) emphasized that for IT-based change to be effective, technology, business processes, and organization need to be adapted to each other. Comparing the present information revolution with the Industrial Revolution, Malone and Rockart (1993) indicated that the latest changes in IT would lead to the evolution of new technology-intensive organizational structures. They project that the advances in IT would result in dramatic decline in the costs of "coordination" which would lead to new, coordination-intensive business structures. Rockart and Short (1989) suggest that IT would enable the firms to respond to the "new and pressing competitive forces" by providing for "effective management of interdependence." Interorganizational relations, that are based upon trust and conditions of unstructured authority (Litwak and Hylton, 1962) would be created using newer types of coordination mechanisms. Malone and Crowston (1991) believe that in light of these new possibilities there is need to reassess our current theories of organizations, of markets, and of management.

On the other hand, recent authors have recognized that information technology is a potential enabler of new types of work organization. Immediately following the changing environment of the mid-1980s, a number of authors proposed new work systems to contrast to the traditional "mass production" style of organization that dates back to the beginning of the industrial revolution. In batch manufacturing processes such as automobiles, new types of organization such as flexible specialization (Piore and Sabel, 1984), high performance work systems (MacDuffie et al., 1995; Ichniowski, et al., 1996), and lean production (Womack et al., 1988) have appeared. These general principles have also been examined by others in broader samples of the economy and in more narrowly defined industries such as

metalworking (Osterman, 1994). While the exact description of these practices vary, they generally involve a combination of flexible machinery, skilled employees, and increased delegation of authority to line workers ("empowerment"), either through teams or through increased individual discretion.

Recent authors have recognized that information technology is a potential enabler of these types of work organization. Milgrom and Roberts (1990) cite CAD systems and manufacturing automation as being complements to these types of work practices. Brynjolfsson et al., (1997) describes a case where new flexible production technologies failed to meet expectations in terms of productivity improvements until they were coupled with increased delegation of authority and a team-based production structure. Hicks (1970) indicate that integration of computers and communication networks with decentralization of decision rights to line workers improves organizational performance. Ichniowski et al. (1996) cite IT as a potential barrier to the diffusion of workplace innovation; despite high productivity gains possible with these work practices, diffusion may be slowed because of the need to make complementary investments in information technology. Hitt (1999) indicates that the value of computer controlled machinery increases with flexible work practices. Numerous other authors have considered the notion of IT-skill complementarity as potential explanations for rising differences in wages between high school educated and college-educated workers (Autor et al., 1998; Krueger, 1993; Berman et al., 1994).

There are at least two possible explanations for a complementarity between decentralized organizations, skilled employees and IT. The first arises from the need to better utilize specific knowledge (Hayek, 1945). Through communications technologies and expert systems, line workers can be provided the necessary information as well as analytical support to take action on specific information that they might posses by virtue of their direct contact with customers or the production process (Fisher et. al., 1994; Brynjolfsson and Mendelson, 1993). Monitoring systems can also enable managers to increase delegation of authority without losing management control.

Second, IT may increase the demand for information processing, creating information overload on key decision makers (Simon, 1976; Brynjolfsson, 1994). One way in which an organization can expand its ability to process information is to delegate authority to line workers (Brynjolfsson and Mendelson, 1993) or by building lateral communication links to

enable individual decision makers to be more effective. As information processing demands increase on line workers it may also need to be coupled with an increase in the demand for cognitive skills (Hitt, 1999).

Altogether, this suggests the possibility that IT will be more complementary to higher skilled labor and those employees that posses high levels of decision authority. For tasks that can be easily codified though rules or require relatively low level cognitive skills (information retrieval and storage), IT can be used for automation, substituting for the use of labor.

The recent developments in industry worldwide have shown that changes in workplaces and working life have, on the one hand, frequently led to considerable improvements experienced by the workers and employees: many unhealthy and dangerous jobs have disappeared in all the industrialized countries, groupwork and decentralization have been introduced in many branches of industry; automation has taken off many burdens from workers etc.

On the contrary, jobs have vanished worldwide in the wake of these changes, at an alarming rate. Furthermore, changes of company ownership have made entire work sites disappear although considerable improvements in the economic viability of these plants may have been achieved through human-centered design of technology and work. The concept of 'shareholder value' has become more important than got hold of many industrial developments against long-term viability concepts.

These and other developments seem to counteract attempts to further improve production and service performance towards human-centeredness. Dissatisfaction, however, is already spreading. It is concerning the general economic strategies which are frequently termed 'rationalization', or lean production, down-sizing etc. Today, rationalization may rather be understood as the continuous effort of humankind to achieve optimum system performance through the most careful cautious consumption of resources (labor, materials, energy etc.), and without damage to the environment. It may not always include using more technology; it may rather concentrate on re-designing work organization to achieve its aims.

5. Conclusions

The design of the organizational structure should take into account and take advantage of the information and information-processing supports which could be designed, and in the not-distant future will be inexpensive. The technology itself is neutral, but it can greatly increase

humanity's welfare, depending on how well it is used. What is missing is the full recognition of the strong interactions between this technology and organization design, and the consequent need to take a systems approach to the joint design of organizations and their information support systems (Holt, 1992). The developing countries should take into account IT integration with their organizational structures seriously. In order to compete with industrialized countries in the same arena and face crucial challenge of survival, application of IT capital and new organizational structures are inevitable for third world countries. Having realized the role of IT in managing organizational change, the firms in developing countries should not misinterpret IT as being substitution for work force. Yet they must give serious attention to provide IT integration as being complementary for labor.

Organizations with higher skilled staff, newer capital, decentralized work practices and lower inventories have a much greater degree of complementarity between IT and Capital, but a similar if not greater degree of IT labor substitution. The observation of differences in complementarities between IT and Capital is consistent with the idea that there are at least two clusters of organizational practices with different fundamental economics: traditional organization, based on concepts of mass production, and modern organization which is characterized by flexible machinery, newer capital, skilled workers, lower inventories and greater decentralization of decision rights to line workers. It is also consistent with recent observed trends in the rapid adoption of ERP systems and the general trend in the U.S. economy of accelerating capital investments. While the increase in capital is often attributed to a rise in IT spending, the amount invested in computers even today is still relatively small compared to the magnitude of other investments (by most estimates IT represents about 10% of capital spending in current dollar terms)(Brandt 1999). However, if computer investment also makes it more profitable to increase capital investment the benefits of computers to productivity can be greatly magnified.

The labor result is somewhat more perplexing. One explanation, that is not inconsistent with the modern manufacturing concept, is that IT increases demand for certain labor skills (IT-skill complementarity) yet the skilled labor complementarity does not outweigh the substantial ability of IT to substitute for relatively low-skill, routine tasks. For example, in many of the classic reengineering stories (Brandt 1999) large staff reductions can simultaneously be accompanied by increases in skill and responsibility for those employees

who remain. For instance, the Ford Accounts payable reengineering project greatly increased the responsibility of the 125 workers who remained in the department, but also led to the elimination of 500 jobs. In other words, even within decentralized organizations there is still a large component of the workforce that is amenable to IT substitution and a much smaller segment of the workforce where IT is a complement (Hitt, 1999).

An alternative story is that organizations that are more decentralized have more staffing flexibility and are therefore able to take advantage of more IT-labor substitution possibilities. Without detailed data on workplace skill, it is difficult to identify this effect by using the approach developed here, but this explanation would reconcile these results with evidence of a complementarity between IT and skill that has been identified in the literature on wage inequality (Krueger, 1993; Autor, Katz and Krueger, 1997; Bresnehan, 1997). While IT is a complement to skill, being able to realize these IT-skill complementarities may require organizational restructuring and staff reduction.

A second possibility is that another aspect of the modern manufacturing system, the increased reliance on suppliers and outsourcing, is also leading the appearance of labor substitution. There is theoretical and empirical evidence that IT investment is associated with decreased vertical integration (Hitt, 1998; Brynjolfsson, et al., 1994; Clemons et al., 1993) which is also consistent with this interpretation. However, regardless of which interpretation is true, it is suggested that even as firms shift toward using modern technology and empowered workers, we still expect IT investment to be associated with workforce reduction. Having claimed this particular result, there is even a great role that IT offers for firms in developing countries; instead of being pro of downsizing policies, they must ensure to make more of IT and labor complementarity in their organizations.

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