QUESTION 15/1
Technology transfer and informatization

ITU-D STUDY GROUP 1 2nd STUDY PERIOD (1998-2002)

Final Report

Telecommunication Development Bureau (BDT)
International Telecommunication Union

THE STUDY GROUPS OF ITU-D

The ITU-D Study Groups were set up in accordance with Resolutions 2 of the World Telecommunication Development Conference (WTDC) held in Buenos Aires, Argentina, in 1994. For the period 1998-2002, Study Group 1 is entrusted with the study of eleven Questions in the field of telecommunication development strategies and policies. Study Group 2 is entrusted with the study of seven Questions in the field of development and management of telecommunication services and networks. For this period, in order to respond as quickly as possible to the concerns of developing countries, instead of being approved during the WTDC, the output of each Question is published as and when it is ready.

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Technology transfer and informatization

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1 Introduction

Today, spending on information and communications technology is a critically important element in the worldwide economy. The information and communications technology (ICT) industry is among the most significant contributors to the overall economic health of the global economy.

Analysts forecast future unparalleled growth in the sector: almost 100 million people had access to the World Wide Web at the end of 1998, and there will be an estimated 320 million by 2002. In 1997 the number of devices used to access the World Wide Web was 78 million; by 2002 that number will increase to 515 million.

- For developing countries, however, the creation of basic infrastructure for the information age – reliable electronic sources, replacing analogue telecommunications, a highly literate workforce – remains a daunting challenge.

- Hardware, software and communication costs are still too high for the majority of developing countries.

- Key potential productivity improvement areas such as enhanced telecommunication bandwidth, digital cash and electronic privacy and security controls need further development. Once introduced, their deployment must be widespread to provide full benefits to all.

While the ICT industry alone can drive much of the progress, governments and other organizations must also lend a hand to address these critical areas and actively encourage deployment of ICT.

- Investment is an important factor as spending on ICT will improve the ability of companies and countries to compete in the global market.

- Companies should also maximize their investments in technology by connecting users to a common ICT infrastructure and the Internet.

- Telecommunication authorities, analysts affirm, should make the deregulation of local network access and interconnection a high priority.

- Competition will allow less expensive access to the global communications network, which enables a greater number of individuals to connect and rapidly decreases investment payback times.

Time is of the essence in implementing these improvements for a country that wishes to improve its economy. For a local economic development strategy transfer is only one of the options available, and its exact use and content will depend on the objectives pursued.

For an industrial enterprise that needs to adapt to changes in its environment, innovation is just one of the approaches that might be envisaged. It is a difficult one and more disruptive than, say, changing the distribution system.

Essentially, technology transfer is applied for one of two purposes: either to create industrializable products or to modernize the industrial fabric as a whole by raising the technological level of production processes. Transfer can also consist in transposing a known technology from one environment or area to another in a different form or process required by the new environment. This type of transfer is faster because the basic technology has already been mastered at the level of the industry, and has greater economic potential.

2 Background and context

2.1 Descriptions and benefits

2.1.1 Description: Informatization and technology transfer

Informatics basically refers to the use of technology to transfer information from the particular avenue of origin to the point of utilization; included therein is the process of acquiring technical capability.

Technology is key to competitiveness and economic growth. Of all the many technologies of our time, progress in information technology has no doubt had and continues to have the greatest influence on the global economy, making it possible to collect, process, and transmit information at breathtaking speed and declining cost, thereby increasing productivity and improving quality and efficiency in all types of industries and services. Most industrialized countries and an increasing number of newly industrializing countries use new information technology in areas as diverse as education, health-care, manufacturing, finance and banking, transportation, commerce, publishing, energy conservation, and environmental management. Some economic historians assert that the impact of information technology on society is tantamount to a second industrial revolution as momentous in its implications as the first.

2.1.2 Issues

When studying developing countries, one would be tempted to say that telecommunications and information technology are luxuries, rather low social priorities compared with other "emergencies" in the areas of development, health, education, etc.

But information and communication technologies are on the way to becoming the base for different and more efficient ways of manufacturing, selling and exporting products, and also for disseminating information, facilitating health care and providing the basic services for which often the State is responsible. These new technologies make it possible to carry out many tasks much more efficiently and rapidly than was possible in the past.

In a Burkina Faso case study, such benefits were found to include:

- user access to public services;
- access to technical, scientific and economic information;
- distance-learning possibilities;
- opening up of rural areas;
- scarce resources management (water, environment, etc.).

Lower costs is an added benefit both to developed and developing countries. Technology transfer by way of foreign investment and increased competition may also be translated into lower service costs to the consumer[1].

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[1] In Japan, the privatization of Nippon Telegraph and Telephone Public Corporation (NTT) and the overall liberalization of the telecommunication environment, introduced the principle of competition into the Japanese telecommunication market. This move allowed NTT to reduce its service charges every year from 1985 to 1990 - a cost reduction of approximately JPY 613 billion over six years.

Source: Norio Wada, "Negotiating Structural and Technological Change in the Telecommunications Services in Japan", *Telecommunications Services: Negotiating Structural and Technological Change*, edited by Brian Bolton *et al.*, 96, 1993.

Technology transfer also facilitates industrialization. The implementation of the TELEBRAS inductive card payphone system in Brazil is a case in point. The system was introduced in Brazil in 1992 following the difficulties associated with traditional token payphones (high maintenance costs, token collection device malfunctioning, logistics necessary to collect, clean, package and distribute the tokens). The implementation of the TELEBRAS inductive card payphone system has resulted in industrialization as evidenced by:

- the growth of the payphone manufacturing sector from a duopoly of token payphones, to a situation of five suppliers, with a total installed capacity of close to 20 000 payphones per month;

- the creation of new capacity in the card sector from a nil capacity, to the existence of four suppliers, with a total installed capacity of more than 80 million cards per month;

- growth of the switching manufacturing sector from a situation where the payphones were considered marginal within the conventional telephone expansion, to a new vision of platforms fully-dedicated to payphones.

Technological changes have made it possible to extend basic telephone service in developing countries to small populations and remote areas, as well as to introduce new services increasingly required by the International Telecommunication Union[2]. Satellite communication reaches otherwise inaccessible areas, where use of cable or line-of-sight radiocommunications would be prohibitively expensive.

Improved telecommunications are the key to development of the country's other economic sectors. Industrial development requires coordination of numerous activities: acquisition of supplies, recruitment and coordination of labour, control of stocks, processing of materials, delivery of goods to buyers, and general market search activities. Commerce, however, is inherently an information processing activity. Effective buying, selling, brokerage, and transport require a continuous supply of up-to-date information on the availability and price of numerous goods and services. In the absence of accessible and reliable tele-communication services, such activities suffer a variety of inefficiencies, including the creation of markets in which a few information-rich individuals are able to gain significant advantage over the majority of individuals who are information poor.

Technological change is likely to bring to developing countries greater opportunities for lower cost and increased capacity networks, affording them possibilities of leapfrogging stages of network development. For example, wireless technology for personal communication has emerged as a strong challenger to the fixed network; the cost of optical fibre systems continues to fall even as capacities increase; the new synchronous format for transmission systems permits flexible and inexpensive access to data streams; and faster computer technology is significantly increasing the call processing capacity of exchanges. These developments are changing the optimal network structure and reducing costs.

The Human Development Report published by UNDP in 1990 introduced the notion of a human development index (HDI). The index takes account of three aspects of a country's human development: longevity (life expectancy), knowledge and income. Countries with an HDI of over 0.8 are considered to have high human development, while those with an HDI of less than 0.5 are considered to have low human

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2 Telebras Inductive Card Payphone System, 1996.

development. The HDI would appear to be a good yardstick for measuring a country's socio-economic and cultural development. There is a correlation between HDI and telephone penetration, and it has been demonstrated that the higher the HDI the greater the increase in telephone penetration. The causal link between HDI and telecommunication growth would need however to be studied in greater detail and quantified.[3]

The information revolution is a real opportunity for developing countries which lag behind with respect to the industrial revolution; which have geographic or logistic disadvantages; where other production factors, energy and raw materials are scarce or unexplored; where specialized human resources are scarce and must be used with maximum efficiency.

These opportunities should not however mask the considerable risks incurred by developing countries due to the information revolution.

Developing countries encounter the following difficulties:

- late awareness of the prospects generated by this revolution;
- loss of cultural identity and references due to the low level of education, which makes them extremely vulnerable and unable to resist the aggressive appeal of foreign cultural products;
- marginalization resulting from a lack of competitiveness linked to a very low innovation capacity associated with a low level of technical and scientific development;
- total exclusion due to unaffordable access costs, the absence of communication infrastructures, the lack of financial resources to make up for backwardness in the field and, finally, the disproportion between the needs of these countries and the development assistance provided by the international community.

2.2 Global trends

The information technology revolution is leading to a revolution in business practices. Information technology is increasingly associated with the adoption of "lean" production and distribution practices, including just-in-time (JIT), outsourcing, and total quality management (TQM). These information and communication intensive practices, which maximize the utilization of physical assets and minimize working capital, are spreading throughout OECD countries and East Asian NICS, and are likely to determine how – and how much – industrializing countries will participate in global industries.

The far-reaching effects of new information technology are not limited to industrial production. All economic activities including agriculture, mining, banking, commerce, and transportation, are becoming fast, flexible and information-intensive. As it changes the generation and distribution of knowledge and ideas in all fields, existing skills and occupations are being undermined and hierarchical organizational structures are being challenged.

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[3] International Telecommunication Union, Telecommunication Development Bureau, World Telecommunication Development Conference (WTDC-98). Agenda Item 4.1 Chapter VI-II.3.

Most developing countries suffer from a dearth of readily available, reliable information with adverse consequences for achieving their numerous development objectives[4]. Worse still, the spread of information technology across all types of industries and services in industrialized countries is so fast and pervasive – with consequent improvements in price competitiveness, design, and quality of products – that developing countries find it increasingly difficult to compete internationally. Researchers predict that the wave of new technology sweeping the industrialized world will widen the gap between the rich and poor countries.

2.3 Difficulties

2.3.1 Need for global telecommunication reform

The dramatic pace of change in the telecommunication sector over the recent years has been extraordinary. Incumbent telecommunication operators have undergone ownership transformation in many countries, while many formerly insulated domestic markets have been opened to the entry of new operators. To implement and sustain these developments, some governments have carried through two related tasks: the reform of existing telecommunication legislation and the creation of new regulatory agencies. Although there seems to be a close correlation between restructuring and the improvement of sector performance, there is no single "reform recipe" that will guarantee a successful outcome. Countries have followed quite different paths with varying degrees of success.

In the Americas, the major regional organizations that support regulatory reform are the Inter-American Telecommunication Commission (CITEL), created in 1965. It is an entity of the Organization of American States which has the objective of facilitating and furthering the development of telecommunications in the Americas to contribute to the overall development of the region. The second organization is the Caribbean Telecommunication Union (CTU), an intergovernmental body established to develop regional policy and programmes for the development of telecommunications, including coordination of regional positions in areas of international decision-making.

2.3.2 Exclusion of some groups

Advanced microelectronics-based information and communication technologies (ICTs) can contribute to social inclusion. ICTs' effectiveness will depend on the context of each country. In developing countries access to ICT-based education and training is only part of the challenge. The new systems need to be maintained and gaps between pedagogy and technology will need to be bridged. The content and styles of learning embedded in ICT-based learning resources are as important as investment in infrastructure (telecommunications and computing). The usefulness of ICTs in education is evident in overcoming obstacles such as geographic remoteness and scarcity of teachers. But there are major problems associated with ICT use in developing countries. Cost is an inhibiting factor in terms of expense of hardware and software, maintenance and infrastructure costs to support new knowledge networks.

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4 Hanna, N. 1990. "The Information Technology Revolution and Economic Development", Discussion Paper No. 120, World Bank, Wash. D.C.

2.3.3 Constraints in information technology

The Burkina Faso recent case study[5] signals constraints facing many developing countries:

- Applications are elementary; some are poorly adapted to local requirements.
- Major economic and public administration sectors have scarcely been computerized.
- In the computerized sectors, there are sometimes problems related to hardware and software operation and maintenance.
- Local service-providing companies, which should be the primary instruments for developing information technology in the country, are poorly organized and lack the necessary skills.
- Despite regular decreases in equipment costs, they are still very high relative to the local level of economic development and purchasing power.
- Where countries are geographically isolated from efficient means of transport, the transport, insurance and maintenance costs incurred in importing the equipment may reach or exceed a considerable percentage of its value.
- The lack of sufficient qualified staff coupled with a demand which greatly exceeds the current domestic and foreign training capacity. This quantitative inadequacy masks an even more significant qualitative insufficiency where a local structure for training computer professionals in the design process is lacking. Often certain specific fields, such as maintenance, do not yet have their own training programmes.
- Computer professionals have difficulties in retraining themselves and maintaining a good level of performance at work in relation to the constantly evolving technology and the increasingly sophisticated tools which are being developed.
- Environmental constraints are social as much as technological.

At the social level, the attitude of the workers who are affected by computerization projects is crucial. The inadequacy of the available means of information and consciousness-raising are obstacles generally faced.

As to the technological environment, the still low quality of telecommunication facilities and their relatively high costs hinder the development of certain applications.

2.3.4 Effects of technology protection on developing countries

One Latin American analyst affirms that when considering strategies for market domination, one has to consider technological protection. Arthur Cardozo[6] argues that the existing system of patents is unfavourable to developing countries. It has enabled patent owners to effectively control Latin American markets. In the last 40 years, Latin American countries have granted many patents to international corporations for products never used by such corporations in these grantor countries. The patents served to block future local competitors from producing such items in the future[7]. UNCTAD/WIPO research findings in 1975 affirm that

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5 Bamogo, Ouedraogo, Bako, Tankoano, *Information Technology in Developing Countries; The Case of Burkina Faso.* The United Nations University Institute for New Technologies, International Workshop on the Information Revolution and Economic and Social Exclusion in Developing Countries, Maastricht, 23-23-25 October 1996, Theme III.

6 Camara Cardozo, Arthur, *Consideraciones sobre el tema de la protección technologica en los paises en desarrollo,* in Reflexiones de Caracas, Taller de Especialistas en Política Technológica, Caracas, 1990, UNCTAD & PRODEC.

7 Vaitsos, C.V., Patents Revisited: Their Function in developing countries.

of the 95 per cent of patents in force, 84 per cent are not owned by local inventors, but by foreigners who have never used their patents in developing countries[8].

Brazil is a case in point, where in the 1980s no fewer than 75 per cent of patent registrations were made by persons not residing in Brazil. In most Latin American countries, almost 30 per cent of patent applications come from North American companies, 13 per cent from German companies, 5.5 per cent from French companies and 4 per cent from Japanese companies. Developed countries urge developing countries to update or put in force a legal system to ensure the property rights of their nationals. Emphasis is given to the duration of the rights, the type of inventions to which protection must be afforded, obligatory licensing, revocation of patents granted and never used, all to favour foreign companies.

One wonders whether the call for developing countries to improve their industrial property laws is in their best interest. Such laws effectively reduce their nationals' access to technology, competition is impossible on the local market and developed nations manage to control local markets. Intellectual property protection is a must, and what is needed is a well thought out plan to offer this protection which fosters development in developing countries, a plan which is just and balanced in an internationally competitive tomorrow.

2.3.5 Technological accumulation

2.3.5.1 Evaluating enterprises' technology requirements

These requirements vary. Generally speaking there are:

- The essential or basic needs of the population which are often poorly expressed. So that they are better understood and formulated properly, experts should preferably be from the same country.
- The requirements of small enterprises, which are usually private.
- The needs of large enterprises, most of which are partly or totally controlled by the State in developing countries.

The means of evaluation are specific to each case. Small enterprises will call on technical agencies or on experts, most of whom are foreign. Large enterprises which are already established and possess the means to evaluate their technology requirements generally make their own technological choices.

2.3.5.2 Finding the right technology

- Once the technology requirements have been identified and prioritized, the question arises as to how best to meet them. The following three-stage approach might be adopted.
- Creation of an intermediation body: Some such mechanism is needed between the user and information sources. Its main task will be to express the user's needs in terms of technology.
- Search for technical information: This may be national and international. At national level, with the assistance of the intermediation body the user may seek information from national research and documentation centres. In their replies the latter must give priority to local technology thus enhancing its value. If the demand cannot be met nationally the user may look to technology available abroad, starting with the immediate environment, with the aim of acquisition rather than passive consumption.

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8 The Role of the Patent System in the Transfer of Technology to developing Countries, United Nations, New York, 1975.

At international level, with the help of the intermediation body the user may contact organizations specializing in technical information such as the European Patent Office (EPO) and the African Intellectual Property Organization (AIPO). Assisted by the intermediation body, the user will analyse the documentation and select the most relevant information and reach a decision.

2.3.5.3 Technological accumulation and industrial growth

Many economic theories assume that developing countries can benefit greatly from the international diffusion of high-productivity technologies already available in the advanced industrial economies. The models underlying such arguments draw a clear distinction between innovation and diffusion; and developing countries, it is argued, can benefit from the diffusion of industrial technologies without incurring the costs of technological innovation. The expectation is that given a reasonably rapid rate of investment in the physical capital in which the technologies are embodied (and learning the basic skills to operate them efficiently), developing countries can achieve high rates of growth of labour productivity in industry and also of total factor productivity.

Analysts argue, however, that such optimistic expectations about the diffusion of industrial technology to developing countries are misplaced. In economies that are considered "borrowers" of ready-made technology from more technologically advanced economies, technological accumulation is misrepresented as a process of accumulating technology that is largely included in physical capital. This process does not lead to the industrial growth envisioned. Also the process of technical change in leading dynamic industries in developing countries bears little resemblance to the technology adoption process in conventional innovation-diffusion models.

From their analysis of technological accumulation in developed, developing and former centrally planned economies, Bell and Pavitt[9] have reached the following conclusions:

1) The model of technical change based simply on the adoption of new vintages of machinery, accompanied by blueprints and operating instructions and followed by productivity improvements resulting automatically from experience in production is inadequate.

    - Such a model ignores the investment in intangible capital necessary not just to operate machines but to "choose" them in the first place, to improve their performance once acquired, to replicate them and further develop them and the products they produce and to lay the basis for related and higher value-added activities in the future.

    - Such a model ignores the key role of the stock of resources for generating and managing change that has been described as "technological capabilities", and it ignores the conscious and deliberate learning required to accumulate those resources.

2) Change-generating resources have become increasingly complex and specialized.

    - They have become increasingly differentiated from the resources required to use given technologies (production capacity), and they in themselves are now increasingly differentiated into, for example, resources for design, production engineering, quality control, R&D and even basic research.

    - Knowledge and skills throughout the operating workforce are additional resources needed for the routine use of unchanging technologies.

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9 In, *Technology, Globalisation and Economic Performance*, edited by Daniele Archibugi and Jonathan Michie, Cambridge University Press, 1997.

3) The learning processes by which those resources are accumulated are also becoming increasingly complex and specialized.

   - Although formal education and training in institutions outside industry provide bases of skill, this has to be augmented by learning within firms. Intra-firm training is key to enable the accumulating of a particular area of competence.

4) Learning activities – their nature, determinants and dynamic economic effects – should now be the focus of analytical and policy attention to enable technological accumulation to enable industrial growth.

2.4 Impact

2.4.1 Towards a "knowledge society"

The term "knowledge society" has been used to shift the emphasis from ICTs as "drivers" of change to a perspective where these technologies are regarded as tools which may provide a new potential for combining the information embedded in ICT systems with the creative potential and knowledge embodied in people. ICTs are best considered as tools or facilitators which may substitute under certain conditions for other means of knowledge creation in innovative societies.

Maximizing benefits and minimizing risks are key issues in the creation of knowledge societies, especially for developing countries. Wealth generation is becoming more closely tied to the capacity to add value using ICT products and services. Only a few developing countries have succeeded in narrowing the development "gap" by harnessing the production or use of ICTs to their development goals. If the changes are consistent with development goals, countries can gain advantages from ICTs and avoid the risks of exclusion and marginalization. However this requires national (or regional) ICT strategies that build upon the strengths of each country. Mapping and measuring the economic and social impact of ICTs and the strengths and weaknesses of technological and social capabilities in developing countries will become an important tool for generating the information needed for informed policy choices.

2.4.2 Environmental informatics

ICTs can contribute to environmentally positive development There is now the possibility of tele-communicating, teleconferencing, electronic commerce, etc. ICTs are thus able to provide a new capacity for monitoring and modeling environmental conditions and can also help to control the level of resource use, pollution, congestion, etc. The use of informatics will also serve the purpose of bringing production closer to consumption, thereby reducing the need for transport, increasing the number of small enterprises and helping to regenerate local economies. Already data networks are enabling environmental groups to coordinate campaigns and exchange information.

2.4.3 Human resource development – human infrastructure

2.4.3.1 The impact of informatics on human resource management

It is important to note, when developing technology, that money must not only be invested in technical infrastructure but should also include needed investment in human capital. The process of technical capabilities must be complemented by investment in human capital (training of personnel and hiring of advisors). There is a need to keep staff properly informed and trained if they are to fully support corporate policy.

Thus as the use of IT becomes more prevalent, Human Resource strategy should focus on:

- on-the-job training for technical staff;
- data processing and project management training to include elements of behavioural, social and political dimensions of computerization;
- streamlining development on a regional basis to ensure uniformity of standards;
- professional development programmes;
- development of local information technology literature;
- further, because of the increasing role of informatization, there are more advanced information systems being employed to assist decision-making when confronted by details of individuals, clients, e.g.:
  - expert systems to chart medical diagnosis, assess entitlement to welfare benefits, etc.;
  - public access terminals to display information on various issues.

2.4.3.2 Technology transfer and employment in the telecommunication industry

Technical changes in telecommunications are decreasing the demand for labour. Experience in the United States market suggests that the changes in technologies and developments taking place in other markets will have major implications for the occupations and skills that will be in demand. Some of the possible employment consequences of a shift toward capital-intensive digital technologies have been summarized by Mansell and Tang (1996).

Representative example

Over the last five years, the number of people working in the field of information technology in Burkina Faso has experienced noticeable growth amounting to 11.3 per cent per year. Yet this number was said to be insufficient to meet the real needs of the country. Training has been undertaken at the public level, in the private sector. The country has a quota of four analyst-programmers and two engineers per year at the African Institute of Information Technology (I.A.I.), located in Gabon. Each institute for higher education has incorporated information technology units in study programmes for different departments, such as vocational education and secondary education. There have also been projects to train government administrative staff, and retraining, proficiency and continuous education is undertaken.

2.4.3.3 The demand for information technology professionals

To solve the staff deficit problem as well as ensure sustainable mastery of new information technologies in developing countries:

- The training systems should be reinforced by opening new networks (design engineers, etc.) and by giving top priority to specialized training.
- National scholarships for postgraduate information technology and telecommunication studies should be granted, and foreign scholarships in these fields should be sought.
- Cooperation with more advanced countries in new communication and information technologies must be developed.

- As should training programmes as well as programmes to popularize the necessary local skills.

- Teacher-training programmes focused on Internet technology (network management, implementation of WWW servers) must be developed.

- Training in scanning and multimedia databases and in the new communications professions must be developed.

- The skills of these new professionals must be perfected and expanded.

- Internet training to help users access the numerous Internet services in an uncomplicated and user-friendly manner is also necessary.

2.4.3.4 Impact of information technology on employment

Freeman, Soete and Efendioglu have recently studied the diffusion and the employment effects of information and communication technology[10]. They affirm that there is a need to take into account the divergent trends in different parts of the global economy and the social equity within countries. Powerful new technologies are being diffused at varying rates in different parts of the world. The most favoured regions, principally East Asia, have been part of a virtuous circle of high output growth, high productivity growth and full employment. In Europe, output growth has been too sluggish to take full advantage of the new employment potential of ICT, so that job destruction effects have outstripped job generation. In Africa and, to some extent, Latin America, exclusion effects tend to predominate and very high rates of unemployment and under-employment generally prevail.

The shift towards the knowledge-based economy has particularly adverse effects on the employment and wages of unskilled manual workers. The analysts recommend that a world employment strategy must thus not only embrace intensive training programmers for long-term solutions but also job creation programmes for unskilled workers in community and personal services which have high growth potential.

One of the most obvious impacts of informatization on employment is to destroy some existing jobs while at the same time creating others. In the foreseeable future, informatization will more than likely result in the destruction of more jobs than the number it creates. The labour market will almost certainly become more flexible and insecure. There is also a fear that informatization would open the gap between "the information rich" and "the information poor" and so result in a widening of the gap between developed and less developed countries.

2.4.3.5 Impact of teleservices on employment

Teleservices are service activities which are carried out over the telephone. When face-to-face interaction is replaced by the telephone, there is less need for production to be located physically proximate to the customer. For example bank and branches, travel agencies, local technical-support offices, can be concentrated in large offices at one or a few sites, where significant cost savings can be made. Similarly, when new firms enter markets or create new markets through the use of teleservices, they tend to establish a few site operations rather than distributed operations.

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[10] *International Labour Review* (Geneva), 134 (4-5), 1995, 587-603.

Arguably, concentration of teleservice operations into call centres leads to cost savings in a number of ways. Property costs can be reduced by rationalizing property portfolios and making more cost-effective use of space. Capital costs can be reduced by using technology more intensively. However, the most important area of cost reduction is labour costs, as economies of scale mean that fewer people are required for the same level of output at a concentrated site.

In essence then, technology has flourished at the expense of labour[11].

2.4.3.6 Conclusions

The above demonstrates the necessity of taking into account divergent trends in different parts of the global economy as well as social equity within countries. Powerful new technologies are being diffused at varying rates in different parts of the world. In the most favoured regions, principally east Asia, they have been part of a virtuous circle of high output growth, high productivity growth and full employment. In Europe, output growth has been too sluggish to take full advantage of the new employment potential of ICT, so that job destruction effects have outstripped job generation. In Africa and, to some extent, Latin America, exclusion effects tend to predominate and very high rates of unemployment and under-employment generally prevail.

2.4.4 Impact of information technology on industrialization

Many economists and commentators suggest that ICT is ushering in an entirely new era or a "post-industrial" society. Today, everyone would accept that the extraordinary reduction in costs associated with micro-electronics in successive generations of integrated circuits, telecommunications and electronic computers is having an enormous effect on almost every branch of the economy, whether in the primary, secondary or tertiary sectors. While previous technologies like steam power and electricity have had similar pervasive effects, ICT is unique in affecting every function within the firm as well as every industry and service. Scientific and market research, design and development, machinery, instruments and process plant, production systems and delivery systems, marketing, distribution and general administration are all deeply affected by this revolutionary technology. Moreover, the counter-inflationary effects of falling costs and prices in microelectronics, computers and telecommunications affect an increasing range of products and services.

An essential condition for export success today is an efficient telecommunication infrastructure. This can be seen from the priority given to the modernization of the network throughout the world, especially in eastern Europe and China. This infrastructure is not only essential for the conduct of everyday business, it is also the basis for a rapidly expanding network of new services which can be traded internationally and which can greatly enhance the efficiency of many other services, especially education and health. This accounts for its importance and for the priority given to "information highways" (and by-ways) in the United States and most other OECD countries in the 1990s.

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[11] Several examples of these cost savings may be found in the airline industry. Delta made cost savings by cutting 12 reservation centres in moving to a single site in London. American Airlines has established a pan-European call centre in Dublin, closing five other sites, Aer Lingus was able to cut its call reservation workforce by a third through closing its United Kingdom sites and centralizing its call centre operation in Dublin.

2.4.5 Gender issues[12] in the field of telecommunications

The main objective of most telecommunication projects has been economic growth, while human and social development – including gender aspects – have been given negligible or no attention.

With a reasonable number of women employed in the telecommunication departments, the potential for improving the consideration of gender in the sector does exist (Paton, 1993).

3 Technology transfer and acquisition methods

3.1 Policy and institutional arrangements to facilitate technology transfer

The case of the Kingdom of Bhutan is presented below, giving a summary of studies carried out on policies to be adopted for reliable technology transfer. A second case is also presented – that of Tunisia – which has adapted a strategy of privatisation through gradual specialization.

The example of the Kingdom of Bhutan

Unlike most developing countries Bhutan was reluctant to accept foreign investment as a means of strengthening the commercial and manufacturing sectors, or enhancing opportunities for technology transfer. It has however welcomed technical collaboration with foreign firms to promote technology transfer, though the option for technologies appropriate to Bhutanese conditions are seriously limited. Bhutan is a land-locked country in the southern buttress of the Tibetan plateau. Its climate is tropical and sub-tropical. Bhutan's population is 1.5 million and its economy is based largely on agriculture.

A number of studies have recently been conducted on Bhutan, and analysts[13] have sought to highlight factors that would help the country to develop its technological base. The findings of these studies may serve as a guide for other developing countries.

Some general policy considerations include:

- Governments should encourage foreign equity participation in lucrative export-oriented industries for which the import content of basic materials is small.
- Special attention should be paid to the support mechanisms for the selection and acquisition of technology.
- A suitable legal framework to facilitate flows of technology and investment should be established.
- A business and industrial development information centre should be established.
- A national consultancy group for policy analysis and development studies should be established to enable national experts to provide authorized advice and expertise and thereby directly participate in the selection and acquisition of technologies most desirable to the economic, cultural and environmental needs of the country.

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12 Brooling & Dahms, *Strictly for Men? Infrastructure in a Gender Perspective,* Swedish International Development Authority, Nordic Consulting Group, 1995.

13 M.A.T. de Silva: *Transfer and Utilization of Technology, A country study of the Kingdom of Bhutan.* United Nations Conference on Trade and Development (UNCTAD).

The example of Tunisia

Tunisia is among the countries to have structured their telecommunication sectors in such a way as to strengthen and encourage technology transfer by creating a very attractive environment. As the country has moved towards privatization and specialization, three main bodies have emerged in the telecommunication sector:

a) The national operator, Tunisie Telecom, which is responsible for network operation and maintenance. It manages telecommunication equipment for the State and as a rule requests the technology.

b) The Telecommunication Study and Research Centre, CERT, which handles technical acceptance activities for the operator and develops study and research activities applying to the sector.

c) A works company, SOTETEL (*Société Tunisienne d'Entreprises des Télécommunications*), which serves both the public and the private sectors largely in the area of cable and equipment installation.

Tunisia's policy is an incentive to foreign technology suppliers and owners to invest and deploy their systems and equipment in partnership with one of the above bodies. In order to remain competitive, the foreign supplier looks after the interests of its partner – or subcontractor, as is sometimes the case. Either way, in the interests of economy it creates local expertise and hence technological potential. Once acquired, that potential and expertise can be put to use in carrying out work or providing services outside the country. The personnel trained under the initial agreement with the partner or subcontractor will thus have an opportunity to work abroad for a local partner or in some cases for the original supplier. In this way countries such as Tunisia which started out as importers of technology are now exporting know-how.

As part of its initiative to encourage technological transfer by creating an attractive environment for multinationals and foreign investors, Tunisia has developed new communication technology park. It provides premises with all necessary installations at low cost and other incentives for foreign investors and local enterprises producing for export. To group several establishments and enterprises together in a single location is conducive to the development of communication and exchanges between "neighbours" and is an incentive to cooperation. It also provides a very fertile environment for technology transfer.

3.2 "Import-adapt" technology strategy for developing countries

Whatever the development strategy chosen by a country, there are conceptually three basic alternative approaches used to raise the country's technological capacity over time. They are:

1) developing all technological assets internally;

2) acquiring them all abroad;

3) developing some and buying some.

In the real world situation, countries usually adopt a "make – buy approach", in which opportunity costs and benefits determine the actual possibilities.

Many developing countries today rely heavily on imported technologies. In the past, the principal sources of technologies have traditionally been the developed countries and transnational corporations. More recently, small and medium-sized enterprises, R&D institutes of consortia or design, engineering and consultancy firms are increasingly coming to the forefront of the innovation process and are gaining importance as sources of technologies of relevance to developing countries.

Some of the more advanced developing countries are also starting to emerge as potential international sources of technology, and in certain instances, technologies that have been evolved or adopted in developing countries may be relatively better suited or more readily absorbed in other developing countries (in terms of scales of production and plant dimensions).

It is in this context of multiple technical alternatives, sources of supply, possibilities of financing and methods of transfer of technology that strategic approaches as well as immediate decisions evolve and are adopted. The basic questions will be:

- what to acquire from the outside;
- how to acquire it at minimum costs;
- how to link it up with internal technological development; and
- how to maximize the developmental impact of the technologies acquired from abroad.

Acquisitions should be at the lowest possible cost for maximum growth impact. Thus the main parameters to be analysed would be the type of technology to be acquired and the vehicles to be used for its transfer.

The decision-maker will have to evaluate and select the technology from alternative sources and negotiate the terms, conditions and payments for obtaining it. These decisions are taken in the light of a general understanding of the working of international markets for technology and the technological capacity of the target economy.

The effects of external acquisition on local technological capacity require analysis when deciding what technologies to acquire and in what forms. Technology unpacking is key in this regard. Technology is generally acquired in a package of various components. The degree of packaging will vary in accordance with the different mechanisms of transfer, joint ventures and licensing and foreign direct investment being the most packaged forms.

The foreign investment package will be composed of a variety of elements:

1) ownerships;
2) finance;
3) capital goods;
4) disembodied know-how/technology;
5) management; and
6) marketing.

The first stage of unpacking entails the separation of these components and the exploration of the feasibility of acquiring some of them wholly or partly from domestic or different foreign sources. For example, the financing components could be separated and alternative sources of financing for the specific project could be explored, including domestic sources, so that the technological components could be acquired from various independent sources.

The next stage of unpacking is to separate each of the components and explore the feasibility of supplying some of their elements locally. For instance, components of disembodied technology could be disaggregated into basic process patents, basic designs, detailed engineering and specific engineering services. The technical assistance for the start-up of operations and certain services could be available with the help of domestic design, engineering and consultancy firms.

Another method would be to disaggregate technological components of the projects into different stages:

1) pre-investment (may include feasibility studies, search and evaluation and selection of technology and negotiating and bargaining, some and perhaps all could be carried out with local skills and capabilities);

2) investment (may include design engineering, detailed engineering, architectural engineering, basic engineering and process engineering and some of these elements could be undertaken internally by the use of local skills);

3) operation.

Each of these components could be further disaggregated into elements and the feasibility of meeting these from domestic or other foreign sources could be explored by the decision-maker.

The process of unpacking in this way could be a way of reducing the cost of technology acquisition. More importantly, it could stimulate the development of certain technical skills and capabilities within the country or enterprise and thereby strengthen the total technological capacity and the domestic component in the technology mix.

As the process from unpacking increases, there would be a parallel increase in the mastery of technology through a learning process. This process in turn leads to the development of the capability to introduce changes in imported technology products, processes, equipment, standards, etc. in order to adapt them to internal economic conditions.

This may mean down-scaling the process of production to suit the requirements of a smaller domestic market, or changing certain parameters to reduce capital intensity in order to increase labour absorption, or alter it to suit local environmental conditions. The local adaptation and absorption process enhances the efficiency of the way in which imported technology is used and suits development needs.

Local absorption and adaptation is also a critical aspect of effective and efficient utilization of imported technology. Decisions on creating an environment for local absorption and adaptation will have to be taken along with the decision on technology acquisition from external sources. These decisions should relate to obtaining:

1) a higher degree of integration among sectors and complementarities between the two elements;

2) encouragement of and/or higher investment allocation in D&E and R&D activities and utilization of results; and

3) a sense of purpose as to what technological changes, imported or domestic, are intended to achieve, as for example, the diversification of exports, increase in domestic production of standard imports, etc.

3.3 Technological transfer through multinational corporations and centres of excellence

3.3.1 Multinational corporations

The ability to create, develop, protect and transfer know-how will be a key capability to enhance future competitiveness among multinational corporations (MNCs). When MNCs transfer technology to developing countries, these countries and the labour force become skilled in new technologies and such a process can

lead to a development of the countries' technological base. An analysis on the transfer processes of MNCs in the electrotechnical and electronics fields as well as in the motor industry have identified some key tasks of know-how transfer[14]:

- the development of long-term competencies in relevant business processes and technologies by pooling resources and leveraging know-how;
- continuous improvement of business process through joint projects, specific information exchange, etc.;
- redesign of business process and improvements in one unit based on concepts or technologies "bought" from other units via rotation of managers, secondments, or use of consultancy services;
- standardization of products and processes across the firm (quality standards, etc.);
- transfer of products from one plant to another;
- planning new factories;
- general information and experience exchange through conferences, visits, meetings, in-house journals and reports, etc.

Technology transfer tasks and patterns throughout MNCs are strongly influenced by the internationalization strategy and organization and the distribution of tasks among plants in particular.

The major obstacles that hinder an effective diffusion of expertise throughout a corporation include:

1) Management may not be committed to know-how transfer and employees consider knowledge as a private weapon to secure their position. As long as there is no clear mission statement at corporate and business unit level stating that developing the know-how base of the corporation is everybody's task, and until management acts accordingly, know-how transfer will be seen as "benevolent" activity.

2) Know-how transfer may be organized around individual technologies (e.g. how to improve welding quality) and does not take into account complete business processes which foster greater competitiveness (e.g. the assembly of printed circuits of a specific complexity, high volume and product life-cycle of 15 months in a specific business environment).

3) Up-to-date, target-group-oriented information on "best practices" within the corporation and with competitors is either not available or not easily accessible. As process know-how is often embedded in knowledge that cannot be transferred by reports but must be communicated by people with specific expertise, it is often time consuming to find out "who knows what".

To enable the MNCs to overcome these obstacles, some analysts propose the creation of a market of know-how exchange within the corporation. Know-how transfer becomes a service process in the corporation.

3.3.2 Centres of excellence

The establishment of centres of excellence is part of an ITU project to develop telecommunications in the public and private sectors in a number of countries. Their purpose is to respond to the training needs of a sector which is highly innovative. At the same time they serve as a forum for discussion on innovation and the evolution of telecommunication development, management, marketing and operation techniques.

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[14] North, Klaus, *Localizing global production – Know-how transfer in international manufacturing,* International Labour Organization, Geneva, 1997.

Their function is to train policy-makers and regulators in the countries concerned to establish and identify priorities in the sector, to train corporate directors in the management of telecommunication networks and to train personnel in network and service operation and maintenance.

The cost of technical transfer is low. Centres of excellence could offer training through videoconferencing. The investment in setting up distance-training activities enables the centre to offer the service at very competitive prices. Furthermore, there is no constraint on the number of trainees and no expenditure on travel. All that trainees need is a terminal that can be connected to the centre's network.

3.4 Consortia in ICT industries

Consortia play a complex role in today's market structure that is aimed at creating technologically integrated business communities. Consortia now operate as a global system, where not all companies participate in consortia technical committees for efficiency reasons.

Hawkins[15] has defined a consortium as an informal alliance of firms, organizations and (sometimes) individuals financed by membership fees for the purpose of coordinating technological and market development activities. Consortia have most of the organizational characteristics of voluntary trade, professional and industry associations. Some consortia have adopted the same kinds of advisory, training and advocacy activities as commonly undertaken by trade and industry associations. Membership in some consortia is open to all interested parties while for others membership can be restricted according to specific professional, industrial or commercial affiliations.

Irrespective of the objectives and structures of individual consortia, they have become a distinct *class* of organization. To greater or lesser degrees, all consortia display all of the following attributes:

- All consortia had their origins in major ICT industry and market restructuring initiatives, mostly those that occurred over the past six to ten years.

- Although some consortia concentrate on market research, information sharing, or the coordination of R&D, all consortia are oriented to some significant extent on the publication and/or implementation of technical specifications developed or otherwise supported by their members. Most of these outputs appear as "publicly available specifications" (PAS) – i.e. they are available on a non-discriminatory basis to members and non-members (most are distributed free, or at relatively trivial cost).

- Consortia are aimed at breaching traditional sector boundaries between "public" and "private" networking by concentrating on specific product and service environments – such as object-oriented programming, teleconferencing, operating systems, transmission technologies, video compression, digital broadcasting or network management.

- Consortia employ working methods in their technical programmes that are generally very similar to SDO (standards development organizations) practices.

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15 Hawkins, Richard: *The rise of consortia in the information and communication technology industries: emerging implications for policy,* In Telecommunications Policy 23 (1999) 159-173.

- Most consortia were established by "core" groups of founder members, made up mostly of multinational ICT supply firms and/or large national public telecommunication network operators.

- Consortia are accountable only to their own members.

There is never a guarantee that all consortia members will be able or willing to contribute technically on an equitable basis, and "free rider" problems do arise. One possible function of consortia is the pooling of knowledge and competencies as codified and protected by copyrights and patents. However the situation here too is somewhat obscure, for example a limited search of the United State Patent Office database made early in 1998 revealed no evidence that consortia are becoming patent assignees.

It seems that the major multinationals are those most to benefit from consortia. They benefit less from opportunities to encourage standardization, than from the strategic position the consortia affords for exploiting new networking environments.

A recent study of the European Commission has developed a new approach to classifying groupings of ICT interests. Incumbents are existing suppliers of telecommunication and computer products and services with an extensive installed base of technology linked to an established customer base; *insurgents* are newer firms seeking to build market shares for goods and services based on new technology; and virtual communities are centred around emerging configurations of dominant users of networked services, especially on the Internet.

The *incumbent* and *insurgent* perspectives led most of the consortia formation that occurred throughout the 1990s. In setting up consortia, incumbents were looking for new ways to maintain and increase revenues by maximising and enhancing existing investments in network facilities in order to exploit the commercial possibilities of these new markets for electronic services. The insurgents sought to use consortia to develop market share quickly by breaking up some of the vertical integration that still exist among incumbents. This saw the birth of consortia like OMG, IMA and the Open Group which focused more on the articulations between software, digitized content and networked services than on platforms and network facilities as such.

Today, consortia are not stand-alone organizations. An international system has evolved in which communication and coordination are achieved primarily through inter-organizational alliances and through cross-membership by firms large enough to have the resources, technological scope and logistical acumen to span the entire system.

The logistical and resource limit for most small and medium-sized enterprises, and even for large user firms, would be to monitor and perhaps contribute to the work of at most a handful of consortia. The systemic nature of the consortia phenomenon could create avenues for smaller and more peripheral stakeholders to get connected with the whole technology coordination context through selective participation in only a few key consortia. But no consortium has mechanisms in place to facilitate this outcome, and selective participation has not been the strategy of ICT suppliers thus far. Policy-makers, some analysts warn, must be vigilant to prevent business communities stimulated by consortia from becoming technological ghettoes.

3.5 Technology acquisition by enterprise incubators and small manufacturing enterprises

3.5.1 Enterprise incubators

Technology transfer takes place not only between national or regional entities but also, at the initial stage, between research centres (laboratories, universities, technical colleges) and enterprises, the end-users of the technology product. An enterprise incubator is an interface between industry and academia which allows these two apparently quite different worlds to communicate. Essentially, it fulfils two functions. First, it serves as a translator, transposing the enterprise's problem into a language comprehensible to the researcher, and then translating the latter's answer into terms understood by the enterprise. Secondly, it is a "time adaptor" connecting the enterprise creator, which wants an immediate answer, to the research centre, which has little thought for time. The incubator is thus the link through which the enterprise can obtain from the research centre a prompt technological response to a specific problem.

The incubator serves as an interface not only for its own "offspring" but for all enterprises in the region, acting as a catalyst for new enterprises and a "dispensary" for existing small and medium-sized enterprises and industries should they become vulnerable or encounter some technological problem requiring intervention by a research centre.

In all parts of the world there are bodies specializing in the small enterprise/research centre interface which translate the enterprise's technological needs and provide research centres with what they lack in terms of know-how, logistical support, administrative staff and relations with enterprises. As a rule incubators work in partnership with such bodies or subcontract their interface activities.

3.5.2 Small manufacturing enterprises

Small manufacturing enterprises (SMEs) are stand-alone or unlinked enterprises which do not have access to technology through a parent company or network partners. Many produce for the local market, and those which are export oriented often do not have close relations with their clients, or else their clients are not in a position to provide assistance. Other SMEs compete with foreign companies in the local market and the foreign competitor will be reluctant to provide assistance. State enterprises are a third category of unlinked firms especially when these concentrate on the domestic market and have a monopoly.

Case studies conducted by ILO[16] show that such SMEs have seven main sources of know-how and these are combined and used simultaneously or consecutively at different stages of enterprise development:

- Sellers of equipment or machinery. These are often the first source approached if a company wants to establish itself, extend operations or introduce innovative technology. Equipment sellers not only train personnel to use the equipment but often assist in production methods.

- Former employees of foreign companies, either hired as managers or technical staff or brought in to found a new company.

- Informal linkages with other local or foreign companies.

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16 North, Klaus, *Localizing global production – Know-how transfer in international manufacturing,* International Labour Organization, Geneva, 1997.

- Training and consultancy services provided by commercial institutions or non-profit organizations such as national productivity centres.
- Study visits abroad or to advanced companies in the country.
- Foster parent schemes, designed so that bigger enterprises assist SMEs in upgrading performance without any formal business link with the enterprise assisted. In Indonesia the Astra Group is known for this kind of support to SMEs.
- Twinning arrangements. For the purpose of cooperation between similar enterprises operating in different settings. For example, cooperation between the Paris metro and the Cairo underground was organized through a technical cooperation project with the aim of upgrading performance in Cairo.

Caridad Aspiras has analysed the phenomenon of technology transfer in the Philippines[17]. Her analysis of Philippine SMEs has brought to her attention some of the criteria to be considered in transferring productivity and quality improvement techniques to SMEs:

- Type of ownership: technology transfer is easier in firms with an owner-manager, as decision-making is simpler and rests entirely with the owner, who can easily integrate new approaches into the company's policies and programmes.
- Management style, which in SMEs tends to be informal but autocratic. Training should also be carried out in a less formal atmosphere, frequent consultation with the owner is however necessary to gain the required support.
- Level of education of employees: most employees have little education, the learning process is slow and any new technology should be presented in a way that they can easily understand.
- Corporate culture, which tends to treat employees, supervisors and managers like a big family. The transfer process should not run counter to such values.
- Market orientation: technology transfer is much easier to export-oriented companies than to local-oriented companies. Export-oriented companies are obliged to cope with the quality requirements of their market.

Measures that enable SMEs to carry out the transfer process include:

Develop the interest of owners/managers in the technology through:

1) Workshops on productivity concepts and approaches to improving productivity, and the roles and responsibilities of top management in promoting and sustaining the programme.
2) The provision of reading materials such as brochures or flyers on the technologies concerned.
3) Organized study missions to companies employing productivity improvement technologies.

Gain the commitment of owners/managers to technology transfer:

- Encourage workers' participation. Consultation with key employees or workers' representatives if the company is unionized is an effective means of encouraging workers to become involved in the technology transfer.
- Train and develop the skills of employees. Training should deal with the technology itself, basic tools and techniques, step-by-step application, and the roles and responsibilities of key people at all levels.

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17 *Transfer of productivity and quality improvement techniques to four small and medium-sized enterprises* by Caridad Aspiras, PDC, the Philippines.

- Set up the organizational support mechanism. The roles and responsibilities of key people involved in installing the technology should be identified during this stage. A timetable for transfer should be agreed between employees, managers and consultants.

- Arrange a pilot application of productivity and quality techniques.

- Conduct regular monitoring or audits to assess performance and employees' progress in applying productivity tools and techniques.

- Organize follow-up programmes or activities such as further training in the use of tools and techniques, data gathering and meetings.

- Maintain the programme by publicizing the results, providing recognition, rewards and incentives.

3.6 The role of national productivity centres in technology transfer

A major problem for SMEs is to identify possible sources of assistance. The know-how brokers such as Chambers of Commerce, national productivity centres (NPCs), trade fairs, seminars, study visits and specialized journals play a key role in linking know-how supplier and recipient.

Case studies conducted in the Philippines, Thailand and Indonesia demonstrate the important role that NPCs can play both in the first phase, as know-how brokers providing a platform for the presentation of new experiences, and in the second phase, as consultants and training institutions linking local consultants and foreign consultants, who would otherwise be out of reach, especially for SMEs. NPCs also provide the possibility of grouping a number of enterprises together to initiate a "learning from each other" process.

3.7 International aid agencies

Analysts affirm that aid agencies should move beyond assistance to IT components of investment projects. They should help governments become effective IT users, build their competence to formulate and manage national IT strategies, and promote IT diffusion throughout the economy. Aid agencies should take a long-term view of the roles and capabilities of the public and private sectors and help create ability to learn and adapt technology. They should promote public-private partnership, and help create local capacity to strategically manage a national process of IT diffusion and learning. This would include the development of consultative and diffusion mechanisms for private sector involvement in planning and implementing IT projects. Such participation is central to building technological capabilities and ensuring commitment to learning and organizational change.

4 Transfer mechanisms

4.1 Legal and financial arrangements for technology transfer

It would be unadvisable to opt for a standard contract for technology transfer or to look for the ideal format. In any technology transfer, the form of the contract should be adapted to the context in which the operation is to be carried out. Negotiation remains an important factor because it provides an opportunity to develop the right format. A "legal consultancy" established in the recipient country would be a useful tool.

In most cases technology transfer is financed in much the same way as tangible investments or intangible investments in the case of know-how. Often, though not always, the investment is tied to the creation of a new company.

There are four recommendations to be borne in mind:

- *Circulation of information*: Many partners search agencies and providers of capital grants are simply not known to promoters in developing countries.

- *Training experts in project studies*: This needs to be done on a large scale, while taking care not to over-inflate the numbers of experts employed by public bodies and development banks.

- *Equity*: Investment must be financed by own funds, long-term credit being resorted to only as a supplement. Most promoters in developing countries lack adequate own funds. In the event of profit, the promoter or owner of the technology would be remunerated by dividends. In the event of failure, it would share the risk with the purchaser of the technology.

- *Support financing*: In all cases the promoter must top up with an input from its own funds as a safeguard against abuse.

4.2 Technology transfer and intellectual property rights

Today, in the global economic competition, the highest challenges are over intellectual property. In 1947, for example, intellectual property comprised almost 10 per cent of all United States exports and today is set to account for well over 50 per cent of them[18].

Most of the world's legal systems divide intellectual property into two main classes: industrial property and artistic works. Industrial property includes trademarks, industrial designs and inventions, while artistic works are literary, musical, photographic, cinematographic, paintings, drawings, jewellery and furniture designs, choreography, records, tapes, broadcasts, etc. Though there is no uniformly accepted method of protection of these rights, most countries do recognize and grant varying degrees of protection in the form of patents, trademarks, trade secrets and copyrights.

In the last 20 years, pressure has intensified for the establishment of intellectual property protection mechanisms which transcend national borders, particularly in the case of copyright and trademarks for artistic works. This is largely due to technological developments in the area of software and sound and image reproduction. Mass-produced recordings are relatively inexpensive when compared to the cost of designing, producing and marketing their artistic components. The temptation to copy popular programmes, books, films and sound recordings has contributed to the emergence of piracy, which may not be punishable by law in some countries.

The ongoing explosion of the software industry and the expansion of databases have further exacerbated the problem. Widespread electronic data transfer means that the physical distribution of data and software is no longer an obstacle to piracy.

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[18] Warshofsky, Fred: The Patent Wars: the Battle to Own the World's Technology, John Wiley and Sons, Inc. United States of America, 1994, Page 6.

The size of such losses has prompted governments of countries with substantial capital investments in intellectual property to react. In order to safeguard their national assets, western governments have encouraged the adoption of an international convention on intellectual property protection. Intellectual property protection systems and bodies have advocated worldwide free trade in intellectual property.

While many nations in the industrialized world have recognized the need for protection of new technologies and have amended their intellectual property laws accordingly, many nations in the less-developed world do not recognize intellectual property as being owned by anyone.

International economist Timothy J. Richards[19] in a 1998 study of the patent protection afforded by seven developing nations affirmed that many benefits can accrue to developing countries that put intellectual property laws in place "... intellectual property protection proves an incentive to businesses to conduct domestic R&D activity, encourages the transfer of state-of-the-art technology into the economy and its diffusion within the economy and creates an incentive for foreign direct investment". However, he notes that "Theoretical economic arguments alone have not provided a sufficient incentive for developing nations to undertake intellectual property rights reform. Only when the potential loss of other economic benefits are introduced into the equation have governments of the nations studies concluded that it is in their interest to reform their intellectual property regime".

Some developing nations actually exclude certain technologies from intellectual property protection, where no product patents are granted for drugs, chemicals, alloys, optical glass, semiconductors and inter-metallic compounds. Others have sparse laws for patent protection for chemicals, pharmaceuticals, food and beverages and agricultural equipment, and the same is true for trademarks and copyrights.

The industrialized countries of the world are looking for a way to protect their intellectual property and thereby their wealth and economic position from free riders and the acquisitive actions of their own trade rivals in the global market place.

Intellectual property is governed by the "intellectual property bargain" under the United States law. The law safeguards economic incentives for the protection of intellectual property by granting individuals the monopoly right to exploit their works for a limited time. In exchange, society benefits from the flow of artistic and innovative works into the market and from technological development.

Ultimately, the works so created will become available after the term of exclusive use expires. Individual property rights are in a delicate balance with the goal of ensuring that the public benefits. The spirit of the United States copyright law is enshrined in the 1909 House of Representatives report that accompanied the Copyright Act, which affirmed that the protection is not based upon any natural right that the author has in his writings. Protection is not given for the benefit of the author but for the benefit and the welfare of the public which will be served and progress of science and useful arts will be promoted, in that it will stimulate writing and invention.

The question regarding software is whether society benefits more from affording creators broad, enduring and exclusive rights to foster creativity than from limiting their rights in order to encourage adaptation and innovation by others. Each country must achieve a public policy consensus on the contours of legal protection for computer software.

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19 Gadbaw, R. Michael, and Richards, Timothy J. editors, *Intellectual Property Rights: Global Consensus, Global Conflict*, Boulder, Colo.: Westview Press, 1988.

4.3 An international code of conduct for technology transfer

Technology advances and their rapid diffusion, especially in the area of information, have contributed to the creation of new markets and the transformation of innovation and production processes. These changes and the attendant shift towards global competition require a continual search for alternative strategies by enterprises and for improved policy instruments by governments that would enable them to respond more effectively to the new world environment. Consequently, considerable attention has been given in recent years to the creation of a legal environment conducive to technology transfer and development. This has led a number of governments to formulate laws and regulations relating to the transfer, development, adaptation and diffusion of technology.

- Most developed countries have introduced changes in their competition laws and enforcement policies on restrictive practices in order to stimulate technological innovation, and have passed laws to protect new technologies.

- The main focus in developing countries has been on the formulation of policies and legislative instruments for the promotion and encouragement of foreign investments and related technology transfer.

- Many developing countries have liberalized their investment regime and technology transfer legislation in order to attract more foreign investment. The main approach taken by those countries towards technology transfer has been to focus on effective collaboration between partners involved in transfer arrangements rather than on the control of the contractual aspects of transactions.

- More recently, a number of developing countries have also modified their intellectual property legislation to strengthen protection of intellectual property rights or to introduce new enforcement measures.

4.3.1 Structural Adjustment and technology transfer

Increasing liberalization trends, adoption and implementation of structural adjustment programmes, changes in the international division of labour and greater cooperative arrangements among enterprises have, in a period of rapid technological change, created a new setting for investment and technology flows.

While it is true that technology is vital for achieving economic development and sustaining competitiveness, the process of gaining technological capability is not instantaneous, costless or automatic, even if the technology was well diffused elsewhere. Apart from physical inputs, it would call for various new skills, technical information and services, contract research facilities, and interactions with other firms, equipment suppliers, standards' bodies, and so on. The setting up of this dense network of cooperation would require the development of special skills and a favourable economic, institutional and legal environment.

All countries, particularly developing countries, could benefit from imported technologies to establish and strengthen local technological capability, including, *inter alia*, the ability to acquire, absorb and adapt new and emerging technology, and to improve their international competitiveness. Such technologies would be obtained largely through foreign direct investment, including joint ventures and capital goods imports. However, in recent years, other channels of transferring technology such as licensing, management contracts, subcontracting and franchising have also grown in importance, including those within the framework of strategic technological partnerships.

Foreign direct investment is attracted most strongly to those countries that have adopted measures to strengthen their domestic technological capability and created an overall policy framework conducive to innovation, investment in infrastructure, intellectual property protection, human capital formation and a stable macroeconomic and regulatory environment. Yet government efforts have not necessarily produced the desired effects in terms of additional investment and technology flows by firms. In most developing countries, the process of technological capability-building might be hampered by, *inter alia*, declining rates of investment, misallocation of resources, external imbalances, lack of diverse and sophisticated skills, weak linkages between domestic R&D institutes and enterprises as well as unfavourable external factors. In that context, the problems faced by developing countries, particularly the least-developed countries, and countries in transition require special consideration, particularly with respect to their need to formulate appropriate strategies on foreign direct investment and transfer of technology.

Some analysts affirm that efforts towards promoting technology transfer and technological capability-building in developing countries and countries in transition need to be coupled with market-based trade and investment policy and pricing systems, and with a stable macroeconomic environment for business activity conducive to overall economic growth and employment. In order to, maximize the efficient use of technology, technology transfer must take place, particularly in the case of developing countries, either as part of international commerce, or included within bilateral or multilateral assistance programmes.

While the role of government remains vital in the process of capability-building, there is a need for closer collaboration between business, academia and government in order to take into account the motivations and needs of the production sector in the formulation of policies. However, differences in levels of economic and technological development may call for different sets of policy mix and approaches towards capacity-building.

4.3.2 The Uruguay Round

The Final Act embodying the results of the Uruguay Round of Multilateral Trade Negotiations was adopted on 15 April 1994. The Final Act includes the "Agreement on Trade-Related Aspects of Intellectual Property Rights, Including Trade in Counterfeit Goods". The Agreement allows for "national measures" to prevent the "abuse" of intellectual property rights or practices which unreasonably restrain trade (Article 8, § 2; Article 31 (k)). It also addresses "licensing practices" which may have adverse effects on trade or on competition and which member States may control through appropriate measures (Article 40). In doing so, the Agreement provides, for the first time in an internationally binding instrument, a number of rules on restrictive practices in licensing contracts.

It recognizes that some licensing practices pertaining to intellectual property rights which restrain competition may have adverse effects on trade and may impede the transfer and dissemination of technology (Article 40.1). The Agreement does not deal in detail with those practices that have been widely discussed in the process of the elaboration of the draft code of conduct. Therefore, countries are free to specify in their legislation "licensing practices or conditions that may in particular cases constitute an abuse of intellectual property rights having an adverse effect on competition in the relevant market" (Article 40.2). The last qualification, namely "adverse effect on competition" is tantamount to the so-called "competition test" for evaluating practices which may be deemed abusive. The provision in question provides a few examples: exclusive grant-back conditions, conditions preventing challenges to validity and coercive package licensing.

Fourteen practices have been deemed restrictive in Chapter 4 of the draft code of conduct[20]: grant-back provisions; challenge to validity; exclusive dealings; restrictions on research; restrictions on use of personnel; price-fixing; restrictions on adaptations; exclusive sales or representation agreements; tying arrangements; export restrictions; patent-pool or cross-licensing arrangements and other arrangements; restrictions on publicity; payments and other obligations after expiration of industrial property rights; and restrictions after expiration of arrangement.

The preamble, objectives and principles of the draft code reflect the concerns and motivations of different groups of countries in the sense that an international code of conduct should be an instrument through which to facilitate and promote the transfer of technology process, to reconcile differences in the approaches and experiences of countries concerning the transfer of technology, to give guidance and provide a framework for national legislation in the field of technology transfer and thus further the convergence of national laws, and to remedy abusive or anticompetitive practices in transfer of technology agreements. These motivations and concerns have found specific expression in the structure and coverage of the draft code, the centre-piece of which was chapter 4, which deals with restrictive practices. However, the positions of the various groups of countries on the provisions dealing with transfer of technology transactions, particularly in the area of licensing practices, were influenced by existing policies and by prevailing conceptual approaches to international transfer of technology and technological development which have since undergone variations.

4.4 Collaboration in the transfer of technology

Recent years have witnessed a growing recognition of the importance of collaboration among enterprises in the transfer of technology and technological capability-building, the need to take advantage of opportunities to enter into various cooperative arrangements, the increasing emphasis in government policies on attracting foreign direct investment and promoting technology transfer, the relaxation of control on restrictive practices, the increasing concerns about the effect of technology on the environment and the growing accent on the creation of a stable legal framework conducive to transfer of technology which involves various economic agents in the process. Laws governing intellectual property rights are considered a key element in the strategic thinking of enterprises and governments and an important means used by firms to safeguard their technological assets.

These developments, which have given rise to conceptual and policy shifts, are of unique relevance to the discussions on the draft code of conduct. This uniqueness arises, in particular, from the effect of such developments on international technology transfer which calls on the international community in the new economic environment to identify new parameters for a healthy competition that would be valid for all parties in an integrated world market. It would, therefore, be important to assess the specific implications of these developments on the international transfer of technology, particularly to developing countries, and assess their possible effects for enterprise and intergovernmental cooperation on the transfer of technology, including the identification of possible rules and principles which might enhance the stability and predictability required for such cooperation.

In light of the above, the Secretary-General of UNCTAD opined that the negotiations then in progress on the current draft code of conduct should be formally suspended. More study should be undertaken on the above factors in order to reconcile past differences and to facilitate the achievement of a better understanding of the principles which should govern international cooperation in the area of technology today, before the code could become a reality.

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20 Discussed in *Negotiations on an international code of conduct on the transfer of technology*, United Nations Conference on an International Code of Conduct on the Transfer of Technology, Report by the Secretary-General of UNCTAD, 1995.

5 Evaluation of experience

5.1 Overview and experiences

The positive impact of technology transfer on telecommunications – The case of Burkina Faso

Since the introduction of the first computer in Burkina in the early seventies and the creation of a National Information Processing Centre in 1972, the importance of information technology has increased to the point where it has become an essential tool for the nation's socio-economic development.

The development of an information technology infrastructure has been manifest in several instances. There are many positive effects to be had from the development of telecommunications in the rural areas. Such development is said to create a "virtuous circle" by[21]:

- stabilizing populations;
- improving quality of life through:
  - greater social cohesion;
  - better access to health services;
  - provision of access to state services;
  - new educational resources;
  - greater security (protection, access to emergency services);
- increasing revenues through:
  - impact on GDP;
  - job creation;
  - development of small and medium-sized enterprises and industries;
  - improvement of agricultural output;
  - greater productivity;
  - access to new markets.

The IT sector in Tunisia

In 1996, Tunisia had a population of 9.1 million and an estimated GDP of USD 1935 billion. The growth rate was 6.9 per cent and the inflation rate, 3.7 per cent. The growth rate of the IT market regularly exceeded 20 per cent between 1986, when the market took off, and 1994, since when it has fluctuated between 10 and 15 per cent. This slow down can be explained by the fact that the market has moved from a start-up phase to one of growth.

The IT market in Tunisia has benefited from the complete liberalization of trade in the sector and from important needs identified by players in the national economy for the purpose of upgrading Tunisian enterprises. Today there are more than 150 IT service companies and 112 franchise holders representing 72 brands of hardware and software.

Sector turnover is estimated at USD 140 million, 25 per cent of which is accounted for by services and 75 per cent, by the sale of IT equipment.

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[21] International Telecommunication Union, Telecommunication Development Bureau, World Telecommunication Development Conference (WTDC-98). Agenda Item 4.1 Document 44, Chapter II.4.

In order to develop the sector, an action programme has been devised to bring it into step with the technological and organizational changes occurring in the sector worldwide. Its objectives include:

– Further restructuring of the communication sector to enable it to offer the necessary equipment and services.

– Extension of the national communication network to meet demand and any future needs.

– Development and diversification of high-tech-based services.

– Strengthening partnership operations.

General situation of the telecommunication industry in developing countries – Local "industry"[22]

Several billion human beings live in the developing countries, mostly in rural and remote areas where telephone penetration is very low or even zero. A substantial increase in telephone penetration requires not only funding, from whatever source, but also equipment adapted to the prevailing conditions (geographical, climatic, etc.) in these countries. Moreover, the cost of constructing a new main line must not exceed USD 2 500, so that operators, whether or not the incumbents, are able to generate sufficient funding of their own to ensure their development.

Too often, the wealth of developing countries, and in particular the least industrialized countries (LICs), comes from the primary sector alone (agriculture), and high-technology equipment manufacture hardly exists. This applies to telecommunication equipment, which in most cases is imported from developed countries.

A questionnaire on industrialization and transfer of technology was sent to various administrations and operators. The facts were reported in a 1996 document.

The following points are worth emphasizing:

- Only 16 of the 92 countries which replied to the questionnaire consider a telecommunication equipment manufacturing industry to be an important component of overall national development.
- Twenty-eight countries consider that they have sufficient expertise and/or experience in the transfer of telecommunication technology, while 29 have neither expertise nor experience.

In conclusion, on reading the questionnaire it is clear that "a large number of countries are lacking the basic elements to create and develop telecommunication equipment manufacturing capabilities. The reasons for this situation are mainly the low level of technology transfer, expertise, research and development activities, the limited economic and technical assistance received and also the lack of plans or policies to encourage and promote the development of this industry".

Conditions for success

The success and durability of a "local industry" of national and subregional scope depend on the fulfillment of a number of conditions:

- at government level, a stated determination to develop an efficient industry that is capable of exporting. This requires not only a stable political climate, but also tax incentives for investment (customs-free area, repatriation of profits, etc.);

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22 Agenda item: 4.1, Fund for the Development of Telecommunications in Rural and Remote Areas and Local Manufacture Feasibility Study, Plenary Meeting - World Telecommunication Development Conference, 1998, Valletta, Malta. Document 44, Chapter II.4.

- at operator level, preparation of medium-term development plans for their networks in rural and remote areas. As far as possible, these development plans should take account of the need to use the same equipment in different countries. Operator participation in a subregional fund for telecommunication development in rural and remote areas will enable the economies of scale needed to ensure an adequate production margin;

- at investor level, an acceptance that no dividends will be served during the first years of the local industry's existence, and that the investor will not have immediate control;

- at the level of the industrial partner(s), the motivation required to ensure smooth development of the local industry, and a willingness to transfer knowledge and technology under the best possible conditions, not looking on the new industry as a potential rival, but as a competent and reliable partner.

5.2 Evaluation of experience and suggestions

International experience shows that the regulation of technology import agreements can play an important role in promoting technological development in developing countries. Studies show that overall, the results are positive particularly as regards stemming currency outflows, improving conditions for the acquisition of technology and making national enterprises aware of the issues involved in choosing technologies and negotiating and implementing agreements.

But problems have been identified as well. They are largely the result of too much bureaucracy and intervention. First, a lack of flexibility can lead to a decline in the entry of foreign technology, an attitude of rejection on the part of foreign technology suppliers or investors and to parallel agreements between contractors. Secondly, many supervisory bodies overlook the time factor. An overlong evaluation period may prevent market opportunities from being exploited and thwart investment projects. Thirdly, government intervention in contract negotiations may be construed by local enterprises as releasing them from any responsibility in the negotiations. Lastly, in a few countries there is a tendency to oversee all types of contracts, which means less thorough evaluation of really important agreements and/or more registrations.

Regulation must not overlook the role played by public and private enterprises in the technological development process. If the legal and formal aspects are overemphasized and the specific circumstances of the local company and the investment project are overlooked, discrepancies may arise between the company's objectives and those of the supervisory body, which will reduce technology flows or give rise to "gentlemen's agreements".

This observation is largely responsible for the shift towards more flexible laws on technology transfer. Supervisory bodies must promote dialogue with enterprises if the latter are to contribute to the country's technological development. Advice and assistance may be more effective than orders.

With that in mind, such bodies should adopt a more "dynamic" attitude instead of the "passive" and defensive approach of simply overseeing the terms and conditions of contracts. They need to forge closer links with the local scientific and technological infrastructure (research centres, technical centres, consultancy and engineering enterprises, industrial enterprises) and play a more effective role in promoting real mastery of imported technologies.

To be effective, technology transfer must focus on people so as to create a dynamic between the acquired technology and its mastery and adaptation on the one hand, and human resource development on the other.

The aim is to move beyond mere consumption of ready-made technologies so that developing countries gain access to technology production and partnership rather than relying on assistance.

- States would be well advised to acquire the means to evaluate their technology requirements themselves, taking account of people's essential needs, the country's natural and human resources and political aims such as export objectives.

- When a large new enterprise is created, advice should be sought from national consultants competing on a par with foreign consultants.

- National and/or regional technology observatories might be established as a source of technological information.

- Study of the problems of satisfying technological requirements has shown the need for intermediation structures.

- Whether such structures are to be national or regional should be determined on a case-by-case basis. They should not be too rigid and their continuity must be ensured.

- National legislation must be adapted to the country's technology transfer policy, particularly investment codes.

- Machinery should be set up to centralize all information on public, private or joint partner-search agencies and compile nationwide information on sources of financing to supplement own funds.

- Experts should be trained in financial institutions in developing countries to carry out feasibility studies and in particular to assess the technological value of projects.

- Entrepreneurs in the developing countries should be encouraged to set up joint ventures as a means of amassing enough equity to finance investments in developing countries.

- More financing banks should be established. They would acquire shares in companies to be set up in developing countries enabling them to acquire the equipment and technology they need for start-up. Companies in the developing countries wishing to acquire new technology could increase their equity by issuing preferred shares. The shares would be non-cumulative and would be acquired by suppliers in the developed countries in exchange for know-how and training.

- The civil service should carry out an impartial audit to satisfy itself that enterprises receiving aid and subsidies for innovation put them to good use.

- Company managers must be given basic technical training as well as management training, since the life of the enterprise is in their hands. They need both management skills and technical know-how.

- At the start of any project a study must be conducted to determine training needs and objectives, staff recruitment and training programmes.

- Training for project implementation should be allocated a percentage of the amount budgeted for continuous training. It should focus mainly on the techniques used, the characteristics of the plant, the equipment acquired and maintenance.

- Technical assistance contracts should contain specific provisions on the number of national or foreign residents at a given grade, the number of middle- or high-level technicians (national or foreign) and training plans for each staff category.

- In larger enterprises innovation is the task of the R&D unit. Small enterprises should be encouraged to form economic interest groupings within their sector with a view to pooling innovative R&D efforts.
- Wider use could be made of the system of awards for original innovations by local companies, giving maximum publicity to winners.
- Scientific and technical information bodies in industrial countries should help developing countries to set up similar institutions.
- Regional grants for accessible innovations could be instituted. They would attributed by regional centres or centres of excellence.
- Tax incentives for enterprise innovation must be introduced in the tax systems of developing countries.

It is also necessary to:

- Extend the role of national research institutions and laboratories to enable them to use the results of their research in a prototype or a demonstration project.
- Recognize although development of research results will involve public funds and the State (loans, advances or shares in equity), the enterprise itself must be encouraged to invest directly as early as possible.
- Promote the involvement and commitment of researchers and management in developing and marketing the results of their work.
- Seek to interest researchers in having the results of their work used rather than published and encourage them to actively assist industrialists.
- Promote the establishment in universities of facilities to test and evaluate the industrial scope of research results.
- Promote the establishment of "industrial incubators", where entrepreneurs with good ideas but insufficient means are afforded facilities to start up operations.
- Develop research by enhancing the status of researchers in developing countries so as to create a technological environment conducive to innovation.
- Set up a network of centres for scientific information and technological development in developing countries along the lines of the Tekasys system in Brazil. This would function as an Internet gateway which extracts and distributes information from universities and research and other specialized centres.

6 Conclusion and proposals

6.1 Policy proposals, practice and guidelines

In helping developing countries to equip with new information technology, manufacturers of tele-communication equipment and industrialized countries can benefit from the participation of such countries in research and development activities in order to set up new technologies which are better adapted to their climatic, social and economic conditions and to identify consumer requirements.

To achieve this aim, reliable policies applicable to telecommunication industrialization and to technological experience and transfer of know-how must be developed, taking both market opportunities and economic and legal restraints into account.

Technology management is key for economic and social development: the concern for being alert to possible deficiencies, for avoiding wrong investment decisions and risks of social conflicts, yet at the same time making the most of the beneficial aspects and the new opportunities opened up by innovation. Fostering the building-up of national and – even better – regional research teams in this regard and developing technology assessment activities in close connection with future-oriented studies is certainly a highly efficient way to provide policy-makers with the quantitative and qualitative information for a better articulation of science, technology and development.

Although it may appear costly and difficult to implement, such a function seems all the more needed in the case of developing countries: what is at stake is to find the best path to maintain the balance or correct the imbalance between, on the one hand, the need to innovate – in order to adjust to technical change and to modernize social structures, and, on the other, the need to preserve the environment – in order to select technical solutions which are suited to the local conditions and to defend the coherence of the cultural roots. This requires what Jean – Jacques Salomon[23] refers to as a social assessment of technology rather than a simple technology assessment.

The information technology policy should be aimed at removing the hurdles and creating conditions under which the best results can be obtained from computerization at all levels.

Analysts suggest the creation of an implementation structure for this policy aimed at promoting information technology in general and, more particularly, at coordinating computerization at the government administrative level. An information technology master plan for a five-year period with necessary flexibility and possibility for adjustment should lay down the quantitative and qualitative objectives for the activities to be carried out.

At the level of human resources, plans call for training more than computer professionals. This will require the creation of new training structures.

With respect to equipment, various investments should be planned, in the public sector, while measures such as the reduction of import duties will be taken to facilitate the provision of equipment to other sectors.

Keys to creating an IT culture:

- Campaigns to stimulate discussion and awareness of the issues and principles associated with the use of IT.
- Introduce every individual to the use of IT in day-to-day administrative chores.
- Encourage the widespread dissemination of consumer electronics through cost minimization.
- Use IT to encourage life-long education and training.
- Use IT to encourage people who cannot follow conventional work patterns to use IT to work from home.
- Use IT to augment quality of leisure and quality of service.

6.2 Market analyses and investment policies

Governments in several developing countries have tried formulate national informatics policies, reforming and upgrading key telecommunication infrastructures, and experimenting with various institutions, incentives, and promotional instruments to develop the local capability necessary for effectively acquiring and mastering information technology. The lessons of their experience have not been extensively researched,

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[23] Policy implications of new and emerging areas in science and technology for development, in New technologies and global restructuring, the third world at a crossroads, Taylor Graham, 1993, United Kingdom.

but the evidence at hand suggests that there is a significant gap between the promise of information technology and what developing countries have gained so far from its adoption, although some developing countries are applying information technology in a wide spectrum of uses.

Some studies of information technology diffusion in developing countries indicate that the use of IT has resulted in significant increases in operational efficiency. Analysts argue that, even at low wage levels, automation can make economic sense, provided certain organizational prerequisites are in place. Computer controlled automation also results in benefits from greater flexibility. The use of new information technology resulted in a significant increase in the Port of Singapore's operational productivity.

Yet the gains from adopting IT appear to vary across developing countries, even in similar areas of application. For example, while Brazilian banks have benefited from the use of computer systems, the automation of Indonesian banks has had almost no impact on their financial performance. Dramatic productivity increases have been possible only where "best practices" were adopted, but diffusion of these practices has so far been quite limited.

The mixed experience of industrial and developing countries thus far – as opposed to the vast potential for information technology use – makes it imperative to identify the critical conditions for effective diffusion of IT. Some argue that, even with appropriate support policies for both the generation and use of IT in OECD countries, expected benefits – particularly in productivity improvements – have been slow to materialize. In the United States in particular, lagging productivity in manufacturing and services has strengthened the view that IT adoption involves a substantial learning process and major institutional and skill changes, and therefore a relatively long gestation period before dramatic improvements can be realized. The recent improvements in productivity in the United States indicate that this gestation period may be over, at least for leading IT users who are now capable of "re-engineering" themselves to reap the transformational benefits of IT[24].

6.2.1 An institutional framework

The IT diffusion strategies of industrialized countries should be adapted to the prevailing conditions of developing countries. Market forces are insufficient to induce investment in new technologies. For early adopters and small enterprises, learning costs are prohibitive if unaccompanied by information and support networks. Country strategies should therefore promote an integrated approach to incentives, institutions and capabilities; access to international networks; development of technical skills, managerial practices, and organizational learning capabilities; focus on demand mobilization and user orientation; and development of government capabilities as a catalyst and strategist.

Analysts[25] have set out some important lessons learned by OECD governments which may be profitable guidelines for other countries:

- Lack of oversight and expertise hinders information sharing.
- Public agencies should contract out systems development and support services given the pace of change and the inability of the civil service to develop a responsive in-house information systems organization.

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24 See, for example, "Re-engineering Europe", in The Economist, Feb. 215, 1994, pp. 63-64.

25 See Hanna, Guy, Arnold, *The Diffusion of information Technology, Experience of Industrial Countries and Lessons for Developing Countries*, World Bank Discussion Papers 281.

- Government should decentralize planning and management information systems. Centralization reduces flexibility to exploit advances and to orient IT investment to needs. But government should set strategy standards and policies and sponsor demonstration projects and the introduction of best practices in public agencies.
- A central agency should provide guidelines for IT procurement, training and occupational streams for informatics professionals, analysis of information requirements, and planning and contracting for the development of public databases and networks.
- Organizational and human factors are critical to computerization in public agencies. Best practices involve top management in leading the computerization process, in analyzing the information needs of various stakeholders and clients of public institutions, and in directing IT investments to enhance services, responsiveness, and accountability.
- The government should set broad directions and priorities for IT application and invest in databases and networks of use across agencies.
- The computerization of complex systems such as tax administration and health management is resource-intensive and requires concentration on priority applications, and phased investments. A comprehensive view of public computerization needs would identify infrastructural bottlenecks and applications with high potential effect on a country's development.

6.2.2 Tailoring strategies to countries

A nation's IT strategy should be tailored to its technological capability, size and structure of its domestic market, industrial development, infrastructure and technology support, literacy, managerial competence, and government and business relationship[26].

6.2.3 Conclusion

The high-technology sector is in a state of constant change. Yesterday's technological innovations are now within reach of the public at large or even obsolescent. Consequently, it is becoming less and less costly to acquire technology of recent design and which offers capacities which were unimaginable five years ago. At the same time, manufacturers are increasingly anxious to be present on the markets and the resulting competition is impacting on products.

But generalized end-to-end digital transmission is the first stage of development. Thereafter, it will be for companies to find interconnection solutions. Lastly, the development of multimedia will be a catalyst in the overall evolution.

Thanks to new communication and information technologies, people around the world will henceforth be able to:

- expand their access to political, cultural, economic, technical and scientific information as much as they desire, approaching this information no longer on a local and fragmented basis but globally;
- see and talk to each other simultaneously, as if they were in the same place, thus pushing aside the limits imposed by distance to their interaction;
- inform and express themselves freely.

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[26] ibid.

From a myriad of industrialized societies where the political, economic and social organization has been carefully woven according to territorial demarcations, and where economic progress and social well-being depend upon the level of industrial development and market diversity, these new possibilities are irreversibly transforming mankind into a global information society foreshadowing Marshall MacLuhan's "global village". They will gradually erase territorial borders between people and disrupt the world's current organization, scale of values and behaviour. Furthermore, these new possibilities will create new, more efficient and easily accessible means of transmitting and acquiring knowledge and know-how, understanding, innovating, working, marketing and implementing essential basic services with respect to the right to education, information and communication, and enabling democracy, individual and community development and competitiveness.

This information revolution can help developing countries to:

- increase their overall administrative efficiency as well as facilitate decentralized administration initiated with the implementation of democratic structures, thanks to improved information circulation and sharing;
- provide citizens with new possibilities for communication with administrative authorities;
- produce timely and reliable information for monitoring the economy;
- provide economic operators with modern means enabling them to:
  - efficiently interact with their international partners;
  - maintain and strengthen their presence on the international market through better knowledge of supply and demand and improved dissemination of information on the economic, cultural and touristic opportunities their country has to offer;
- in so doing improve their competitiveness by means of distance learning;
- increase their ability to be part of a continuous process of productivity improvement, thanks to continuous training;
- solve fundamental educational problems;
- remove specialists from isolation and strengthen their innovative capacities by providing them with access to scientific and technical information and putting them into contact with the world community;
- ensure better management of the environment and natural resources thanks to better management control of information on site;
- create, in this manner, more favourable conditions for investors and a sustainable development process;
- take the best advantage of globalization by reducing the gap between developed and developing countries.

6.2.4 Proposals

Analysts have suggested that when faced with a total absence of industry and the need to cut computer purchasing costs, the following steps should be taken:

- Establish a microcomputer assembly structure aimed at partnership with foreign manufacturers.
- Implement incentives such as:
  - revised customs formalities and, in particular, procedures relating to the import of components and the re-export of finished products, tax reduction on parts and components used in assembly and the creation of a standard exchange system for faulty pieces or components permitting the exchange of parts or components with the supplier (on condition that the part or component to be exchanged is guaranteed) without having to pay taxes on the new part or component.

- Register computer assembly on the list of activities eligible for benefits under the investment regulations, such as government compensation for employer contributions and maintenance costs for staff graduated from institutes of higher education during the first five fiscal years (from the degree date), in order to urge industrialists to recruit very high-level executives.
- With respect to the software industry, the objective should be to intensify training in very high-level skills by implementing incentives such as the registration of software development on the list of activities eligible for benefits under investment regulations, i.e. government compensation for employer contributions and maintenance costs for staff graduated from institutes of higher education during the first five fiscal years (from the degree date).

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