

RECOMMENDATION ITU-D 5

Industrialization and transfer of technology**Question 5/1: *Industrialization and transfer of technology***

The World Telecommunication Development Conference (Valletta, 1998),

recognizing

the sovereign right of each Member State to regulate its telecommunications sector and the implementation of the ITU's instruments,

recognizing also

that technology transfer is one of the keys to a country's industrial restructuring,

noting

the report of the ITU-D Study Group 1 on Question 5/1 "Industrialization and transfer of technology",

taking into account

- a) that the introduction and use of technology can contribute to substantial gains in terms of increased productivity, creation of employment and enhanced added value in the economy;
- b) that technological change may also lead to significant problems such as rising unemployment and increased costs of imports;
- c) that while the impact of introduction of new technologies or the process of transfer of technology may vary from country to country, it is imperative that policies be fashioned so as to maximize the beneficial effects of technology transfer and to assuage the negative effects,

recommends

that governments and administrations take account of the following principles when addressing industrialization and technology transfer.

1 Market analysis

The introduction of new technologies requires a thorough market analysis. Knowledge of the requirements of the market is essential in order to understand, for example, in what segments of the market (large customers, business or residential customers) is there demand for what types of technologies and services? Is there heavy demand for existing services, or is there demand for new services? A primary role for policy makers is to track the growth of the market and encourage technology transfer when the time is ripe. While the product mix of industrial production within a country depends on the strategies adopted for industrialization (e.g. import substitution, export promotion, assembly/full manufacturing) and the future changes in technology, the amount of value added can be increased by strengthening vertical integration where feasible through assembly or manufacture of final products and intermediate products.

The international transfer of technology involves the issue of importing, utilization, further developing, and the whole question of technological institutionalization by a country other than that in which this technological knowledge originated. For the developing countries, it is not only a problem of importing machinery and components, but importing the types that can be diffused and institutionalized by the importing country. Technology transfer should therefore involve the following elements which may vary across countries, sectors and enterprises:

- i) **Assessment of technology** – In most industries, one sole technology is rarely the best for all circumstances. Resources vary from one country to another, as does the nature of intermediate inputs. Therefore, when choosing among alternative technologies, the recipient enterprises must find the most appropriate technology, that is, the one that makes optimum use of available resources.

The first step to take in assessing and selecting a technology is to identify local needs and conditions. This is essential in developing countries, where the needs and conditions are often very different from those in the countries that supply most of the technology. The second step is to search out the available technologies on the international market. This requires extensive information about different technology suppliers. The third step in assessing new technologies is to evaluate their associated benefits and cost. This involves essentially economic considerations, but social and environmental aspects could also be analysed. The fourth step is to decide if the capabilities that can be acquired from experience with different technologies will enable the enterprise to make future improvements and innovations in order to increase productivity, or move on to new activities. One way for developing countries to improve access to the latest technology is through establishing common procurement procedures for equipment. Developing countries could thus pool their knowledge of dealing with manufacturers and equipment suppliers, create economies of scale and be able to negotiate improved contract terms.

- ii) **Assimilation and adaptation of technology to local conditions** – Once the different technological possibilities have been properly assessed, the enterprise should then move on to the phase of assimilating and adapting the selected technology to local market conditions. The aim of this is to understand the technology and use it to fit local conditions. The challenge is to take advantage of local demand and supply conditions to improve productivity and international competitiveness. This phase will most likely involve minor innovations or modifications of the technology to increase productivity, reduce costs, stretch capacity or improve quality.
- iii) **Diffusion of technology** – When the enterprise has gained sufficient knowledge of the technology's potential and some experience in its use, the technology can be diffused on a larger scale. Additionally, efficient diffusion requires knowledge of capable construction companies, relevant management capabilities, ability to bargain with local authorities, and economic resources to acquire production site.
- iv) **Innovation** – This will be the result of efforts to overcome constraints on the enterprise's production capacity. It may involve invention of new devices, products and production processes or improvement of the existing technology. The lessons of the Telebras inductive card phone system case study illustrate several preconditions which are necessary for successful transfer, in this case as an indigenous effort. An important lesson to be drawn from the Brazilian project is the relationship between the developer of the technology, manufacturers and the end user (the operator) that accounted for the success. The project not only met the needs of the operator but also created 3,000 jobs in the industry, while at the same time giving Brazil a comparative advantage in the export markets. The equipment supplied by the developed countries is not designed for developing country environments. The high cost of imported equipment and spare parts adversely affects operation, maintenance and capacity utilization. Increasingly shorter product cycles create problems of supply of spare parts for equipment that still has economic life. Equipment designed and produced elsewhere does not provide access to engineering design, know-how and know-why. Low or non-existent research and development capacities in the developing countries is a major bottleneck in technology development and transfer, where as R&D in the developed countries is normally geared towards meeting the needs of the developed country markets. Establishing manufacturing plans to cater for the demands of the region or a subregion and development of local R&D capabilities in association with manufacturing units are a desirable priority for developing countries.

Clearly spelt out conditions on the rights and obligations of the supplier of technology and the recipient on aspects relating to access to markets, quality assurance, intellectual property and licensing conditions are integral to the process of successful technology transfer. It is important that the quality of the product must fully match that of the same product manufactured elsewhere and carrying the same brand name. Appropriate quality assurance arrangements and compliance specification in collaboration with the technical staff from the transferring company are important aspects of the process.

2 The role of government

The growth of telecommunications technology depends on the State and government policy. The government therefore has an integral role to play in formulating a comprehensive and coherent national policy for the strengthening of the country's technological capacity. Such a policy should create and reinforce an autonomous decision-making capacity in technological matters consistent with the realities of its political, economic and social situation and its development objectives. The technology policy should be implemented through the adoption of technology plans as integral parts of national development plans. The technology plans should embrace essential responsibilities, such as budgeting,

management, coordination, stimulation and execution of technological activities and cover specific requirements at the sectoral and intersectoral levels for the assessment, transfer, acquisition, adaptation and development of technology. They should reflect short-term, medium-term, and long-term strategies, including determination of technological priorities, mobilization of natural resources, dissemination of the existing national stock of technology, identification of sectors in which imported technology would be required and determination of research and developmental priorities for the development and improvement of endogenous technologies.

Regarding safety and health, governments should make effort to: enforce laws and regulations which make provisions for the use of safety and health monitoring equipment and strategies; develop the necessary capability to choose technology in such a manner as to ensure proper safety and health provisions and working conditions for the workers; develop the necessary occupational safety and health infrastructure to deal adequately with all problems related to safety and health and working conditions involved in technology transfer.

3 Investment policies

Expansion of the telecommunications sector involves huge investment in building up networks, training facilities and the development of proper technologies. Development of capital markets for both domestic and foreign investors is a crucial aspect of investment policies. Liberal investment policies are therefore encouraged to attract and mobilize resources into the telecommunication sector. In India, for example, expansion of the telecommunication sector has been sustained by appropriate investment policies. A summary of such policies and procedures governing foreign investment into that country include:

- i) Import Policies – All capital goods are allowed on Open General Licence; and imports of all telecommunication equipment, other than consumer telecommunication equipment, are allowed without any licence and at lower customs duty.
- ii) Export Policies – Value addition of 30%, and automatic approval for imported capital goods within 15 days are allowed; establishment of export-oriented Electronic Hardware Technology Parks (EHTP) and Software Technology Parks (STP) for export of software.

4 Institutional framework

The legal and institutional arrangements in many developing countries are often quite weak and do not facilitate the effective participation of private enterprise and capital. Examples of inadequacies include lack of or ineffective laws and enforcement mechanisms to protect private property; absent or outmoded trade laws; a complex tax regime that is often anti-business; and controls on access to foreign exchange. The institutional arrangements are also often quite weak. Examples include a judiciary that lacks independence from the executive power or is prone to manipulation by interest groups; a legislative branch that is either captured by the executive branch or paralyzed by party fragmentation; unstable governments; and slow, ineffective, and sometimes corrupt government administration.

The establishment and sustenance of an appropriate economic environment, legal and regulatory framework, as well as political environment is therefore a prerequisite for enhancing technology transfer in developing countries. The laws and regulations guiding the transfer of technology from advanced nations to developing countries should be designed to strengthen the hands of negotiators in commercial technology transfer deals, maximize gains from the transfer, and enhance the development and successful adoption and diffusion of imported technologies. Laws should be designed to direct and control the importation of foreign technologies for the benefit of individual countries.

5 Intellectual property rights

Protection of intellectual property is integral in developing a country's technological capacities. Effective protection of know-how through copyrights, patents and licences will enhance the transfer of technology. This is especially true with machinery, equipment and chemical formulations. Under broader national laws governing intellectual property, in the case of technology transfer agreements the recipients need to respect the provisions setting out the details of the design of hardware and software, but also require other valuable knowledge such as manufacturing techniques and market information.

For example, China, in pursuit of the development of its information technology industry, has made fast progress in the promotion of its intellectual property system. In fact, a legal system has been set up for the protection of computer software in China in which copyright law, trademark law, patent law, anti-competitive law and technical contract play an important role in the protection of intellectual property.

6 Human resource development

Investments must not be confined solely to the acquisition of new technology; it is also vital to invest in human capital in order to guarantee the quality of the technology or service. The process of acquiring technological capabilities must be complemented by investment in human capital (training of personnel and hiring of advisors) which will create a capacity for change and adaptation. A key aspect of educational system in developing countries is the need for development of practical-oriented educational curricula at the universities with a view to enhancing utilization of products of these institutions. Technological know-how is absorbed by people and if there is a scarcity of people available, the technology transfer process will be halted. Industrial organizations in many developing countries are characterized by shortage of industrial skills on the one hand and at the same time high turn-over of trained staff largely owing to adequate incentives.

An adequate education and training strategy should include:

- the recruitment and retention of indigenous staff;
- on-the-job training for technical staff and users;
- data processing and project management training with appropriate elements of the behavioural, social and political dimensions of computerization for relevant computer staff;
- streamlining curriculum development on a regional basis to ensure uniformity of standards;
- professional development programmes;
- development of local information technology literature and resource materials.

For example, Telebras, the single largest employer in the telecommunication sector in Brazil, has a training policy for its personnel. It provides vocational training both in Brazil and overseas. At the national level, it has several exchange programmes with federal technical schools and research institutions, and it also sponsors employees to pursue tertiary education. Through the United Nations Development Programme, technicians are sent on missions to Japan, the United States, Canada and France, and international specialists are frequently invited to provide training and consulting services.

In Singapore likewise, in the country's effort to increase its technical capabilities, education and training have received high priority in the government's industrial policies. Technical institutes have been established: to train human resources with technical capabilities required to attract high-tech industries; to train human resources with attractive profiles for major investors; to provide an outlet for the country to learn about new work processes and technologies; and to ensure a supply of highly technically trained people for the key sectors of the economy.

It has been recognized that the shift towards a knowledge-based economy can have particularly adverse effects on employment of unskilled manual workers. Consequently, a world employment strategy must embrace not only intensive training programmes for long-term solutions, but also job creation programmes for unskilled workers.

The International Labour Organisation's approach has focused on identifying the training needs and priorities of workers and industries engaged in advanced technology-based production. Technical cooperation activities that endeavour to assist countries in developing their new technology-related training programmes should be increasingly promoted.

7 Health and working conditions

The transfer of technology arouses concern in terms of its effects on the safety and health, and the working lives of those involved.

Some factors to be considered in the transfer of technology have been advocated by the International Labour Organisation. These include:

- any appropriate or necessary adaptations should be made to the original technology to ensure that the processes, plants and equipment take due account of the differences between the receiving and the supplying country;
- technology should not be selected for transfer on purely economic or technical criteria;
- technology should be transferred only after careful consideration of all factors affecting occupational safety and health and working conditions;
- the proper use and safe operation of the processes, plants and equipment by the country receiving the technology should be ensured through appropriate training and instruction; and
- facilities for the proper repair and maintenance of processes, plants and equipment should be available to or within the developing country.

In recognition that technology should take safety, health and working conditions into account, a Code of Practice has been drawn up by the International Labour Organisation providing recommendations for all those with responsibility for safety, and health hazards arising from the transfer of technology. The objectives of this code are many and include:

- the need for the appropriate design, proper installation and safe operation and use of new equipment, processes, projects and related products being transferred to developing countries;
- the means of analysing, from the standpoint of safety and health and conditions of work, existing technologies imported by developing countries, and of modifying them to remove the hazards discovered by the analyses; and
- guidance in the setting up of administrative, legal and educational frameworks within which preventive and remedial measures can be implemented.

8 International affiliations

Developing countries should consider membership of international and regional telecommunication organizations as one way to gain access to the latest technology, to promote the development of services, to receive training and to obtain support in developing appropriate technology. Thus far, many have come together at regional and subregional levels to create organizations for mutual cooperation in telecommunications. These include the Pan-African Telecommunications Union (PATU), the African Postal and Telecommunications Union (UAPT), Asia-Pacific Telecommunity (APT), the Arab Telecommunication Union (ATU), and the Inter-American Telecommunications Conference (CITEL).
