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AN ESTIMATE OF THE NEEDS OF DEVELOPING COUNTRIES FOR THE TRANSFER OF TECHNOLOGY 1/

by

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1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been translated from an unedited original.

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Man's spirit of observation and capacity for comparison have enabled him to discover facts that are mutually related. Through the repeated observation of cause and effect he has established relations, which have then been transformed into rules, thanks to his power of reasoning. At an advanced stage of the process, differentiated structural bodies of such rules finally make up coherent rational groups, which will later serve to define arts.

Later, a new stage will be reached and, as the highest manifestation of his intellect, which distinguishes him from his fellow creatures, man will develop in addition to his previous aptitudes the intellectual capacity for generalization and abstraction and will thus reach the threshold of science.

Science and art, mutually consolidating one another and transforming one another in depth, yield results through research carried out in their respective interrelated fields.

Science and art thus reach higher levels and open up a range of special fields, one of which is technology, particularly industrial technology. Roots, trunk and branch continue to develop.

Thus we see that applied research is a source of technology which at the next stage of concrete application makes it possible to satisfy society's needs for goods and services.

In the process, definite stages have crystallized and objectives have been achieved.

The asset created, considered as an input, comes on to the market and is transferred as a commodity.

Analysis thus reveals the noteworthy conclusion that technology has the property of being transferred and that man markets it. The wealth that it implies is an inexhaustible source since it has the special characteristic of not being consumed by use, although its relative value may vary. New research will maintain the value of the capital involved.

This transfer of technology takes place in many forms which, as we shall see, is only one aspect of the general question of the function of science and technology in economic and social development.

From the economic point of view, the transfer of technology may entail explicit and implicit costs.

Explicit costs are those that the recipient of technology expressly pays for it, being thus a clear counterpart of the benefit that he receives in return.

Implicit costs are those which, being incorporated in some form in the product acquired, form a component of the over-all price that the purchaser is prepared to pay, a price that includes payment for technology.

There are other costs, which cannot be recorded but which occur in many cases:

(a) Limitations imposed in licence agreements

(b) Transfer of wrong or inappropriate technology

(c) Delays in transfer

(d) Non-completion of the "transfer" process

(e) The importation of techniques and technical knowledge which do not encourage the formation of a national policy for the promotion of the country's technological capacity.

Technology that is transferred takes various forms which can be classified as follows:

(a) The distribution of books, publications, periodicals, documents, reports, etc.

(b) Professional training and teaching

(c) The exchange of information and personnel under technical co-operation programmes

(d) Consultancy agreements and the employment of foreign experts

(e) The exchange of machinery and related documentation

(f) Licensing agreements on manufacturing processes, patents, etc.

(g) Direct foreign investment

In line with what has already been said, each of these forms of the transfer of technology has a cost which can be either explicit or implicit; in actual fact there is a blend between factors so that the rigid classification given loses its validity and various intermediate forms appear.

In the present century, we are witnessing a real flood of changes. Initially, production was influenced mainly by the factors of capital and labour but today, in the last quarter of the century, technological innovations and education have taken pride of place.

Technological innovations take various forms which materially affect the possibilities for their use.

As invention patents and in other legal forms, technologies are protected for certain periods of time, and constitute industrial property over which the owner has full right of disposal and which he sells in the market.

However, in general, invention patents do not include all the essential technological information required to exploit the relevant innovation; a large proportion of the data that are essential for its use remains secret. This secret portion, which is also marketed, is referred to as "know-how" and plays a fundamental role in licensing agreements.

Finally, some technologies are freely available on the market and are accessible to all; this category consists of invention patents that have lapsed or have been abandoned, former trade secrets that have leaked out or simply technology that from its origin remained in the public domain.

Technological innovation activity flourishes in some countries.

In the manufacturing sector, according to statistics, more than two-thirds of the annual increase in production in the United States of America comes from the introduction of new techniques; similarly, during the specific five-year period 1954-1959, the growth of the gross national product arising out of technological development was as follows in the countries indicated: Netherlands, 39 per cent; Germany, 53 per cent; France, 68 per cent; Belgium, 70 per cent; Italy, 72 per cent.

This is the result of the creation of technology through investment in research.

In a study by the Organization for Economic Co-operation and Development (OECD) covering the year 1967, it was stated that the United States of America spent 3.4 per cent of its gross domestic product on research, the United Kingdom 2.4 per cent, the Netherlands 2 per cent, Germany 1.5 per cent, Japan 1.5 per cent, Sweden 1.5 per cent, Belgium 1 per cent, Canada 1 per cent and Norway 1 per cent.

By comparison, the percentage of the gross national product spent on research in certain developing countries was as follows: Colombia, 0.4 per cent; Argentina, 0.3 per cent; Brazil, 0.2 per cent; Bolivia, 0.2 per cent; Venezuela, 0.2 per cent; Peru, 0.1 per cent.

The following figures for annual *per capita* investment in research and development give another very graphic comparison:

United States	US$110
Latin American countries	US$1

The few data provided are in my view sufficient to give a broad picture of the situation; this is aggravated by the fact that, according to available data, the developed countries spend between 12 per cent and 18 per cent of their gross national product (GNP) on promoting pure science, whereas the developing countries spend between 21 per cent and 32 per cent.

The technological gap between one group of countries and the other is obvious and, bearing in mind that those who invest more are also more developed, the differences are of such a proportion as to deserve attention.

I shall consider below some possible measures that suggest ways and means of reducing the gap and breaking down the almost impassable barrier that exists at present.

I have said that education fulfils just as important a function as technological innovation in the transfer of technology; that is so because technological innovation is the tangible and material expression of a process, whereas education is the human, living and creative element that gives the capacity to interpret what is made available, to commence production, to assimilate its very essence and finally to adapt to the environment technology that was previously unknown. The adaptation of technology closes a circle, ensuring the genuine transfer of technology, since it finally gives rise to a technological innovation which will then undoubtedly belong to the environment, as it will reflect conditions in that environment.

The all-round training of human beings is part of education and draws on three sources: teaching, the imparting of skills and information.

The three elements are important in order to reach higher levels of knowledge and human skills which give the qualification for more appropriate decisions.

Teaching and training lay the basis for operations in any given sector within the broader framework of economic activity.

Training in this sense cannot be restricted to the technical field but must include a considerable body of administrative, legal, commercial and financial knowledge, which is necessary for the purpose of deciding on action to be taken, and evaluating it.

Various proportions of these types of training will be required according as to whether the technology transferred is more or less dynamic in character, that is, whether it is characterized by a constant process of innovation and is generally more sophisticated (for example, electronics, etc.), so that a larger component of technical training is needed, or whether it is more static (for example, textiles, tanning, etc.), in which case the other components will predominate.

In a changing world, in which it is necessary to develop flexible and pragmatic criteria appropriate to situations which are in a constant state of flux, information comes to be of particular relevance - indeed, entrepreneurs have to be permanently information-minded.

Information and the service rendered by means of information must be given in rapid, precise and economic form, and an attempt should be made to foresee the needs of those who require it.

Information is found in free and protected form. Free information is available in books, reviews, leaflets, catalogues, etc., and national, regional and international agencies and centres have technological information networks. Here, reference should be made to the Industrial Information Service of UNIDO, which has organized a world network that gives undoubted service to the sector. In the Eastern Republic of Uruguay the technical administrative office of the National Committee for UNIDO (whose headquarters is in the Ministry of Industry and Energy) has taken on the duty of acting as correspondent to the UNIDO Information Service.

Information in the form which is generally restricted or protected as an industrial secret comes from the field of research; it belongs to whoever carried out the research and is exploited by him in his field of action.

The technological wealth that information can bring should be compiled rationally and processed by sectoral planning agencies competent in the matter so that its potential can be channelled into the entrepreneurial market. That would provide a use for capital that may be idle and employment for skilled and unskilled labour, vitalizing national economic activity and possibly generating more foreign exchange by means of the export of various items.

In selecting industries to be set up, it would be desirable to choose those that are best suited to the country's potential in the form of available primary resources and economic and social conditions.

Priority should be given to the processing of national raw materials, thus incorporating a maximum of value added in the product marketed.

We shall consider below possible sources of technology for the processing of such raw materials.

Also, a very careful analysis should be made, in the programme drawn up, of the degree of capital intensity of the enterprises to be established. Naturally, that will depend on the type of technology to be developed; in principle it is desirable that these technologies should have a large labour component.

The components mentioned will greatly affect the long-term results of the action to be taken since the distribution of the wealth generated will differ according to the origin of the capital used and the quantity of manpower employed.

According to this scheme, and under the system of free competition, it is left to the decision of private initiative to make investments. It is considered that even small investors would be attracted by the possibility of finding an adequate return in relation to the risk.

Furthermore, available manpower thus finds additional sources of employment in accordance with its special skills.

There will not necessarily be an inclination to adopt any one particular technology available in the programme but, irrespective of the element of voluntary choice, the very existence of the technology, on reliable and well-structured bases, would offer an important infrastructure for the sector.

It would also create a definite incentive in the existing training institutes to achieve the necessary individual training level so that knowledge can be applied in enterprises to be set up in the field in question.

It should be remembered that manpower needs would cover a wide range since specialists would be required in various branches, not only to carry on the work of each enterprise, as has been said, but also, and more important, to evaluate future technologies to be developed.

It is at the moment hard to imagine industrialization in a developing country without the importation of foreign technology, and the scheme proposed gives grounds for assuming that some of it will find acceptance provided that there is an appropriate technical infrastructure capable of appreciating, assimilating and adapting to the environment the technology to be introduced.

The programme entails a cost-benefit equation according to which a favourable return may be yielded in the long term; of course, as in all human activity, there is an element of risk, benefits being in proportion to that risk. It is not expected that risks will be disproportionate and, on the other hand, one benefit assured is the development of conditions for existence and growing self-confidence as a foundation for the future.

The technologies to be imported may come from various sources. As we have said, those that are directly relevant to the raw materials of the country will deserve priority attention, but others that can be imported under temporary admission systems leading to the export of finished products should not be discarded.

Free technology includes invention patents which have lapsed or have been abandoned and thus belong to the public domain. Such technology is available throughout the world and would only have to be systematically collected to make it available to any person who wished to develop it by adapting it to the environment.

Progressively, the developed countries are orienting their activities towards more complicated technology with a larger capital component, replacing natural raw materials by synthetics and finally also abandoning technologies which involve an expensive manpower component. Consequently the latter activities are supplanted and then finally forgotten. These technologies also can be incorporated in the developing environment.

There are also technologies that have been discovered in unfavourable circumstances (through lack of raw materials, etc.) and for that reason have not found their true home.

Consideration can also be given to technologies which are protected legally (by invention patents, etc.) or are trade secrets, in which case they must be acquired by means of appropriate agreements.

In the transaction involved, it is possible to act freely in defence of one's own interests and in an entrepreneurial spirit of competition, trusting in one's own resources.

It is necessary to compare relevant information, which must always be available to parties to the agreement since there must always be awareness of universal trends in the subject in question, regional conditions, the state of the corresponding sector and the possible alternative technologies available in the sector.

The planning agency concerned will provide the necessary framework to ensure that the activity is carried out with the independence, ethical consciousness, funds, technical capacity and sense of social expediency that is appropriate in each circumstance.

The implementation of a programme such as the one proposed will require, on the one hand, joint action by national agencies and, on the other hand, co-operation agreements at the regional and world levels in which developed and developing countries will undertake joint commitments.

International organizations such as UNIDO could play a major role in the organization of such action.

It is necessary to fix very concrete and well-defined objectives and fields of action, which would be established, regulated and controlled by the national planning agency.

A scheme such as the one outlined would provide the developing countries with a new type of aid which would help them to develop a spirit of independence and to understand that they must seek the sources of authentic, self-sustained development through their own efforts.

Once the passive attitude that "All things come to him who waits" has been replaced by an aggressive attitude of self-help in a climate of universal co-operation, a way may be found to avoid the technological gap between the developed and the developing countries or to build a bridge that could provide a short-cut.

The developing countries are starting out from a different point of departure from the developed countries, and the means at their disposal also differ, so that they must use their own imagination and their own creative powers to generate their own form of development and, in it, new technologies that correspond to their needs and specific conditions.

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