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MAJOR PROBLEMS OF TRANSFER OF TECHNOLOGY IN RELATION TO THE ISLAMIC WORLD

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A brief review of the major problems involved in the transfer of technology from the developed to developing countries has been undertaken, especially with a view to examining prospects for speedy technological development in the latter countries. The economic and socio-economic issues involved in such transfer have been indicated. The situation obtaining in Islamic countries has been considered as a special case and the discussion has been concluded by suggesting a number of measures to effectively achieve the desirable objectives.

INTRODUCTION

Technology developed by man in different parts of the world, and at different stages of history, has played a vital role in socio-economic development of various nations and regions. However, in an overall perspective, it has always remained dynamic, both 'horizontally' and 'vertically', and, thus, no matter where developed and by whom, after due lapse of time, each technology has become the common heritage of man. The phenomenon of transfer of technology from developed countries to developing countries has assumed special significance over the last fifty years in view of the important objective of improving the quality of life in the latter countries, in order especially to feed, clothe, and provide other basic necessities to their teeming millions.

What is surprising, however, is that despite all this talk about transfer of technology and the consequent measures adopted, not only the economic but also the technological gap between the developed and the developing countries has appeared to be ever-widening, adversely affecting the lot of the less-developed. It is, therefore, highly important to analyse the causes for this and generate wider awareness of the same, in order to attract due attention to this phenomenon of high contemporary importance. Unfortunately, the issues involved range from socio-economic patterns and industrialization to development planning and policy options and, therefore, each discussion on the issue is likely to leave much to be desired; what is desirable is a continued evaluation as well as contribution from all concerned.

The present paper attempts to discuss briefly the important issues involved, with a view to highlighting the problems and difficulties being faced and indicating some suggestions for their solution. The situation with regard to the Islamic countries has been discussed in some detail as a special case.

PROBLEMS AND DIFFICULTIES

Import of Technology and Policy Options. A number of difficulties are being faced in the import of technology from the developed countries to the developing countries; the more important of these may be summarised as follows:

i. The donor country is in a stronger position in transfering what it agrees to, and withholding what it does not. This *limits the options* open to the recipient.

ii. The transfer is often expensive and tied to a number of conditions that favour the donor, e.g. essential employment of donor's inputs and experts, and restrictions on export of products. This, together with high costs for patent rights, etc., renders the enterprize extremely expensive.

iii. More especially, the technology offered is often out-dated, non-competetive and even already discarded in the donor countries.

iv. Likewise, some of the technologies offered are inefficient in terms of energy consumption, leading to high energy bills.

v. The recipient is often at a disadvantage in terms of adequate knowledge of the comparative merits of alternative choices available.

All these problems pose an immense challange to the recipients and are often difficult to surmount. Their solution partly lies in adequate policy decisions and partly in creating systematic infra-structures for comparison and selection, for which wide-based regional institutions would have to be established. The case for an Islamic Centre of Technology Transfer has been referred to later on, in this paper.

Socio-Economic Consequences. Experience has revealed wide-spread effects of import of technology on the existing socio-economic patterns, including the following further difficulties of serious nature:

vi. Mechanization gradually reduces use of man-power and often results in un-employment of labour rendered surplus.

vii. Import of new technology also often affects adversely the existing traditional industry, thus generating poverty in affected artisans/owners and upsetting cultural patterns [1–4].

viii. More especially, it leads to a surplus of agricultural labour in rural areas, which in turn results in migration to urban areas, creating several socio-economic problems.

ix. The imported technology, being expensive, is purchased in the private sector by those who can afford it. When it pays dividends, it enriches the buyers, thus benefiting the elite [2–4] and widening the gap with the poor.

x. Imported technology has resulted, in many cases, in environmental pollution and damages to the ecological balance.

These difficulties reveal the importance of paying due consideration to possible socio-economic consequences while making decisions for the import of a particular technology. More especially, adequate planning must be undertaken in time so as to employ the labour expected to be rendered surplus by the new technology. Where this is not possible, emphasis should be laid on importing such technology as increases production, improves quality and reduces costs, but is still labour-intensive. Other possible effects upon social and moral structure should also be kept in view.

Assimilation and Generation of Technology. Experience of the past several decades has revealed the following:

xi. Leaving aside the "embodied" technology, the transfer of the "packaged" and even the "un-packaged" technology does not involve the transfer of complete technical knowledge [5,6]. The machinery and the particular patent details are transferred but it does not enable the recipient to develop such plants/processes by itself, and there is little or no real change in the technological level of the recipient [6].

xii. Particularly, the recipient remains dependent upon the donor for import of spares, additional units for balancing and trouble-shooting.

xiii. Meanwhile, further improved technology is developed in the donor countries, which renders obsolete the technology imported earlier. The improved know-how has to be re-imported a second time and the process continues. This, instead of an actual transfer of technology, results in perpetuation of dependence on the donor countries.

xiv. The import of technology very often suppresses, rather than develops, the growth of indigenous R&D. The technology developed by local S&T institutions is at a serious disadvantage, as its credibility is not yet established, and very often it has not been demonstrated on a large pilot-plant scale, what to talk of a commercial scale.

xv. One major reason for lack of assimilation of the imported technology has been identified in most cases as unavailability or shortage of trained manpower, both at the professional and the technician level.

A consideration of this class of problems would reveal that most of these can be effectively overcome through proper planning and management. Firstly, an effective programme of man-power training, both at the professional and technician level, is called for. Apart from creating institutional frame-work and drawing projections of trained manpower requirements, an important short-term measure to be adopted is to make necessary arrangements in each transfer deal for training of professional and technical manpower, right at the time of initiating the project. Secondly, suitable arrangements would have to be made for R&D activity in each individual case for undertaking modification and further development of the imported technology. This would ensure competetive production at the international level, generation of further improved technology and significant reduction in re-import of similarly improved technology in future. A most appropriate example has been provided by Japan, which spends 4 Yens on such R&D work, related to modification and improvement, for each Yen spent on the import of technology [7]. By comparison, such R&D expenditure in most developing countries is almost nil. This may be identified as one of the major reasons enabling Japan to make a breakthrough in the development of technology.

Low Technology versus High Technology. Adverse socio-economic consequences of high technology as reviewed above, and inadequate assimilation of technology in several cases leading to the ever-widening economic and technical gap, have given rise to the concept of technology 'Failure'. This has resulted in alternative approaches for technological development in the developing countries. These alternatives have been named as "Appropriate" technology, 'Intermediate' technology, etc. Considerable effort has been made to undertake a number of such projects in several countries. The approach has met some success, particularly in rural areas, but a number of difficulties have been experienced and observations made, which may be summarised as follows:

xvi. Whereas the intermediate or appropriate technology approach has its uses in several areas, its impact on a country's overall economic development is often insignificant.

xvii. The approach diverts attention from the rapid pace of technological and economic development and is of little or no use, even of negative effect, in bridging the ever-widening gap between the

developed and the developing [8].

The last point has been made most vocally in a recent book by Arghiri Emmanual [8], an inhabitant of a developed country itself. The view expressed indicates that this approach is an attempt to frustrate the developing countries' efforts to join the mainstream of technological development. On the other hand, the developing countries ought to acquire the most up-to-date technology for rapid development. The author has suggested to the developing countries: *Burn the development stages* and *leap-frog* over 150 years of technical progress into the world of western high technology (Italics: author's). The book has been severely critised by the advocates of the appropriate/intermediate school, but a *useful compromise* has been suggested: import selected technologies and simultaneously take positive measures to promote local technology [9]; this may be well worth trying, especially in Muslim countries.

An analysis of the different factors related to the above dichotomy would reveal that two different development objectives are involved:

(a) Development of technology to increase production, improve quality, reduce costs, etc., with a view to generating employment (rather than reducing use of human labour) and in consonance with the traditional and socio-economic patterns of the country. This advocates development of local, appropriate/intermediate technology.

(b) Deliberate push to reduce technological and economic gap with the developed world, in order to minimise trade imbalances and eliminate perpetual technology dependence on the developed world: This advocates import of high technology in selected areas – (thrust areas) and building necessary technological and R&D infra-structure with special reference to these thrust areas.

Both of these objectives are equally important and the compromise approach indicated is to give *due importance to both*. It may be pointed out that several new technological developments of great import are taking place in the developed world. These are likely to cause significant socio-economic changes in the near future and further aggravate the economic imbalance between the developing and the developed countries. It would, therefore, be unwise to avoid totally the acquisition of high technology. This question has been reverted to in the next section.

THE CASE OF THE ISLAMIC WORLD

The second half of the 20th century has witnessed the growth of several regional and other organisations of countries with common interests. In the Islamic world, the Organization of Islamic Conference was established in 1969 and it has since created a number of cooperative bodies for development, including the Islamic Foundation for Science, Technology and Development (IFSTAD) and the Islamic Bank.

The significant factors with regard to technology transfer in the case of Islamic countries may be summarised below:

1. Barring a few gaps, the 46 member/observer states (and even the non-member Muslim majority areas) lie in a geographical contiguity from North-West Africa to Indonesia: hence there exists the possibility of joint ventures as well as distribution of benefits among the neighbouring countries.
2. A large number of raw materials, ranging from cotton and jute to fossil fuel and minerals, are available within the Islamic World: hence the possibility of acquisition of technology based on a wide variety of raw materials.
3. Taken individually, there is a serious shortage of trained personnel in the different member states. But when looked at collectively, a sizeable number of trained personnel both at the professional and the technician level are available within the Islamic World. A large number of these are working in other foreign countries, but can be got back, by providing them with necessary incentives, to meet the requirements of the Muslim World.
4. All the Muslim countries are identified as being developing countries. On an overall basis, less than 5 % of their income is from the industrial sector, and they are largely suppliers of raw materials to the developed countries, depending upon the latter for manufactured goods, received at the cost of a trade deficit. Taken individually, they do not have the necessary resources to alter this situation, but with collective action, most technologies can be acquired on collaborative basis, to increase the component of industrial sector to their income.

The infra-structure for a *systemetic* technology transfer to the Islamic World can be constructed on the following lines:

A. *Islamic Centre for Technology Transfer.* The establishment of such a centre is the first step towards the process. The concept was discussed and agreed upon, in principle, at the first meeting of the OIC Standing Committee on Science and Technology held at Islamabad in May, 1983 [10], where the Islamabad Declaration on Science & Technology was adopted. In addition to several other necessary functions, the two vital functions of this Centre should be:

i. Collection of necessary information and data on the availability of various technologies throughout the world, followed by comparative studies on each of them in respect of all relevant technical, financial and other aspects.

ii. Preparation of feasibility studies on transfer of

technology in all major sectors for individual member countries as well as for joint ventures.

B. *Indigineous R&D Base.* An effective transfer of technology is not possible unless a viable indigenous R&D base already exists for R&D in the country. Apart from the basic role of local R&D institutions in exploiting indigenous raw materials, improving local technology level, meeting day-to-day technological requirements of the local industry, evolving technologies commensurate with the local socio-economic conditions, the specific role of the local R&D base with respect to technology transfer may be identified as follows:

i. To keep abreast of the technological innovation in the world, so as to be able to advise the government/industry on the choice of most suitable proposals.
ii. To undertake in-depth studies on the local resources, with a view to recognising genuine needs for both local R&D investigations and technology imports for an accelerated pace of development.
iii. To be able to fully unpack the imported technology, to assimilate and adapt it to local environment and to modify and improve it, in order to avoid re-import of similar technology in the future.

The above would indicate the crucial importance of establishing/strengthening of a local R&D base and the provision of necessary funds and facilities for the purpose.

C. *Traning of S & T Manpower.* History bears evidence to the fact that the overall development of a nation is directly proportional to the general level of education obtained in the country, together with its necessary orientation to science and technology. Both the assimilation of imported technology and the development of a viable indigenous R&D base are closely linked with the acquisition of scientific and technological knowledge. Systemetic planning, both in the educational and scientific sectors, is the only key to ensure adequate S&T training, ranging from technical skills to most advanced professional competency. The first meeting of the O.I.C. Standing Committee on S&T has already recommended institutional frame work for training on collaborative basis [10]. In relation to technology transfer, the following points may specially be kept in view:

i. Planning for adequate manpower training should closely correspond to the present and future requirements of the scientific, technological, industrial, agricultural and other sectors.
ii. In industrially advanced countries, such as the USA, W. Germany and Japan, more than 60 % of scientists and technologists are engaged in the industrial sector itself [11], while, by comparison, the number is almost nil in several developing countries. This should be given due attention and, to start with, a sizeable proportion of the scientists and technologists working in the state-sponsored institutions should be integrated with the relevant industrial concerns.
iii. As pointed out earlier, each deal for technology transfer should provide for necessary training of local professional and technical staff right in earnest.

D. *Islamic Centre for High/Frontier Technologies.* The historical fact that the development of new technologies by different nations/regions has enabled them to march ahead of others and possibly dominate the latter in various ways can hardly be denied. The development of a few significant new technologies in the near future can drastically widen the already existing gap between the developed and the developing. The only way to keep pace with the world is to keep abreast of technologies in the offing and take necessary measures right in time. This is a gigantic task and it is not possible for *individual* Muslim states to afford to undertake it [10]. To-day, new avenues of far-reaching consequence, such as Biotechnology, Micro-processors, Space Technology and Laser Technology, are opening up that are expected to tremendously alter the present state of affairs in favour of the developed world. It is, therefore, not possible to ignore such developments any longer.

In view of the above, the establishment of a special organisation for high/frontier technologies is urgently called for. The organisation would keep abreast of all emerging and future sciences and technologies and prepare proposals for establishment of specific institutes for individual technologies. These institutes would be established at different suitable places in the Islamic World, and financed by such organisations as the Islamic Bank, IFSTAD, and several collaborating Islamic Countries.

CONCLUSIONS AND SUGGESTIONS

A large number of problems are involved in the acquisition of technology for economic development. These problems may have serious dimensions for individual countries. Fortunately, however, the establishment of the Organisation of Islamic Conference, together with its various organs, can be of immense use in systemetically overcoming a large part of these difficulties. Adequate planning, followed by effective implementation both at the country-wise and the Ummah levels, is the key to a meaningful technology transfer, leading eventually to technological independence.

On the basis of the above review, the following suggestions are made.

1. With a view to enhancing the pace of positive technology-transfer to the Islamic World, the proposed Islamic Centre for Technology Transfer should be established without further loss of time.
2. The centre should collect necessary data on world-wide basis on all prospective technologies for import, prepare comparative statements on all essential aspects and undertake feasibility studies for specific projects on behalf of individual Islamic countries or for joint ventures.
3. Apart from economic issues involved in various proposals, the socio-economic effects should be estimated in each case, particularly with regard to large-scale replacement of human labour by machines and, if necessary, rehabilitation programmes should be undertaken in right earnest.
4. Institutional arrangements may be made, both at the national and Ummah-level, to train manpower, both professional and technician, to meet the short and long-term requirements.
5. To ensure a real transfer of technology and to eliminate repeated import of improved technology, local R&D institutes should be integrated with each project to undertake necessary work on assimilation, modification and improvement of the process. Also, in each deal, provision should be made to train local personnel at the professional and the technician level right at the time of initiation of a project.
6. Indigenous R&D systems should be adequately developed to undertake the above work and necessary funds may be provided for the purpose, so that, for each dollar spent on the import of technology, at least an equivalent amount is spent on R&D aimed at its assimilation, modification and improvement.
7. The following two development objectives involved in technology transfer should be identified clearly and given due weight in their own right: (a) To import suitable technology for increasing production, improving quality, reducing costs, etc., in accordance with the socio-economic conditions obtaining in the country and (b) To import technology to bridge the ever-widening technological gap between the developed and under-developed countries and to reduce the perpetual technological dependence on the former.
8. The objective of bridging the technological gap and reducing the perpetual dependence can best be realised and attained on a collective basis. For this an Islamic Centre for High/Frontier Technologies should be established at the earliest, which should keep abreast of the latest and future developments in high technology and help establish Institutes for specific technologies at the *Ummah* level.

REFERENCES

1. M.K. Garg and R. Burne, *Project Report Serier No. 1,* (Appropriate Technology Development Association, Lucknow, 1978).
2. M. Perelmen, *Farming for Profit in a Hungry World (Landmark Series,* 1977), p. 148.
3. P. Alexander, *Transcripts on the Political Economy of Development* (Australian Broadcasting Commission, Sydney, 1977), p. 140.
4. M. Howest, *Knowledge and Power: The Transfer and Exploitation of Technology in a Rural Area in Thailand* (Ph.D. thesis, University of Sussex, 1977).
5. United Nations, *Handbook on the Acquisition of Technology by Developing Countries* – (UNCTAD/TT/AS, U.N., New York, 1978), p. 4.
6. R.M. Bell and S.C. Hill, *Paradigms in Practice: Innovation and Technology Transfer Models* in G. McKerron (editor), *Readings on Science Policy* (John Wiley, London, 1978).
7. A. Rahman and S. Hill, *Science, Technology and Development in Asia and the Pacific, Progress Report 1978-1980* (UNESCO, SC. 82/CASTASIA II/Ref I, 1982), p. 51.
8. A. Emmanuel, *Appropriate or Undeveloped Technology* (University of Paris, 1982).
9. M.E. Hartado, Sc. Tech & Dev., 2, 44 (1983).
10. Ministry of Science & Technology, Pakistan, *Proceedings of the First Meeting of O.I.C. Ministerial Committee on Scientific Cooperation,* 10–13 May, 1983 (Ministry of Science & Technology, Government of Pakistan, Islamabad, 1983), p. 19.
11. Anonymous, *Science Resources Newsletter* (OECD/DSTI, NO. 1, PARIS, 1976).