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TECHNOLOGY AND PROBLEMS OF SELF-RELIANCE IN BANGLADESH

INTRODUCTON

Recent debates and analyses have demonstrated that "technology" is the engine for growth–even more so than capital. Several empirical studies in the recent past have suggested that technological innovation and advances in knowledge have accounted for as much as half of the increase in national output in major developed countries. Many attempts have been made to assess the specific contribution by technology. According to one analysis over 87% of productivity growth is linked with improvements in technology, while another estimates it to be 30% to 56%. In the case of Japan, it has been estimated that nearly 29% of growth in the manufacturing industry (overall) between 1955 and 1979 could be attributed to technological innovation. It has also been predicted that in this decade technological progress could be expected to contribute as much as 65% to the economic growth of Japan. It also appears that in developing countries productivity increases through application of technological innovations have come about more frequently as a result of deliberate investments and intervention for transfer of technology than in response to invisible market forces.

When the Third World countries started to become independent after World War II, there was a general belief that the cause of under-development was the kind or nature of Govern-

ment in a country. It was perhaps hoped that economic development would be ensured by the installation of the right kind ot government. However, it has been lately realized that the developing countries are in fact "technologically less developed", even though some may be highly developed in the areas of arts, culture, philosophy and so on, and may possess an enormous amount of natural resources. While no one disputes the need for an effective government, the fundamental requirement for the economy of a developing country to move forward is the successful transfer and development of modern technology. Technology has emerged as the major criterion for measuring economic development. More importantly, it has also been observed that investment per se does not necessarily result in transfer of technology.

TECHNOLOGICAL UNDER-DEVELOPMENT

Viewed in the above context, the use of per capita income can be considered inadequate as an indicator of national development. There are quite a few countries which have attained high income through the export of naturally available resources, and are not considered as developed. Moreover, it can be observed that, most developing countries may be rich in many ways (such as : in terms of resources, culture, etc.) they are indeed very poor in terms of technology. Thus, it is possible to argue that the major differences between the developed and developing countries is their relative strength with respect to technology. Developing countries are in fact technologically underdeveloped.

Technological underdevelopment stems from the reality that the developing countries are, in general, weak and dependent on external sources for the major elements or building blocks which are essential for development, viz.,

- Quality or facilities for production (Technoware)
- Technical abilities and skills of the people (Humanware)
- Extent and utility of available knowledge (Inforware)
- Effectiveness of existing organization and management (Orgaware)

In many developing countries "Technology" is most commonly perceived to be only the physical means or as "black box" used for production. As such, the importance of the related skills, information and management are often not realized. Therefore, to facilitate a thorough understanding and for effective transfer of technology, consideration of all components of the technology "black box" should be useful.

It is important to note that all four components of technology are complementary to one another and are required simultaneously for any production activity. The inherited weaknesses and consequent external dependence in all the components (or building blocks) appear to set in motion four corresponding vicious circles in developing countries which result in the overall vicious circle of technological underdevelopment.

The vicious circles of technological underdevelopment shown in Figure 1 are not intended to lead one to accept technological underdevelopment as predestined. On the contrary, it clearly reveals the areas in each one of the vicious circles where policy interventions can set in motion reversal of trends which can change them into spirals of development. There has to be intervention in each of the four areas and the specific point of intervention will depend on the strategy adopted by a country based on its own judgement. This is clearly borne out by the recent successes of some of the newly industrialized countries where the vicious circle has been broken.

CRITICAL PROBLEMS AND ISSUES IN BANGLADESH

Technology is now injected into the Bangladesh economy by public and private enterprises. They buy fully developed plants

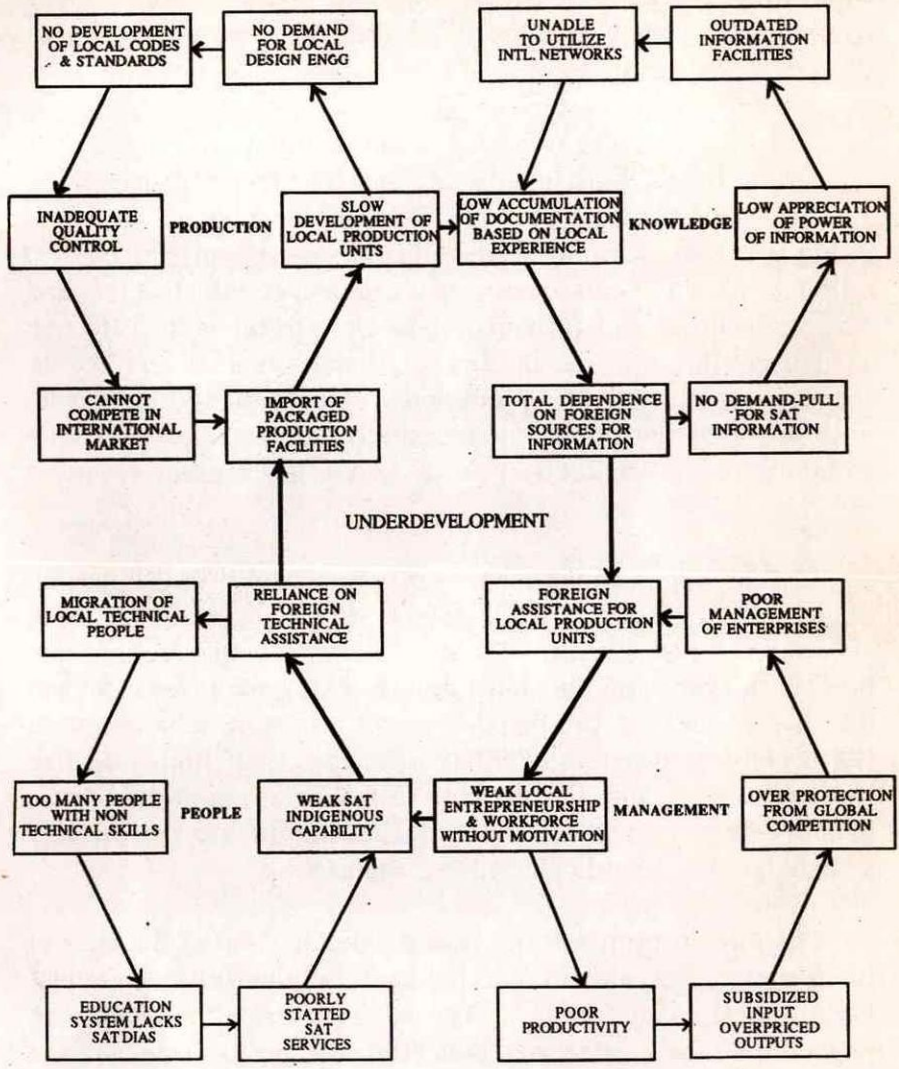

Fig. 1. Vicious circles of technological underdevelopment.

with mature technology (on a turn-key basis). These plants are constructed and their personnel trained for operation by the plant seller. Under these circumstances the enterprises do not rely on

supporting research services from the country. Because of overprotection. many of these firms are inefficient and yet some of them make profit.

The instruments of policy the country has used for industrialization consist mainly of fiscal and financial incentives. The New Industrial Policy of 1982 and the revised Industrial Policy of 1986 simplified import and investment procedures; introduced a significant degree of liberalization, privatization, and decentralization; and provided about 30 percent more effective assistance through fiscal, financial and other incentives to industrial investiment and producton. Yet, according to an indepth assessment of the impact of industrial policies at the Planning Commission, entrepreneurs have failed to respond to these policies.

Various explanations have been advanced for the stagnation of industrialization in this contry. Some of them mistake symptoms for real causes. When economic considerations are brought to bear upon the stated causes of sluggish investment and thereby hidden costs are bared, two root causes of most industrial ills become transparent: (1) The side effects of high effective assistance have caused more harm to industrialization than direct benefits, if any, and (2) the critical factor of growth, namely technology, has been neglected in Bangladesh.

The former result follows from the deceleration of the rates of investment, decline in total factor productivity, stagnant industrialization, and so forth. For the latter result, the analysis of technology was carried out both from the results side and the source side. From the results side, it was found that not only the levels of Bangladesh's productivity and technology are lower than those prevailing in its neighbouring countries, e.g., Thailand and India, but relative rates of growth of productivity in numerous industries are also lagging behind. The productivity gap is

increasing and Bangladesh is losing in international competitiveness in shrimp, fruit juices, textiles, sugar, coir, hospital services, communications, and so forth.

On the source(input) side of technology Bangladesh lags far behind in research and development (R & D) as a percentage of GDP, ratio of science and technology (S & T) personnel with postgraduate degrees to total S & T personnel, fiscal and financial support for technology, organization and institutes of technology transfer (from abroad), indigenous technology generation, creation and levels of diffusion of industrial innovations, development and standardization of spare parts and other equipments, advances and effort in various technology areas, and so forth.

Investments in R & D are regarded as consumption and hence receives low priority in budgetary allocation by government as well as industry. The Government does not have the time and capacity to assess the economic implications of R & D work. Demand for locally developed technology does not exist in domestic industry. Industry can avoid R & D expenditure due to over-protection and lack of market competition. Technologies transferred by multinational companies do not always meet the needs and objectves, or use the existing capabilities and resources in the developing countries.

Before liberation of Bangladesh only about 0.13% of the GNP used to be spent for R & D activities in the country. In recent years the investment has increased to about 0.2% only. In view of the extremely low level of GNP, in absolute figures the investment is rather insignificant. Case studies of some of the major research and development institutes (RDI's) in the country reveal that in their respective revenue budgets the funds kept for R & D project activities varied from 9% to 15%. For the industries sector the

allocation in the annual development plans for activities related to R & D, Design Engineering, Technology Treansfer, Training etc., has been quite small. Following table (Table 1) shows such investment allocations in R & D during two Five Year Plan periods (1980-88).

Table 1 : Investment allocations in R & D in the industrial sector of Bangladesh

Year	R & D as % of ADP	R & D as % of Expenditure	R & D as % of GDP (Industry Sector)
1980-81	0.10	0.20	0.03
1981-82	0.33	0.50	0.07
1982-83	0.06	0.17	0.02
1983-84	0.66	0.70	0.08
1984-85	0.81	1.06	0.08
1985-86	0.88	1.03	0.12
1986-87	0.79	0.89	0.14
1987-88	0.92	1.08	0.10

Source : Institute of Appropriate Technology (IAT), Bangladesh University of Engineering and Technology (BUET).

GOVERNMENT INTERVENTION AND INSTITUTIONAL REQUIREMENTS

Most developing countries have chosen to implement their plans through a mix of investment allocations and guiding policy instruments. The methods/mechanisms of formulation of such instruments vary considerably and essentially depends on the forms of government, socio-cultural traits and the political environments existing in specific situations. However, one can

observe several common traits and commonality of objectives among such instruments even if they have been introduced and implemented by different forms of government at different times.

The rationale for government intervention in national technology based development efforts can be summarized as follows :

— Inability of private sector to appropriate adequate share of total gains for such efforts.

— Imperfections in capital markets, which precludes automatic provision for bringing about technological changes.

— Inadequacy of market mechanism to coordinate and direct large scale cross sectoral development initiatives.

— Social failures in the dissemination of desired level and intensity of scientific and technological information.

Additionally, some form of central direction is necessary because:

— Human Resource Development and building of technological capability can only be viewed from a country wide perspective.

— Strategic macro level implications of international trade need to be appreciated centrally.

Creation of appropriate climate for technology is one of the principal prerequisites for technology based development. In addition to the conventional ministries, government departments and agencies, some special efforts and institutional initiatives are called for if creation of proper technology climate is to be aimed at in a country. Table 2 lists some of these special policy measures which constitute essential ingredients for the government intervention process alluded to earlier. It may be observed from

Table 2 that existence of all the ingredients is not universal in the Asia-Pacific region. Only those countries with success records in technology based development effort appear to have instituted all the policy measures deemed essential for the purpose stated above. Such policy measures lead to formulation of appropriate policy instruments.

Policy instruments are modes of pormotion and control affecting other policies, dealing with goals and programmes in many areas, making use of a variety of intervention mechanisms, operating through many departments of government, and influencing the activities of a wide variety of government and non-government institutions.

Policy instruments, once formulated, need a vehicle or an organizational set-up to operate it. The institutional set-up for explicit instruments is usually housed in government departments directly concerned with technology development like the Ministries of S & T, Industry, Agriculture, Energy, etc. However, the implicit ones are usually administered by institutions and organizations far removed from those directly concerned with technology development such as the Ministries of Finance, Trade and Commerce, the Central Bank, Office of Import Control, and Development Finance Institutions. In many ways, they can also operate explicit policy instruments to promote certain technology development initiatives.

TOWARDS TECHNOLOGY BASED PLANNING

With the acceptance of technology as an important strategic variable in development the need emerges for establishing modalities and procedures for the critical process of integration of technological considerations in national planning. Obviously, depending on the government policy planning practices and preferences, such modalities and procedures will vary. However,

Table 2 : Special Measures for Creation of Policy Environment in Technology-Based Planning Regime

Policy Measures/ Institutional	Nature and Purpose	Intended Role	Examples in the Asia-Pacific Region*
National Science and Technology Policy	Declaration of national goals and objectives in the development of S & T in the country	Formal declaration of intent	Present in almost all the countries
National Councils for Science and Technology	High level policy making body	National policy Making and Advisory	Established in almost all the countries
Councils for Technology specific Development	Expert level body with participation from business and industry	Advisory and Policy Review	Present only in some countries notably, Japan, India, China, Korea
Ministry of Science and Technology/ Division of S & T	Usually oversees some selected research laboratories, can act as secretariat to NCST, authority may not extend to R & D in other Ministries	Formulation and review of Programmes and Policies and R & D institutes under the Ministry	Exist in almost all the countries
Special purpose ministry for technology based development and integrated planning	Cross sectoral responsibility and authority to oversee both the supply and demand side of technology; involvement of business and industry	Formulation and review of cross sectoral programmes for technology and trade in technology	Ministry of International Trade & (MITI) in Japan. Recently established in Korea and Malaysia.

* Many of the countries in the region have recently adopted similar policy measures. Since, according to APCIT country studies, some of these are operating at subcritical level they have been excluded.

Table 2 : contd.

Policy Measures/ Institutional	Nature and Purpose	Intended Role	Examples in the Asia-Pacific Region*
Intermediary agents for technology development for all four components	Absorption adaptation, improvement of imported technology and innovation of products for international trade	Highly mission oriented R & D Inforware and Humanware development	AIST of MITI in Japan, KIST/KAIS in Korea
Public funded research laboratories	S & T research in various fields	Development of new process and products	Exists in about all the countries (CSIR)
Technology development finance institutions, research development institutions	Financing of commercialization of locally developed process	Promotional, entrepreneurial	Present in Japan, Korea, India, China
National recognition and certification agencies for highly skilled technicians	Social and national recognition of skilled technician and equating them with professionals in terms of prestige and emoluments	Skill enrichment and moulding value system	Present in Japan and Korea, to a lesser extent in China
National technology transfer regulatory bodies	Formulation of techno-economic basis and legal instruments for importation of technology	Promotional, strengthening of terms of trade	Have been or being established in almost all the countries
S & D popularization programmes	Dissemination of S & T inforware and use of media for public exposition of role of S & T	Promotional	Present in all the countries but intensity and coverage vary considerably

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there are certain features in such procedures which remain common to all situations. These elements include, inter alia, planning mechanisms of different agencies at various levels, institutional arrangements for technology assessment procedures, the policy instruments formulated from time to time, the operational linkages necessary for plan implementation and the monitoring and review mechanisms at various levels. These elements may cut across several policy areas and involve several ministries and departments.

SOME BASIC STEPS IN INTEGRATED PLANNING

The integration of technological considerations during the national planning process can be viewed to take place involving certain basic steps, viz.,

- Establishment of a Vision and Development Goals.
- Building a scenario in the form of long term Perspective Plan which identfifies certain strategic areas for development.
- Acceptance of Technology as an important Strategic Variable.
- Classifying national development plans programmes and projects into three technology domains, viz., Importing Technology Domain, Evolving Technology Domain and the Exporting Technology Domain.
- Establishment of public as well as private sector assessment mechanism at appropriate functional levels.
- Clear identification of the technological gaps and opportunities based on above analysis and prioritization of remedial measures based on overall development goals.

- Introduction of governmental intervention mechanisms in the form of legal, fiscal and financial policy instruments in order to bridge the identified gaps, explore the potential and promote development in the strategic areas taking into consideration all the four components of technology.
- Implementing investment decisions to bridge the gaps, explore the potential and promote development.
- Introduction of review, monitoring and feed back mechanisms at appropriate levels.

While looking at all the steps it should be obvious that the process of plan formulation, integration and implementation have been viewed essentially from the technocratic context for the present discussion. equity considerations, political overtones etc., remain important considerations but are beyond the scope of this analysis. Such considerations are integral part of all planning processes. In the present discussion the modalities of integrating the technological aspects for self-reliance is the princpal issue.

BASIC TECHNOLOGY MANAGEMENT AND DEVELOPMENT STRATEGY

Overall consideration of the options and opportunities available to late starters like Bangladesh in technology development reveals two basic strategic considerations in designing a frame-work for management of technology-based development :

- It is necessary to select and buy some mature technologies and digest these in the socio-economic milieu through an evolutionary learning - absorption process during technology transfer efforts.
- It is essential to attain the capability to make some technologies in the technology generation institutions so

that the country is in a position to trade in the international technology market.

The conjoint strategy, also known as the make-some-buy-some strategy, forms the basis of a working agenda for a country. It is important that parallel initiatives on both the fronts be taken. Pursuit of either option alone results in stunted technological growth. The two initiatives are mutually reinforcing and stand to gain from each other's innate dynamism.

National efforts for managing technology and capability building starts with the identification of national technological needs. This is followed by the decision making process by which the needs which are to be met by investment in imported technologies are separated from those for which technology generation capability exists within the country.

For importing technologies the country needs institutional framework for searching through the world technology and making proper technology assessment before investments are made. At present, both for public and private sector investments in Bangladesh import of technology in majority of cases takes place in a packaged form under turn-key contracts. In the public sector most of the projects are funded through external assistance agencies. Technological resources presently being imported are usually processed through a largely bureaucratic negotiating mechanism.

The corporations in the public sector do have local technical experts of long experience in relevant enterprisees. Lately these experts have been involved in evaluation of technology proposals. However, institutional arrangement to assess, adapt and absorb the technology are still in a rudimentary stage.

In has often been observed that mere transfer of hardware and service for installation and start up of an enterprise has satisfied

the investor with respect to technology transfer process during investment in an imported technology. In real sense this does not constitute any transfer of technology at all. More often, however, investors insist on transfer of skills for the operation, maintenence and trouble shooting of the physical plant. Such transfer still constitute a 'static' form of transfer of technology. The ideal would be 'dynamic' transfer where one obtains the knowledge, skills and experience to manipulate and change the production system and gains the capacity to innovate and thus continuously upgrade overall productivity and get most out of the investment.

The widespread belief that R & D is meant only for generating new knowledge is obviously a narrow one. For an importing country, the R & D infrastructure has to be productively deployed with the task of unpacking the technology. This can ensure gradual increase in productivity with an imported technology through an evolutionary process.

At this point, it is also worth mentioning that some developed countries invest $5 for $4 worth of imported technology in order to master it through a step-wise learning-absorption process. For imported technologies, the process consists of the following evolutionary steps :

- Maintenance
- Replication
- Adaptation
- Improvement
- Creation

At each step of the evolutionary process, the country is expected to achieve a certain level of human resource and skill

development activity of a certain level of technological sophistication.

Mastery of imported technology through the evolutionary process has been achieved by several erstwhile developing countries. This was accomplished by the augmentation of national technological capability through widespread knowledge assimilation and skill development programs, namely : universal literacy, technical and vocational training, management training, industrial and production engineering, product and process engineering, design engineering, information system development, consultancy services and strong R & D capability.

In present day Bangladesh, perhaps only the first two steps of the learning absorption process for imported technologies are being carried out to some degree, albeit, informally. There is an urgent need for investment in institutional arrangement which can help carry out the entire range of the evolutionary process.

It may be pointed out that in the process of "make-some" efforts national RDI's play the critical role. However in this country the status of research activities leaves much to be desired. Pilot plant and process development activities have not progressed in any big way. The Syndication process which involves, inter alia,

Engineering design,

Prototype development,

Testing and

Commercialization

have not been carried out in any organized manner. Thus, there is need for investments in institutional arrangements to promote and

undertake these activities in right earnest without further delay so that the investments made in imported technology have a high pay-off rate.

CONCLUDING REMARKS

(a) For Bangladesh, investment decisions for self-reliance need to consider efficient and dynamic transfer of technology as high priority activity. Investments per se do not automatically result in transfer of technology. Similarly, there has to be a recognition that technological innovations need allocation of resources and they are results of organized activities and not of random activities of "creative" individuals.

(b) Planning for transfer of technology in Bngladesh should initially involve planning for technological preparedness. The attitude for catching up and creating conditions for preparedness require technological awarness.

(c) Technology has to be understood in all its four forms or components, viz., Technoware, Humanware, Inforware and Orgaware. The existence of the vicious circles involving technological underdevelopment should not lead us to accept under development as predestined. On the contrary, it is possible to clearly identify the problems in each of the vicious circles where strategic investments can reverse the trends and change them into spirals of development. There has to be investment in each of the four components of technology. The specific point of intervention will depend on the strategy adopted by the country based on its own judgement. This is clearly borne out by the recent success of some of the newly industrialized countries where the vicious

circle of technological underdevelopment and poverty has been broken.

(d) Dynamic transfer of imported technology involves attaining capacity to maintain the facilities, developing skills to replicate technology when necessary (thus avoiding repetitive imports) and adapt technology to suit local conditions. It is now widely recognized that countries which have benefited from large scale investments in technology did not stop at its adaptation but went ahead and introduced improvements and were able to go for innovation and creation of new technologies. This process of successful absorption of imported technology was possible through the establishment of appropriate institutions for transfer and development of technology.

(e) The basic technology development strategy i.e. "make some-buy-some" strategy involves initiatives not only to generate new technology but also to go through a learning - absorption process to digest imported technology in order to gain the capacity to continuously upgrade productivity at the firm level through dynamic technology transfer (as opposed to the static form of transfer).

(f) Technology can be viewed as a new form of currency with which to trade in the international market. A country with a better technology has the natural advantage. On the other hand, a country without an indigenous technological capability or some unique advantage in some form of technology is in no position to bargain for the right price. Comparative resource advantage is not enough, in addition competitive technological advantage is essential for growth.

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