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INDUSTRIAL DEVELOPMENT AND TECHNOLOGY TRANSFER FOR BANGLADESH

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INDUSTRIAL DEVELOPMENT AND TECHNOLOGY TRANSFER FOR BANGLADESH

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INTRODUCTION

This work was undertaken for the Harvard Institute for International Development (HIID). Its project in Bangladesh is concerned with improving employment there and with other matters related to improving the welfare of the country's people.

The work is based on certain premises. One of the important premises is that industrial development needs to be accelerated in Bangladesh for the following reasons. Increased industrial development would provide more jobs and higher paying jobs for the people. This would provide more money for the people to buy the goods that are needed to improve their standard of living. Increased industrial development of certain industries would also produce more goods for export. This export trade would gain the currency needed to import goods required for increasing the standard of living of the people. This reasoning is summarized in Figure 1.

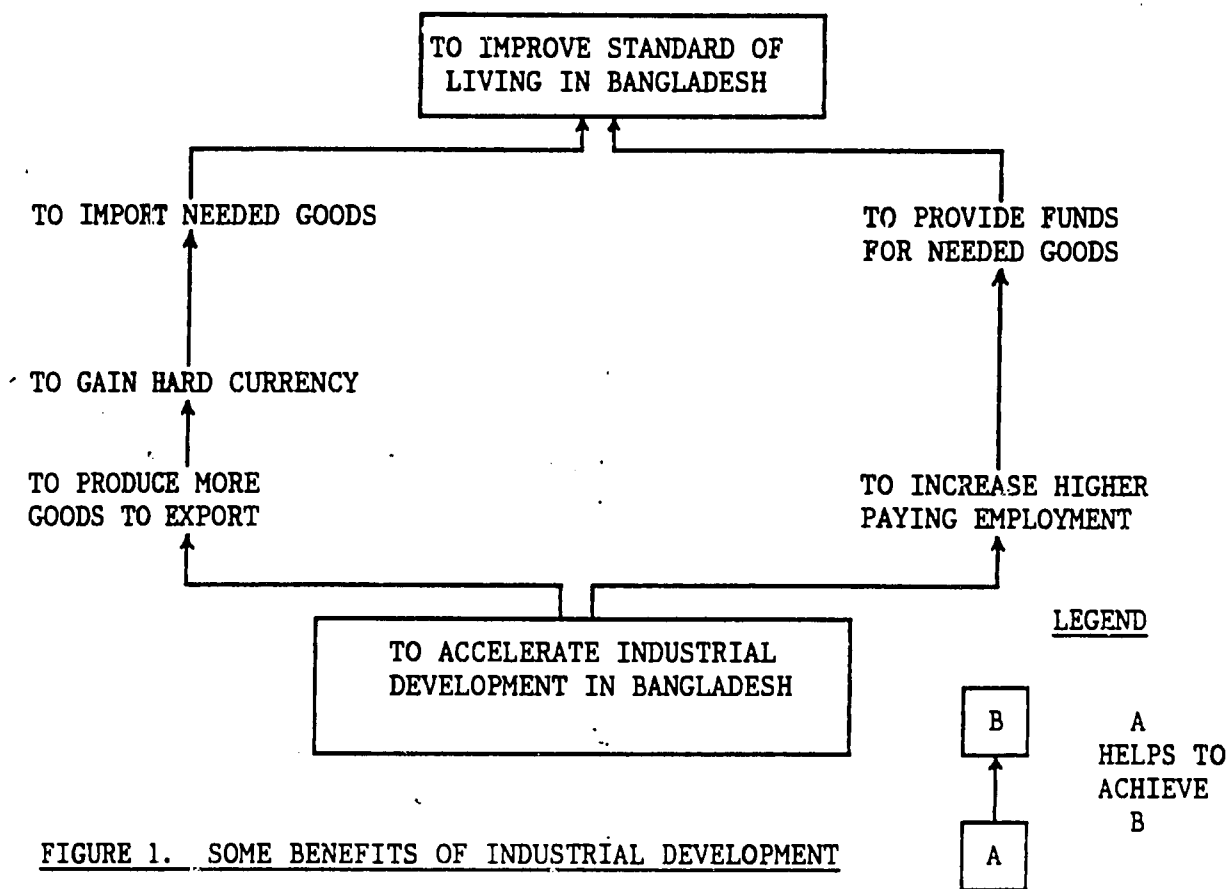


FIGURE 1. SOME BENEFITS OF INDUSTRIAL DEVELOPMENT

A second important premise is that industrial development in Bangladesh can be accelerated. To accomplish that, several facilitating factors need to be given attention. One would be the provision of better conditions for private investments to be attractive, e.g., reduction of inhibiting duties on machinery, increased control of smugglers, etc.. Another would be the provision of required infrastructure, e.g., a supply of electricity to manufacturers that does not fail, less seemingly capricious restrictions on gas supplies, etc.. A third facilitating factor that would help is more entrepreneurs. The provision of the first and second factors would encourage entrepreneurs, but in addition, better educational programs aimed at producing entrepreneurs would also help.

Although the three facilitating factors described above are very important, they are not the main focus of this work. A fourth factor is, namely, the provision of technology needed for industrial development.

To provide for industrial technology, human resources are needed. Of course these include scientists and engineers. But equally important are persons who are knowledgeable about market research. They are the ones who can obtain information about what technologies are needed to satisfy market opportunities. Engineers who are knowledgeable about industrial technology are also vitally important. Why? Because industrial development requires more than a report by a scientist about a new scientific principle. It requires putting principles to use. And engineers are trained for that.

To provide technology for industrial development requires information. One kind of information has been referred to above, i.e., market information. But other kinds of information are needed also. Patent disclosures might be one kind, technical books, another, and computer data bases, another. Without adequate information, time and money may be wasted developing something that has been developed already. To prevent that, technical journals and other sources of information need to be accessible.

To provide the technology needed for accelerated industrial development, modern laboratories with up to date equipment and computer facilities are also important. This requires appropriate software, calibration services, repair services, supplies, and maintenance to insure that the laboratories are useable.

In addition to what has been described above, a number of other requirements are needed. An important one is managers who are able to manage the development of technology for industrial development. Although there are short courses on engineering management or on management of technology that are offered occasionally in Bangladesh, the author looked for, but did not find, any

degree programs on these subjects. Moreover, no persons were identified who had majored in these areas in universities outside Bangladesh.

To provide all of the factors described above, Bangladesh needs to mount a national effort that will assure the technology needed for accelerated industrial development is provided. All of this is summarized in Figure 2.

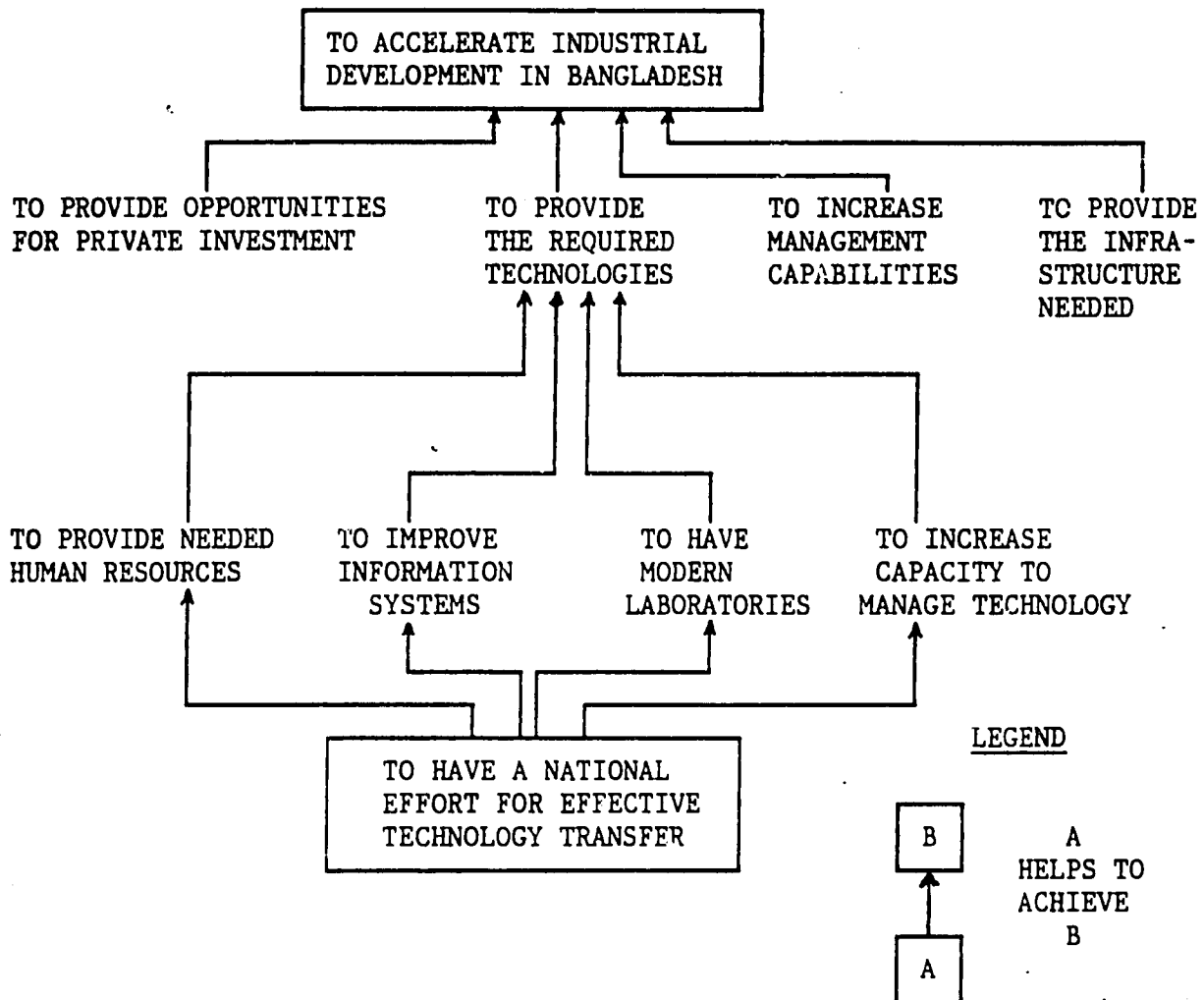


FIGURE 2. SOME FACTORS FOR FACILITATING INDUSTRIAL DEVELOPMENT

SOME REQUIREMENTS FOR INDUSTRIAL DEVELOPMENT

Market Research

One of the first requirements for industrial development is the decision on which industries to focus development efforts. Bangladesh cannot, of course, develop every industry. Consequently, it becomes important for the Planning Ministry and the Ministry of Industry, at least, to identify which industries will be given focused development assistance. In addition, other ministries may need to give support to the selected industries. Which ministries will be needed will depend on which industries are selected.

The purpose here is to consider what is required for industrial development after an industry is selected. Others have given attention to which industries should be developed. For example, a recent study by the Asian Development Bank* recommended three industrial subsectors. They are: 1) electrical and electronics subsector; 2) food processing subsector; and 3) small scale engineering industry. We assume in the following that the industry has been chosen for development by some means. Then the question is what kinds of market research information would help in the development of that chosen industry.

One kind of information would pertain to market opportunities in Bangladesh. For example, in the electrical and electronics subsector, maybe information on the sales of power transformers or of video cassette players might be useful. In addition to data on the most recent year's sales, trend data might also be useful.

* Mid-Term Technology Planning for Industrial Development of Bangladesh, Asian Development Bank, T.A. 1101, November 1989. (draft)

A second kind of information might pertain to the desires or the needs of Bangladeshi consumers for changes in existing products, processes, or services or for new products, processes, or services.

A third kind of information might be the assessment of the strengths and weaknesses of existing or potential Bangladeshi products compared to competing products made outside Bangladesh, e.g., comparing power transformers made in India with those made in Bangladesh.

A fourth kind of information might pertain to potential markets for the industry outside Bangladesh. These markets might be nearby, e.g. Burma, India, Nepal, etc., or farther away, e.g., Europe and North America.

A fifth kind of information, based in part on the results above, might be the conceptualization of modifications of existing products, processes, or services to gain increased market acceptance. Similarly, the conceptualization of new products, processes, or services could be important. In either case, the conceptualizations would be in terms of features or functions, not in terms of how to achieve the features or functions which is the responsibility of product development described in the next section.

A sixth kind of market information might pertain to pricing strategies. For example in certain cases, products, processes, or services would need to be priced to produce very low profits to gain market share. But in other cases, if the industry had an established position, prices could be set higher to produce higher profits.

A seventh kind of information might result from studies to test potential markets. The purpose would be to determine the likely success or failure of products, processes, or services. These might be existing ones to be sold in new markets. Or they could be new or modified products, processes, or services planned for existing markets or for new markets.

All of these kinds of information resulting from market research are important for helping to insure that the industries developed are successful.

Product Development

Product development is an important part of industrial development. (To save space we include in product development here the development of processes and services when they are developed to be sold to other firms. When processes and services are developed for the firm's own use, they are discussed separately later). How well products are developed can influence greatly the success or failure of an industry.

One of the functions related to market research that can be important for the development of products is the assessment of existing products made by competing companies outside Bangladesh. The assessment may be of the features or functions of the products. Or the assessment may be made to gain an understanding of how the functions are achieved, i.e. how the product is made. (This is sometimes called reverse engineering).

A second function is related to the fifth kind of information provided by market research, i.e., the conceptualization of new or modified products with market potential. In this case, the features or functions of the products have been conceived by market research, and products need to be developed that have the desired features or functions.

A third function, important in developing products, is testing to insure that the products will work in all the expected environments. For example, humidity in Bangladesh is more severe than in most places on earth. Humidity can cause corrosion, shorts in electrical products, fungus, etc. Products that can be affected adversely by humidity should be tested to insure that they will work successfully in the anticipated environments.

Another kind of testing of products may also be important. This kind is aimed at insuring that the product does not have any undesired consequences. An example would be the testing of pharmaceuticals. Another example would be the testing electrical products for possible lethal shocks, especially in Bangladesh where the user of the product might come in contact with water.

Another important consideration in developing products is determining what will be needed to produce them on a large scale. Some products that could be made in a controlled laboratory setting or even a pilot plant have been found impossible to produce on a large scale. Consequently, manufacturability or producibility should be considered when a product is being developed. This leads to the next section.

Process Development

We consider here processes used by the firm to produce its own products or services as contrasted with processes developed to be sold to others. An example might be, on the one hand, the development of software for controlling some manufacturing operation inside the firm. On the other hand, software might be developed to be sold to other firms in which case it is considered in the preceding section.

The layout of manufacturing plants and the organization of work are often important considerations in process development.

Control of raw materials inventories, work in process inventory, and finished goods inventory is another aspect of process development that may require attention.

Ergonomics or human factors engineering considerations may need to be involved in developing manufacturing processes.

The design, construction, and testing of pilot plants may be required in some industries.

Purchasing, receiving, testing, certifying, and installing manufacturing equipment are often involved in process development.

Once a firm is in operation, manufacturing processes may need to be modified or redesigned for several possible reasons. One might be to reduce costs. A second might be to improve the quality of the product. A third might be to improve working conditions for employees. A fourth might be to accommodate changes in the design of the product.

Production

After a product is developed and production processes are in place, attention turns to producing the product profitably. This requires a number of factors.

One is a qualified work force. This involves selection, orientation, training, and motivation of workers.

A second factor is the acquisition of the inputs required to produce the product. This involves purchasing, lines of credit or working capital, inventory control, etc..

A third factor is adjusting production to match demand. This requires market information such as demand forecasts or sales information.

A fourth is ensuring that operations are in compliance with relevant laws and regulations.

A fifth is ensuring that the product is produced with the quality required for the targeted markets.

A sixth is a continuing effort to control or to reduce the costs of production.

Sales and Distribution

For industrial development to succeed, there must be customers who are buying the products, processes, or services of the industry. This requires a number of functions to be developed and managed.

One of these is to develop some means for potential customers to become aware of the availability of the product, process, or service. This may be accomplished through advertisements in various media, through demonstrations at fairs, through word of mouth, through traveling sales persons, or through other channels. The important point is that customers won't buy products, processes, or services if they are not aware of their existence.

Awareness is a necessary condition for sales but not sufficient. Another necessary condition is the development of distribution channels through which the products can move from the production site to the customer's site. It is this function that the Japanese have managed so superbly and which accounts largely for their worldwide marketing success. The key was the development of the Japanese trading companies. If industries in Bangladesh are to succeed in markets outside Bangladesh, this function will need to be developed carefully and well.

To sell some products, processes, or services, direct contact with the potential customer/user may be required to communicate about the product, processes, or services and to learn about the customer's particular requirements and circumstances. This may involve demonstrations for and even training of the customer's employees in the use of the product, process, or services.

To insure that products, processes, or services provide the customer all the potential values in use, several other factors may need to be managed well. One is to insure that products are not damaged in shipment. A second is to ensure that products, processes, or services are installed properly. A third

is to ensure that the installations work, and if they don't, to determine why and correct the problems. A fifth factor is to ensure that qualified personnel and a supply of spare parts are available to make repairs.

Customer Service

Once a customer has purchased and is using a product, process, or service, it may be important to provide the customer with services to ensure that he continues to obtain value in use. One example of this is the after purchase services provided by makers of office copiers or their agents.

Customer services may be of several types. One might be to ensure a supply of consumables required for a product to continue functioning correctly.

A second would be to make periodic adjustments or calibrations required to get the best performance from the product, process, or service. And, when needed, a third service would be to provide or arrange for repairs.

For some products, process, or services, it may be desirable or necessary to instruct the customer's employees in the proper use of the product, process, or service. This kind of service has given IBM a competitive advantage for many years.

A fifth service for customers of some products, processes, or services is to modify the products, processes, or services after they have been in use for sometime. These modifications may be done to improve the capabilities of the products, processes, or services, to correct some recurring problems due to wear, poor design, poor operating procedures, etc., to enlarge capacities, or for other reasons.

Some of the major reasons for developing customer services well are to build customer loyalty, to achieve referrals to other potential customers, and

to ensure that the firm gains and maintains a reputation for producing reliable and valuable products, processes, or services.

Technologies for Industrial Development

All of the requirements described above must be met for an industry to achieve its full potential. Yet in many of the discussions in Bangladesh, most of the attention was focused on only one or two of the requirements, namely, product development and sometimes process development. Little concern was expressed for such matters as market research, sales and distribution, and customer service. Yet these requirements are the ones that are often neglected, causing businesses to fail. Consequently, it is important to insure that all of the requirements for industrial development are given attention. A framework is described below to help insure this. The columns in the framework are the six requirements for industrial development. The four rows are activities (described in the next section) for providing technologies. The cells in the matrix are for the appropriate technologies.

To help insure that all of the requirements for industrial development are met, appropriate technologies should be used. These technologies may be of four kinds as described in the Technology Atlas Project.* The first kind is called technoware. It refers to technology that is embodied in objects such as tools, equipments, machines, vehicles, and physical infrastructure.

The second kind of technology is called humanware. It refers to technology that is embodied in humans' abilities such as knowledge, skills, wisdom, creativity, and experience.

* A Framework for Technology-Based Development. 6 Volumes, Asian and Pacific Centre for Transfer of Technology, 49 Palace Road, Bangalore India, March 1989.

The third kind of technology is called inforeware. It refers to technology embodied in information sources such as patent disclosures, computer files, drawings, technical journals, operating manuals, repair manuals, books, etc..

The fourth kind of technology is called orgaware. It refers to technology embodied in organizational arrangements that effectively integrate humanware, technoware, and inforeware such as in plant layouts, management systems, sales and distribution channels, etc..

Activities to Provide Technologies

For the successful development of an industry, technologies should be provided to help satisfy the six requirements for industrial development, i.e., market research to customer service. Four kinds of activities provide the technologies: 1) needs assessment; 2) acquisition; 3) installation; and 4) use.

By needs assessment we mean that activity which results in the recognition that some kind of technology is needed to meet the requirement being considered. In addition to recognizing the need, the needs assessment should also specify the kind(s) of technology needed. This is required for the next activity.

The second activity is the acquisition of the needed technology. This begins with searching for sources of the technology. For technoware this might involve searching through industrial catalogs to find sources. Once a source is found, contact would have to be made with the supplier of the technology to determine what would be needed to acquire it. And then the conditions for acquiring it would have to be satisfied.

The third activity is the installation of the technology. If the technology is humanware, this may involve giving workers training. If it is technoware such as a piece of machinery, it may involve putting in a foundation for the machine and providing electrical power. For orgaware such as a new

management system, it may require orientation meetings for those involved and, perhaps, training and the preparation of operations manuals.

The fourth activity is the use of the technology. If the technology is in the form of technical journals in a library, this may involve the operations of retrieving and reading them. For humanware such as engineers, it may involve communicating assignments, monitoring progress, and receiving engineering designs.

A Framework

To help manage industrial development, the framework shown in Figure 3 is proposed. The framework should be used with one particular industrial subsector at a time. The electrical and electronics industry is considered below for suggesting how to use the framework. This industry is chosen because it has been recommended by the Asian Development Bank* and others as an industry with much potential in Bangladesh. Also, The Bangladesh Small and Cottage Industries Corporation is building a twelve story "Electronics Complex" currently.

	MARKET RESEARCH	PRODUCT DEVELOP.	PROCESS DEVELOP.	PRODUC-TION	SALES & DISTRIB.	CUSTOMER SERVICE
NEEDS ASSESSMENT						
ACQUISITION						
INSTALLATION						
USE						

FIGURE 3. A FRAMEWORK TO HELP MANAGE INDUSTRIAL DEVELOPMENT

An assessment of the technology needed by a particular industry is begun by considering one of the cells in Figure 3. For illustration we consider the cell at the intersection of the row headed "Needs Assessment" and the column headed "Production". In some of the electrical and electronics companies the author visited in Bangladesh, one of the operations performed was the stripping

*op. cit.

of insulation from the end of a piece of insulated wire so that it could be soldered or otherwise connected to a part of a circuit. The method employed by the laborers was to put the insulated wire on a hard surface. Then the insulation was scraped off with a razor blade. The results were often not good for these reasons. a) Sometimes some of the strands of wire were cut, and the remaining strands had less current carrying capacity. This could lead to an open circuit due to melting or, worse, to a fire. b) Sometimes the wire was cut completely causing wastage. What is the technology needed in this case? To use the terms of the Technology Atlas Project*, four possibilities to consider are technoware, humanware, inforware, and orgaware. We consider technoware first.

In the situation described, some device (technology) is needed for stripping insulation from the wire without damaging the wire. One possibility is a device something like a simple pair of scissors with notches in the blades. The notches would be semicircles whose diameter would be the same as that of the wire from which the insulation is being removed. A stop would prevent the blades from being closed any more than the diameter of the wire. The laborer would hold the insulated wire in one hand and with the other close the modified scissors over the insulation. Then by pulling, the insulation would be removed without harming the wire. Such technoware as described could probably be fabricated on the premises. A second kind of technology needed would be humanware in that the laborers would need to be trained to use the technoware. Thirdly, inforware would be needed such as providing the brief description above to the owner or manager. And orgaware, or management in this example, would need to obtain the technoware and arrange for the training of the workers in its use.

This illustration may seem trivial. Yet in terms of output per labor hour and reduction of wastage, the introduction of the technologies described could

*op.cit.

have a significant impact on the profitability of a small firm.

Reflecting on the penultimate paragraph above one can see implications for the three cells under the top one in the column headed "Production" in Figure 3, namely, the cells in the rows headed "Acquisition", "Installation", and "Use".

To illustrate the use of the framework in Figure 3 more, we consider the cell in the top row and in the left-most column. In other words, we consider Needs Assessment for technology to do Market Research in the electrical and electronics industry. One kind of inforware that would be helpful here would be data on the kinds of products that have been increasing in sales in Bangladesh at more than 10% per year, say. A second kind of information would be the results of a survey of world market trends. These kinds of inforware would be used with other information to decide what products to consider for producing in Bangladesh for the domestic market as well as for the export market. The technoware in this cell might include survey instruments, computers, and data analysis software. (In fact, HIID has used such technoware in its survey project in Bangladesh in 1989).

As mentioned earlier, the Bangladesh Small and Cottage Industries Corporation is currently building a twelve story "Electronic Complex" in the Mirpur Section of Dhaka. Market research information among other things will be needed to help insure that the future companies occupying this complex are successful.

Returning to the beginning of this section, the purpose is to give an indication of how to use the proposed framework to aid in developing and transferring technology for industrial development. The illustrations for the electrical and electronics industry are given to show how the framework might be used. But the main purpose is to provide a tool to be used in managing industrial development.

ORGANIZATIONS AND INDUSTRIAL DEVELOPMENT

In this section we consider some organizations which could potentially support industrial development by carrying out the activities described in the preceding section. In particular, we look at each of the requirements from market research to customer service to see which organizations might help to meet the requirement.

One caveat needs to be stated first. Although the author talked with many persons as listed in Appendix I and studied many documents, the findings in this section are his own. It will not surprise him if some readers differ with some of his assessments. In fact he encourages others who are interested in or responsible for industrial development in Bangladesh to use the proposed framework to make their own assessments of which organizations could help satisfy the requirements for industrial development.

The Bangladesh Small and Cottage Industries Corporation (BSCIC)

It must be said first that the author did not have in mind the size of businesses that BSCIC serves when he proposed the framework. Nevertheless, it seems that it can be useful for BSCIC. From discussions and documents, it appears that BSCIC has the charter and an organizational structure for meeting all the requirements for industrial development, from market research to customer service. BSCIC is probably giving the most of its emphasis and effort to the production requirement in that it gives much attention to working with its clients (owners of small and cottage industries) to help them produce good products profitably. BSCIC probably gives the least attention to market research and customer service. However, this does not mean necessarily that these requirements are not being met. It may be that these requirements are satisfied by the efforts of non-governmental organizations. The author tried to learn the

locus in BSCIC where its performance in meeting all of the six requirements for industrial development is monitored, evaluated, and managed. He did not succeed.

The published functions of BSCIC are shown in Table I. BSCIC has about 1500 staff.

TABLE I.
FUNCTIONS OF BSCIC

1. To promote the establishment of industrial units with priority for agro-support, agro-processing, import substitution and export oriented enterprises utilizing indigenous raw-materials.
2. To promote establishment of small industry through ancillary units and sub-contracting arrangements.
3. To promote area/regional development through establishment of small scale industries on the basis of locally available raw-materials, skills and growth potential as per district development plans.
4. To provide information to target people on industrial investment opportunities through mass media (including Radio, Television and Newspaper) and publications.
5. To assist existing enterprise to operate at optimum capacity.
6. To provide counselling and extension services including in-plant advisory services, group services and training program on technical quality control, marketing and financial management.
7. To supply statistical information and operational data for inter-firm comparison on productivity.
8. To provide services to the entrepreneurs for proper utilization of financial resources of their industrial units.

9. To undertake proper financial analysis and pre-investment feasibility for proper utilization of loan and equity financing resource.
10. To ensure timely loan recovery for further investment.
11. To set up the infrastructure such as Industrial Estates and Common Facility Centres, Design Centre etc. and ensure their optimum utilization required by the industrial units.
12. To maintain efficiently the facilities such as electricity, gas, water, etc. to uninterrupted production of the units set up in the Industrial Estates.

The Bangladesh Council of Scientific and Industrial Research (BCSIR)

BCSIR is the oldest research and development institute in Bangladesh.* It has over 1400 staff including 55 with doctorate degrees and 99 with masters degrees. The majority of the staff are scientists in three areas, chemists, applied chemists, and biochemists. There are fewer than 10 engineers.

In discussions with persons in Bangladesh, BCSIR was often mentioned as the organization most responsible for providing technology for industrial development. However, the author believes that BCSIR primarily provides support for only two of the six requirements for industrial development, namely, product development and process development.

In discussions with the Chairman and Directors of BCSIR, it became clear that they thought of BCSIR as a scientific institute as contrasted with an institute for industrial technology. In the author's judgement that is true, especially when one considers the technologies required for industrial development that have been described herein.

*The data presented are taken from a BCSIR Brochure dated 1988.

The Bangladesh University of Engineering and Technology (BUET)

BUET is the primary center for engineering education in Bangladesh. Its main purpose is education. However its professors do work with industry either as individuals or through BUET's Bureau of Research, Testing, and Consultancy (BRTC). The work done is mainly aimed at meeting the industrial development requirements of product development or process development. As an institution BUET has no focused responsibility for industrial development. Although the name might suggest otherwise, BRTC is primarily engaged in contractual and accounting matters that formalize the agreements already made between professors and industry, government, or non-governmental organizations. (The Institute of Appropriate Technology in BUET is discussed separately below).

The Bangladesh Industrial Technical Assistance Centre (BITAC)

BITAC serves the metal-working and machinery industries primarily. Its activities include the design and manufacturing of spare parts for imported machinery, development of prototypes of products, designing plant layouts, solving quality control and other production problems, and training. Through the design of tools and dies and manufacturing them, BITAC also supports the plastics industry. In terms of satisfying the requirements for industrial development, BITAC works mainly in product development, process development, and parts of production. It has extensive facilities for work in these areas to serve its targeted industries.

The Institute of Appropriate Technology (IAT)

IAT is a part of BUET but has its own building which is mostly empty. Its staff consists of about eight persons. IAT has done mostly system studies and convened short courses. Its laboratory facilities are quite limited. In terms

of industrial development, IAT has been mainly involved in market research. Also, it has done some studies on the impacts of new products, e.g., a rice milling machine. Because of its system work IAT could probably make assessments of the state of technologies for all six of the requirements for industrial development in some industrial subsectors. Then other agencies could use the assessments in making allocations of resources to satisfy the requirements that were not being met.

Micro Industries Development Assistance Society (MIDAS)

MIDAS is a non-government organization established to promote and develop small enterprises. Much of this is done through fixed and working capital loans. It also assists its clients in developing project feasibility studies. Many of its clients are donor agencies. In terms of industrial development, MIDAS has done mostly market research and limited work in product development and process development. MIDAS has no laboratories. Much of the work is done by non-permanent staff who are hired and work when their services are needed. MIDAS has an exceptional library of over 2,000 books, 1200 microfiche documents, 90 journals, and subject files on a number of development subjects.

Summary

The results of the analysis above are shown in Figure 4. An X in a cell signifies that the organization does much to meet the requirement.

REQUIREMENTS FOR INDUSTRIAL DEVELOPMENT						
ORGANIZATIONS	MARKET RESEARCH	PRODUCT DEVELOP.	PROCESS DEVELOP.	PRODUC-TION	SALES & DISTRIB.	CUSTOMER SERVICE
BSCIC		X	X	X	X	
BSCIR		X	X	X		
BUET		X	X			
BITAC		X	X	X		
IAT	X					
MIDAS	X					

FIGURE 4. ORGANIZATIONS AND INDUSTRIAL DEVELOPMENT

From Figure 4, several observations can be made. First, no organization is providing technologies for all of the requirements for industrial development. BSCIC is doing the most perhaps. But from the information the author received in discussions and from documents, he believes BSCIC is not satisfying the requirements of market research and customer service in a significant way. (It should be noted that customer service here does not refer to service that BSCIC provides to its clients. Rather, it means BSCIC does not help its industrial clients much to provide services to their customers after these customers have been sold a product or service).

The second observation is that none of these organizations is significantly helping industries to meet the requirement of customer service. And only one is providing some help in sales and distribution but only to small and cottage industries. Moreover, only two of the organizations are providing some help in market research. Thus, these are some important areas that need attention.

The third observation is that there are several organizations that are providing help in product development and process development.

Finally, no organization exists currently that can help to provide technologies to meet all the requirements to accelerate the development of medium and large industries in Bangladesh.

Another organization that has been proposed is discussed next.

NATIONAL CENTER FOR TECHNOLOGY DEVELOPMENT AND TRANSFER

As indicated in the previous section, it appears that there is no organization now that can help to provide all of the technologies (as defined herein) to meet the requirements for developing industries. It may be that the same situation prevailed in Korea when the Korean Institute of Science and Technology (KIST) was established.* KIST was founded for the development of industrial technology.

It appears that some members of the Government of Bangladesh also realized that no existing organization had the capabilities to provide the technologies required for industrial development in Bangladesh. The evidence is found in the Bangladesh Gazette, February 25, 1986, a special issue on The National Science and Technology Policy of the People's Republic of Bangladesh. In that issue, a National Centre for Technology Development (NCTDT) and Transfer is mentioned, but no details are given.

What might such a National Centre be like? Some ideas are presented in the next two sections.

Proposed Functions for a National Center

One of the first functions would be to identify existing and/or potential industries that could accelerate the industrial development of Bangladesh if the industries were provided the factors identified in the top of Figure 2 for facilitating industrial development. In carrying out this function the Centre

*Much of the history about the founding of KIST is given in "Report on Battelle's Assistance to the Korea Institute of Science and Technology, 1966-1971," Battelle Memorial Institute, Columbus, Ohio. June 30, 1971. A copy is held in the HIID Office in Dhaka.

would need to consider a number of questions, e.g., what industries are possible for producing goods that are being imported in large numbers?, what industries are possible for producing goods for export?, what industries are possible that import few inputs and can add high value?, etc..

Another function of the Center would be to communicate with relevant organizations or entrepreneurs about the industries that have the potential for accelerated development. One of the purposes would be to identify persons with the vision and the willingness to take the risks necessary to develop the industries.

After promising industries have been identified, for each one the Center would assess the needs for and the kinds of technologies (as described previously) required for accelerated growth of the industry. These technologies could be for market research, product development, process development, production, sales and distribution, and/or customer service _____ whatever is needed to accelerate the development of the industry.

After the needs for technologies have been assessed, the Center would determine if the needed technologies are available in Bangladesh, perhaps in some of the organizations discussed in the previous section. If the technologies were not available in Bangladesh, the Center would search for the technologies outside Bangladesh.

If the technologies were found, inside or outside the country, then the Center would determine what would be needed to transfer the technologies to the industry and facilitate their installation in the firms in the industry.

If the required technologies were not available in Bangladesh or outside, then the Center would consider preparing a plan for a project or projects for developing the required technologies. The project(s) would then be costed, and the estimated costs would be analyzed against the expected benefits. If the

analysis proved favorable, the project plan(s) would be presented to individual firms, to groups of firms, perhaps in a trade association, to a government agency, or to a non-governmental organization to ask them to fund the development of the required technologies. The development(s) might then be done by the Center or by other organizations such as those discussed above, or by the industry itself.

Another important function of the Center would be to monitor closely the progress of the industries selected for accelerated development. This would facilitate the early detection of existing or incipient problems that firms in the industries were encountering. Such problems might occur in market research, in the development of products or services, in the development of manufacturing processes, in production, in sales or distribution, or in customer services. Whenever and wherever a problem was identified, the Center would work with the firm to understand the problem, identify the cause or causes, and find solutions.

After initial startup support to enable the Center to hire its staff and to develop its laboratories, the Center would be expected to obtain its operating funds from firms or trade associations in the selected industries. Thus, it would have to depend on its marketing and problem solving abilities.

What kind of organization might carry out these functions is addressed in the next section.

AN ORGANIZATION STRUCTURE FOR A NATIONAL CENTER

A possible organization structure for a National Center for Technology Development and Transfer is shown in Figure 5.

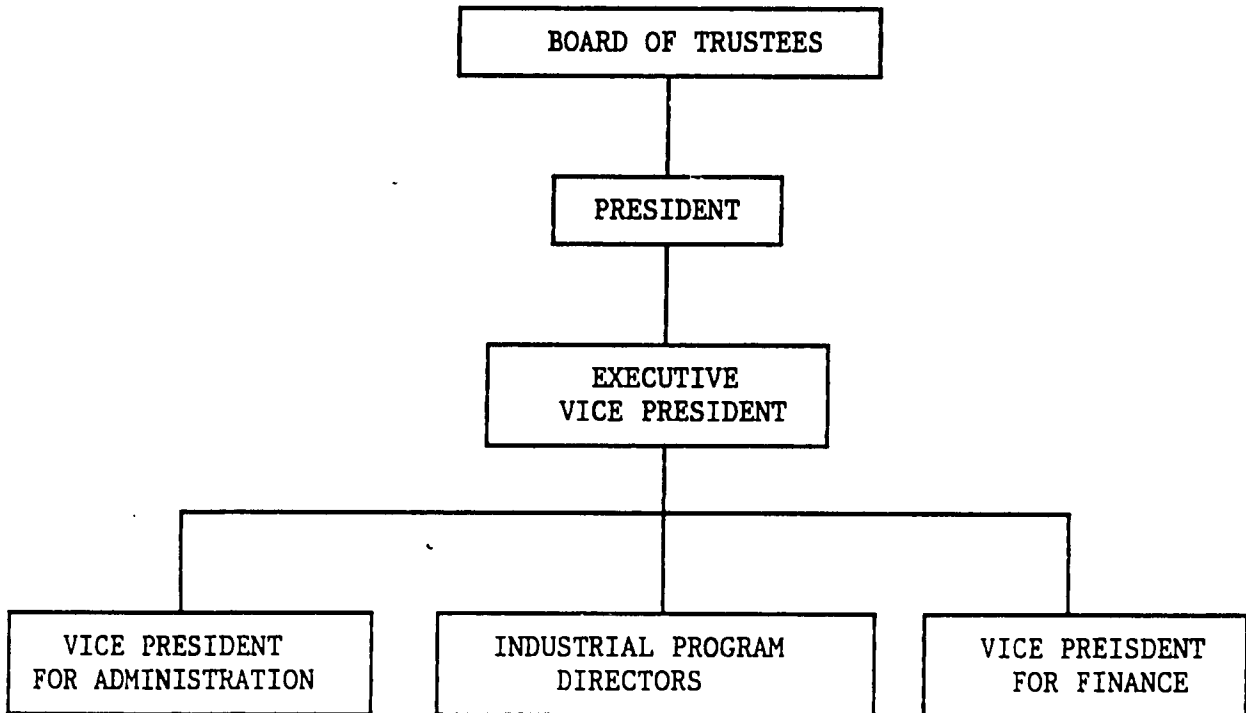


FIGURE 5. A POSSIBLE ORGANIZATION STRUCTURE FOR A NATIONAL CENTER

Board of Trustees

The membership of the Board of Trustees should include: industrialists who are respected by other industrialists, who have thoughtful visions of the industrial possibilities for Bangladesh and who have access to the highest levels of government; engineers who have made significant industrial accomplishments, who know the requisites for technology to be developed, and who are respected and admired by other engineers; economists or bankers who can anticipate government policy changes that will affect the Center and who can advise the Center's President on the acquisition of funds; current or recent qualified government officers who know how the bureaucracy operates and who can advise and

help the Center's officers to get things done that require government actions; and other thoughtful persons inside or outside the country who know the ways that technology can contribute to the nation's industrial development and who can advise on the development and operation of the Center for the benefit of Bangladesh.

During the early years, the members of the Board should meet monthly to learn of progress and problems in establishing the Center and to provide guidance. The individual members should be on call to advise the Center's President when he calls them. Once the Center is established, quarterly meetings of the board should suffice.

President

The President should be an engineer who has been recognized by his peers for his technical accomplishments, who has a wide acquaintanceship with accomplished Bangladesh engineers and scholars throughout the world, who has demonstrated a comprehensive knowledge and vision of the industrial development potentials of Bangladesh, and who is of the highest integrity.

In the beginning, the President will probably need to be involved in or knowledgeable about almost all of the major activities required to establish the Center. But particular activities to establish the Center will need his special attention. These are described below.

One of the first activities of great importance will be the selection of the industries that will be given attention initially by the Center. The technologies required for the development of these industries will dictate decisions on staff recruitment, buildings, laboratory equipment, financing, even, perhaps, the location of the Center, and other matters. The President (with the advice and consent of the Board of Trustees) will be the primary person involved

in the selection of industries to be helped by the Center.

Once some industries have been selected, the identification of outstanding Bangladeshi in the relevant fields of technology will be needed. (Of course this may not be necessary if such persons have been involved in the selection process above). If appropriate Bangladeshi can not be identified, then other persons will need to be identified.

Once key persons in the relevant fields of technology have been identified, the next task will be to recruit these persons. This will require a significant amount of the President's time, energy, and persuasiveness. It is impossible to overemphasize the importance and the difficulty of this task. The results will influence the character and the significance of the Center more than any other single factor probably.

After the key persons have agreed to join the Center, the President will work with them to design the initial programs that will be done by the Center. These designs will determine the kinds of skills, equipments, facilities, materials, etc. that will need to be obtained.

Concurrently with the activities above, the President will need to be in continual contact with funding organizations to insure their support. In this function, he should be aided by members of the Board of Trustees.

As the Center begins to function, the President will need to be involved in communications with the highest levels of government and industry to report the accomplishments of the Center and to obtain their support and recommendations for the future development of the Center.

The President will be the chief architect of policies to guide the operations of the Center. Among the most important will be those that insure the excellence of the work of the Center. Technological obsolescence will be a constant threat to be avoided. One possibility might be to have limited term

appointments for the technical staff below the industrial program director level, say, for five years, with one renewal in exceptional cases. After the completion of his term, it might be planned that the "graduate" would go to work for the firm for which the technology had been developed to facilitate the transfer of the technology or go to teach in a university. Whatever the mechanisms, the President will need to work constantly on excellence through organizational renewal.

Executive Vice President (EVP)

The Executive Vice President will be in charge of the technical activities of the Center. He will act in place of the President when the President is absent from the Center.

The EVP will define the organization for the technical activities of the Center and allocate resources to accomplish the programs of the Center. These resources include personnel, funds, space, equipment, materials and whatever else the industrial program directors may require to carry out their work.

The EVP will determine the need for and plan for the acquisition or development of facilities and equipment required for the technical programs. This function will be done with the assistance of the industrial program directors described below.

The EVP will establish the standard operating procedures and reporting systems of the Center to insure its work proceeds effectively. This will include systems for fair and objective performance evaluations of staff to help them improve and to help them in career planning and advancement. It will also include procedures for assessing the usefulness and quality of the work of the Center.

From the assessments made by or for him, the EVP will report to the President often and to the Board when requested on the progress, accomplishments, and deficiencies of the industrial development programs.

Working with the President, the EVP will help to define and plan for new program areas.

The other Vice Presidents will report to the EVP.

In summary, the EVP will be responsible for and have authority over the Center's internal operations.

Vice President for Administration (VPA)

In general, the Vice President for Administration will be responsible for providing the infrastructure necessary for the Center to operate effectively.

One of the first tasks of the VPA will be to obtain facilities for the Center to begin operations. These facilities may be borrowed, rented, or leased initially. Later he will probably be responsible for the construction of new facilities. This responsibility will also include the provision of laboratories and equipments required for the industrial programs and technical information services.

A second area of responsibility will be the human resources including recruiting, arranging for interviews by appropriate managers, hiring, orienting, counseling, and training. In addition, the wage and salary structure will need to be established and monitored along with career ladders. It will be necessary to comply with laws relating to employment.

The VPA will also have to obtain telephone service, electricity, water, gases, etc. that are required for the operations of the Center.

As the Center grows, provision for housing, schools, security, maintenance of buildings and grounds, safety, medical care, insurance policies, etc. may be needed.

Provision of supplies and materials, control of inventory, receiving, inspection, acceptance of goods received, and authorization of payments will be important parts of the responsibilities under the VPA.

Vice President for Finance (VPF)

The Vice President for Finance will be responsible for all matters dealing with the receipt, holding, and disbursement of money.

In the beginning stages of the development of the Center, two important tasks for the VPF will be the preparation of an operating budget for the first two years of operation and a budget for capital investments. These will need to be prepared with the advice and approval of the President and the other officers, of course.

Contracts with construction companies, suppliers, clients, and others will have to be arranged, costed, and administered carefully.

Payroll administration will be necessary from the very beginning.

Other important functions under the VPF will be cost accounting, billing, collections, taxes, and disbursements. Probably, short term investments will also need to be made.

One function that should not be under the VPF is auditing. That function should report to the Board of Trustees and the President.

Industrial Program Directors (IPD)

An Industrial Program Director will be needed for each industry whose development is targeted to be helped by the Center. In the first five years there would probably be less than five industries. And there might be fewer than five initially.

An IPD is responsible for assessing the requirements for the industry to make significant process. This will require a knowledge of the world's state of the art in the technologies that are important for the growth of that industry. And an IPD will have to convince the industry that the Center can help to satisfy the needs identified.

Based on the assessed needs, the IPD for an industry will develop and implement a program for providing the technologies to the industry to help it make significant advances. In some cases the required technologies may have to be obtained from sources outside Bangladesh. In these cases the IPD will identify the best sources of the technologies and help the industry to acquire them, to implant them, and to use them successfully. This may require adapting the technologies to conditions in Bangladesh, training workers to use them, maintain them, and repair them, and whatever else that may be required for advancing the industry.

In other cases, indigenous technologies may have to be modified to serve the intended purposes. In these cases, development programs for making the necessary modifications will need to be planned and implemented.

In still other cases, no appropriate technologies will be found that can be imported or modified. In these cases, the IPD will have to make plans for developing new technologies to satisfy the identified needs.

It must be apparent by now that an IPD will have to work closely with the managers of firms in his industry to identify the needs of the industry, to obtain the required technologies to meet the needs identified, and to transfer the technologies to the industry successfully.

In addition an IPD will need to work closely with the Center's managers of the projects in his program. He will need to communicate with them well to insure their projects meet the needs of the industry under the constraints faced

by the industry. He will have to insure that the resources required by the project managers are provided. He will need to motivate the staff under his program to strive to do their very best.

An IPD will have to plan for acquiring the human skills, the facilities, the information, and whatever other resources are required for his program to succeed. And he will have to work closely with the Vice Presidents for Administration and for Finance to provide the resources needed for his programs.

SUMMARY

Industrial development is badly needed in Bangladesh. Industrial development requires a number of facilitating factors. One of these is the provision of required technologies. These technologies are needed to satisfy six requirements for industrial development that have been identified herein, namely, 1) market research, 2) product development, 3) process development, 4) production, 5) sales and distribution, and 6) customer service. These technologies may be in four categories, 1) technoware, 2) humanware, 3) inforware, and 4) orgaware. There are organizations in Bangladesh that have capabilities for providing some of the technologies needed. But no organization was identified that could satisfy all of the requirements. A proposed organization was identified that could potentially help to provide the technologies to meet all of the six requirements if it were developed. Some of the desired functions for it are described herein. And a possible organization structure is given with descriptions of tasks for persons in key positions. It is hoped that this report will provide ideas that will assist in the provision of technologies required for the industrial development of Bangladesh.

RECOMMENDATIONS

1. The Government of Bangladesh (GOB) should select a limited number (less than 5) of key industries with growth potential to develop.
2. The GOB should identify or create an organization and give it significant power to manage the growth of the selected industries. The organization should not be a part of the government. Otherwise, it will not have the flexibility that it will need to accomplish its mission.
3. The managing organization should:
 - a) monitor progress of the selected industries;
 - b) identify needs of the industries;
 - c) obtain technologies needed and other necessities for growth;
 - d) intercede between other organizations and the selected industries on their behalf, e.g., in getting loans, in getting needed inputs through Customs, and whatever is needed to smooth the way for the selected industries to grow.
 - e) give special attention to insure that the requirements of market research, sales and distribution, and customer service are met.

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APPENDIX I, SITE VISITS

The author visited the following organizations in Bangladesh.

Bangladesh Council on Scientific and Industrial Research (BCSIR)

Bangladesh Ministry of Planning

Bangladesh Ministry of Education, Secretariat for Science and
Technology

Bangladesh Small and Cottage Industries Corporation (BSCIC).

Bangladesh University of Engineering and Technology (BUET)

Carew and Company

Garment Factory

Institute of Appropriate Technology (IAT)

Institute of Business Administration (IBA)

Micro Electronics Limited

Micro Industries Development Assistance Society (MIDAS)

Mirpur Agricultural Workshop and Training School (MAWTS)

Prantik Electrical Industries Limited

Productivity Services Wing of Bangladesh Employers Association

Tan-Elco Limited

United States Embassy and Agency for International Development.