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INDUSTRIAL BANKS AND DEVELOPMENT OF ENDOGENOUS TECHNOLOGICAL CAPABILITIES

CONTENTS

CONTENTS (continued)

LIST OF TABLES

LIST OF FIGURES

Introduction

The importance of technological development in industrial development has not been given adequate consideration in the ESCWA countries. Generally, very little attention has been given to developing mechanisms and strategies for upgrading and improving industrial technology in the ESCWA countires. The overwhelming concern in these countries has been primarily with the expansion of the industrial production capacity. Development of endogenous technological capability in industry has always been assumed to be an automatic outcome of industrial expansion. This assumption, in the experience of the newly industrialized countries, has proved not to be correct. The result of this erroneous assumption has been an almost total absence of financial intermediaries to provide the required support for medium and small-sized industries to upgrade and improve their technology. The weak capital market and the generally unconducive economic policies have not helped either. This study focuses attention on the importance of technological capability-building in industry and makes a number of suggestions for the type of mechanisms, new functions for financial intermediaries and a strategy for the development of technological capability in medium and small-sized industries.

Although there are references to the industrial banks, they have been made for purposes of illustration. No specific arguments have been included for making these banks the designated financial intermediary to perform the new functions. This has been left to the deliberations of the Meeting.

The present study is in implementation of programme element 1.2, in the ESCWA work programme in Science and Technology for the biennium 1988-1989.

The study is composed of six chapters. Chapter I gives the definition of endogenous technological capability and develops an operational concept of this term. Chapter II reviews the different components of technological capability at the industry level and distinguishes between the capabilities related to production capacity and those related to building technological capacity; it also reviews how development of technological capability can be treated in project evaluation methods. Chapter III is a brief review of the manufacturing sector and the industrial banks in the region (the latter is presented as one institutional option for housing the functions of a financial intermediary concerned with technological development). Chapter IV contains suggestions for a technological strategy. Chapter V presents a brief review of experiences of three newly industrialized countries showing the type of institutions, policies and strategies which have been used in developing technological capabilities; they are presented to enrich knowledge of other countries' experiences. Chapter VI contains a summary and conclusions.

This study has drawn on a number of other studies and sources. Two of them were particularly useful. The World Bank made available a number of studies and reviews dealing with the experience of the newly industrialized countries and the Bank's view of these new developments. These review studies constituted the main source of the ideas contained in chapter IV. The information in chapter V is largely based on a study in Spanish carried out by

the Junta de Acuerdo de Cartagena in Lima, Peru in January 1989. Special thanks are given to these two institutions. Special thanks also go to the ESCWA Conference Services staff for the efficient translation into English of an abridged version of the Spanish study.

Finally, the study is one of six which have been developed to deal with the subject. This study provides the main framework for discussion in the Meeting; the other five studies together with a number of indvidual papers by the participants in the Meeting organized in relation to the subject under discussion will develop case materials from the experience of Egypt, Jordan, Iraq, Lebanon and the Syrian Arab Republic. The final version of the present study will incorporate the findings of these studies and the recommendations of the Meeting.

I. ENDOGENOUS TECHNOLOGICAL CAPABILITY: DEFINITION AND IMPLICATIONS

This chapter is composed of two sections. The first contains the definitions of the terms used in the study; the second develops the operational concept of the term "endogenous technology capability".

A. Definition of endogenous technology capability

The main message of the Vienna Programme of Action on the Application of Science and Technology for Development is the creation and strengthening of the endogenous scientific and technological capacity of developing countries.

The formal definition of endogenous capacity according to the Vienna Programme of Action is:

> "the full recognition of the necessity for all countries to rely on their own endogenous scientific and technological capabilities. Such self reliance ... (means) in essence, to take and implement autonomous decisions for the solution of national problems, and the strengthening of national independence."1/

The concept of endogenous capacity according to this definition is still illusive for the purpose of this study. First, the term self-reliance needs to be defined; secondly, the differences between the following terminologies: "endogenous" and "indigenous"; "capacity" and "capability"; and "techniques" and "technology" also need to be clarified.

The term self-reliance is used here to mean that developing countries can exploit the technological resources of the more industrialized countries more aggressively and effectively than at present. Therefore, to achieve self-reliance, the relationship between importing technology and the development of local technological capabilities must be examined. This means where, when and under what conditions technology imports constitute: (a) substitutes for local capabilities; (b) constraints on the development of their capabilities; and (c) facilitate transforming substitutes into complementarities. In other words the strategy for attaining self-reliance in technology centres around how to exploit foreign technology to make it contribute to the development of local technological capabilities. Thus, contrary to self-sufficiency, which means opting out of the international market, self-reliance means using the market more effectively.2/

1/ The United Nations Conference on Science and Technology for Development, The Vienna Programme of Action on Science and Technology for Development (United Nations, New York, 1979), para. 12.

2/ M. R. Bell, Study Module No.2 attachment A, "The acquisition, absorption and diffusion of imported industrial technology", Science Policy Research Unit/IDRC Research Workshop No.2, Sussex University (United Kingdom), August 1977.

The term endogenous means growing from within; "an endogenous capacity is one which is internally generated within a society and which is self-producing."1/ This is the definition of endogenous given by the United Nations Advisory Committee on Science and Technology for Development (ACSTD).

Since the development of endogenous capability is the central issue of this study, further elaboration of the definition would be useful. According to ACSTD:

> "Endogenous capacity building is a dynamic process; it involves a cumulative learning process based on the local context of developing countries. It requires a practical approach in the capacity building (to) be directed towards tangible outputs and goals ..., moreover, it calls for the participation of all social groups including producers and users of technology and people at large
>
> "Endogenous technological capacity may be assessed in terms of its interrelated elements as the ability of a given country to choose, acquire, generate and apply technologies which contribute to meeting its development objectives. Further disaggregation would introduce elements such as ability to search for technological alternatives, to identify technology sources, to negotiate reasonable conditions, to actually transfer technology as and when necessary from abroad, or within countries... The ability to generate technologies, as noted, covers adaptation, upgrading, innovation and invention. It also includes the capacity to produce tools and machines and other capital goods required to generate technological alternatives. Finally, the crucial capacity to apply technologies which are technically and economically viable, requires a capacity to ensure their diffusion, adoption, proper uses, maintenance and repair.
>
> "The factors which determine the level and nature of each and all of the elements of an endogenous capacity in science and technology include policies and pertinent institutions, human and financial resources, information, and environmental conditions. These interrelated factors should be seen as constraints or opportunities in order to give rise to the formulation of concrete measures for strengthening capacities."2/

In the following section this concept of endogenous technology capability will be put into an operational form. It should to be added however, that the term indigenous refers to strictly internal technology and relates to the concept of self-sufficiency.

1/ Advisory Committee on Science and Technology for Development, 8th session, "Concept paper on endogenous capacity building", Goa, India, 26-30 September 1988, p. 1.

2/ Ibid., pp. 1-2.

The term capacity refers to the possession of a basic infrastructure, while the possession of a capability implies the active use of that capacity for the pursuit of defined objectives.1/

"Techniques" and "technology" are also two terms which need to be clearly understood. Often the two terms are used synonymously. There is also a tendency to use technology to refer to most advanced techniques while the term "techniques" is used to refer to less complex and less advanced ways of applying scientific knowledge. Both uses, however, have limitations.

In this study, "technique" refers to the range of procedures and resources used by a science or art, as well as to expertise or skill in the use of the procedures and resources. "Technology" is the sum of knowledge and applied scientific procedures that makes possible the achievement of a defined objective on the basis of mastering the underlying scientific knowledge.2/ The definitions, as can be noted, are made on the basis of the person who uses the applied sciences rather than on the basis of the terms themselves. Thus, according to these definitions, when a person who uses the applied science embodied in the technique does not need to know the basic principles on which the technique is based, the person would be using "techniques". For example, someone who repairs a knitted fabric would be using a darning technique; the astronaut who lands on the moon uses a modern technique but would not have to be familiar with the scientific basis of the operation. However, when the person who would be using the applied science also needs to have knowledge of the scientific principles behind it to be able to adapt the technique to his purpose, the person would be using "technology". For example, one can speak of a biogenetic "technology" because the application of the knowledge is still in a continuous state of flux; therefore using the knowledge demands familiarity with the scientific principles of the subject.

B. Operational setting of endogenous technological capability*

It is now clear that technological capability embraces both "technological transfer" focus and endogenous science and technology focus. There is a widespread realization that effective transfer of technology

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* Two authors, Norman Girvan and M. R. Bell, synthesized the operationalization of the concept of endogenous capability. Section B above draws heavily on their work. The two publications which have been extensively used are (1) Norman Girvan "Working notes on technology capability", paper presented to the Caribbean Technology Policy Studies, Phase II (CTPS II) Workshop, held in Port-of-Spain, Trinidad, 5-9 May 1981, and (2) M. R. Bell, "Technological capability: its characteristics and modes of accumulation", SPRU/IDRC Research Workshop No. 4, 1979.

1/ Sergio C. Trinidad, "Endogenous capacity building in science and technology in developing countries during the past decade", a paper presented at the Conference on Science and Technology Policy for Self-Reliance in the Muslim World, sponsored by the Islamic Academy of Science, Islamabad, 3-6 December 1988, sect. 5, p. 7.

2/ The definitions and the examples are given in a study entitled "The financing of technological development", published in Spanish by the Junta del Acuerdo de Cartagea (JUNAC) in Lima, Peru, January 1989. See the English translation by ESCWA (unpublished), pp. 1-2, paras. 1,2 and 3.

is closely related to the development of local technological capabilities and vice versa. What are these technological capabilities? What policies are required to develop them and how?

There are at least three different but interrelated approaches to defining what technological capability is. One approach stresses the meaning of technological capability; the second specifies what it consists of; and the third attempts to illustrate what technological capability is by giving concrete examples. These three concepts together provide a useful operational concept of technological capability.

1. In the first approach, technological capability is specified in terms of the ability to do certain things, i.e the ability to perform certain tasks and carry out certain activities (e.g searching, selecting, negotiating, adopting, setting up, operating and developing an innovative technology.1/

A more precise approach distinguishes between four groups of capabilities according to the type of functions: those related to the initiation; the operation; the modification; and the innovation of a production system. These groups may be further classified according to the level of aggregation from specific product level to the industry and the national level. Moreover, within each of the functional groups the tasks and functions could be further classified according to whether they relate to the product, to the material, or to the components that are used to make the product.2/

2. In the specification approach, Martin Bell identifies technological capability in terms of five components: (a) people who possess basic scientific knowledge or skill to carry out functions; (b) stocks of technical knowledge, i.e., the operational experience and technical knowledge that can be drawn upon to carry out various functions; (c) tools and instruments which are needed for performing the functions; (d) institutions which can provide the environment for accumulating and deploying the stocks of technical knowledge and instruments; and finally, (e) values and attitudes which form peoples approach to solving problems. This include motivation, organization, efficiency and hard work.

Thus, according to this approach, carrying out tasks and activities requires certain kinds of skilled personnel, working with certain kind of technical knowledge and information and within an organization that deploys them meaningfully and motivates them appropriately towards a given task.

By so identifying the technological capability components and by listing them side by side with the tasks to which they relate, a "resource requirement matrix" can be built. In this matrix the task and activities are arranged in rows, and the categories of resources required, personnel, knowledge, information, hardware and organization in columns. The matrix can further be subdivided according to main products, industries and the economy. When all

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1/ N. Girvan, "Working notes on technology capability", paper presented to the Caribbean Technology Policy Studies, Phase II (CTPS II) Workshop, held in Port-of-Spain, Trinidad, 5-9 May 1981.

2/ Ibid.

these requirements are summed up across industries they would give the approximate amount of resources required for a national technological capability. The format of this matrix is shown in figure I. Table 1 contains an illustration of tasks and activities involved in the initiation of a production system.

Figure I. Outline of matrix of resources required for technological capabilities

	CATEGORIES OF RESOURCES				
	Human resources				
	Management + Decision-makers	Skilled personnel	Stocks of technology-related knowledge+ information	Stocks of tools and instruments	Origanizations and institutions
TASKS + ACTIVITIES					
Initiation					
A. Process-related					
Tasks: 1					
2					
B. Product-related					
Tasks: 1					
2					
C. M + C related					
Tasks: 1					
2					
Operation					
Tasks: 1					
2					
Modification					
Tasks: 1					
2					
Innovation					
Tasks: 1					
2					

Source: Based on, M. R. Bell, Study Module No. 2, attachment A, "The acquisition, absorption and diffusion of imported industrial technology", SPRU/IDRC Research Workshop No. 2, August 1977; and "Technological capability: its characteristics and modes of accumulation", SPRU/IDRC Research Workshop No. 4, 1979.

Table 1. Schedule of tasks and activities involved in the initiation of a production system

A. PROCESS RELATED

1. The identification of the general process know-how required.

2. The procurement of general process know-how for the management of technology transfer.

3. The conduct of process related feasibility study.

4. The procurement of basic process-related know-how.

5. The execution of overall plant design.

6. The procurement of non-standard machinery.

7. The procurement of standard machinery.

8. The conduct of initial process operation.

9. The training of process operators.

10. The execution of process trouble-shooting.

B. PRODUCT RELATED

1. The conduct of market research studies.

2. The procurement of product technical knowledge.

3. The design of specification of products.

4. The execution of pre-production product testing and quality testing.

5. The execution of initial product quality testing.

C. MATERIALS AND COMPONENTS (M AND C) RELATED

1. The conduct of surveys of materials and components (M and C) sources.

2. The procurement of M and C know-how.

3. The execution of M and C testing and quality analysis.

4. The determination of M and C specifications.

5. The conduct of initial M and C testing and quality control analysis.

Source: Bell (1977), pp. 15-16.

Two characteristics of technological capability have important implications. The first is that some components of technological capability are adjustable. A good manager and an efficient organization are recognizable as such, irrespective of the industry or activity they are engaged in. This characteristic implies that the total resources required nationally will be less than than the sum of the resources required for each individual product group and industry. The second characteristic is that the process of technological development is cumulative. Technological capability developed in one area can be used in another area. This implies that a developing country can seek to identify a "critical mass" of technological resources which can be economically utilized in a number of basic activities.

What the above clearly leads to is that a country can formulate a strategy for the development of a technological capability. The strategy should consist of pursuing a sequence of development over time that maximizes the possibilities of using some activities as the basis for developing capabilities that can subsequently be used in other activities. This process is very much the theme of the third approach to defining technological capability.

The starting point in this approach, which is known as the case-study approach,[1/] is that the two approaches discussed above do not have an operational use: they may succeed in identifying what capabilities a country should have but they fail to show how the country can acquire or develop them. In the context of developing countries faced with scarce human and capital resources, establishing priorities and scales are of great importance. Therefore, it is equally important to study the process of capability accumulation. This importance has been heightened by studies of technology assimilation at the enterprise and industry level that have come out of the newly industrialized countries. These studies have all concluded that the process of "learning-by-doing" is one of the most important sources of technological accumulation. They have also shown that the terms and mechanisms of the transfer of technology can be such that they may deliberately restrict the technology assimilation process. What is significant therefore is the need to identify policies and strategies which can overcome these restrictions. Strategy is particularly important because through it the country can make its choice about which areas to address immediately and which areas to leave for a later stage. Whichever choice scheme is selected, however, it will have to be based on informed judgement about the areas which create a basis for further development.

In the two annexes to this chapter a detailed example is presented about Japan's strategy in developing its technological capability in petrochemicals in the post-war period. The example is given only for illustration purposes. It does, however, bring out six important points.

First, the crucial role played by the Government of Japan in initiating the process for formulating and implementing the strategy, and then in designing the required policies to ensure its usefulness for private industry;

1/ N. Girvan, "Working notes on technology capability", paper presented to the Caribbean Technology Policy Studies, Phase II (CIPS II) Workshop, held in Port-of-Spain, Trinidad, 5-9 May 1981, pp. 14-15.

Secondly, the necessity for industrial enterprises to be motivated by commercial purposes, irrespective of type of ownership, and to be producing for the commercial market;

Thirdly, the fact that the form and the mechanism used in the transfer process was very much dictated by the objective of the transfer strategy. The objective in this case was assimilation, modification and generation of the technology. Thus, while licensing from foreign companies was the main method of transfer, the Government insisted right from the beginning on the form of licensing which permitted unpackaging of the technology and a significant degree of local participation. This created opportunities for learning-by-doing for the local engineering firms in the design and construction of petrochemical complexes;

Fourthly, the lesson of experience that there is a time sequence for the development of the industry. This time sequence (which in this particular case took 20 years) is to be understood in each case. Within this time sequence, exporting does not exclude further importing of technology;

Fifthly, an important point also in relation to the type of local resources that were deployed to the technological effort. Each firm employed only 8 to 10 qualified persons to carry out the initial task of searching and identifying the basic technological need. The initial work was done by no more than 40 persons (excluding management staff and the construction engineers). Moreover, on the insistence of the Government, once production was started the next critical category of local resources deployed was the research laboratories and pilot plants built by the enterprises to incorporate modifications and innovations into the imported process.

Sixthly and finally, the changing role of the Government at different stages of the development sequence. At the beginning the Government was concerned mainly with regulating the technology transfer process and to back up the industrial enterprises concerned. When the industries were set up, the Government changed its emphasis to promoting more difficult aspects of research and development which were not sufficiently attended to by the private enterprises.

As mentioned above, the Japanese example was given as an illustrative example on the "case-study approach" to studying the development of endogenous technological development. Whether or not the experience of Japan is relevant for the countries in the ESCWA region, or whether petrochemicals are the kind of high technology industry to develop technological capability in, are not the issues.

Recently a number of case-studies have emerged from the newly industrialized countries which supplement the Japanese example.[1/] The case of the Republic of South Korea's postwar development is one such example. An underdeveloped country at the end of the Second World War, the Republic of Korea had by 1985 became a major exporter of footwear, textiles, clothing, plywood, transport equipment, automobiles, electric machinery and appliances as well as various manufactures of metal and non-metallic minerals. It has also mastered basic production engineering in most of these industries and developed capability in project execution in a number of them.

1/ See references at the end of this chapter.

What were the major factors responsible for the Republic of Korea's growing technological capabilities? There is a general agreement between students of the Republic of Korea's experience on the following:

1. Industrial growth and transfer of technology in the Republic of Korea owes a relatively small part to direct foreign investment. The latter was confined mainly to a few industries, namely, textiles, apparel, chemicals and electric machinery.

2. The Republic of Korea did gain some transfer of technology in manufacturing during the period of Japanese colonization of what was then Korea up to the Second World War. More significant, however, were the skills gained by the Korean workers from the presence of a large number of skilled Japanese workers in Korea until the end of the war, and a large number of Koreans who worked in Japan and returned home with new skills after the war.

3. Production and export activities were largely in the hands of native Korean entrepreneurs who have acquired technology mostly through indirect transfer process. Technology licensing agreements were used but more often other forms and sources of technology acquisition were employed. These included: (a) product specifications for manufactured goods which foreign buyers requested for Korean products; (b) copying of foreign products; (c) mastery of the process involved in the application of the knowledge to other production activities; (d) copying of foreign machinery and equipment originally purchased through "turnkey" contracts; and (e) the experience gained by local engineering firms in project design and implementation, through participation in "turnkey" contracts.

The experience of many newly industrialized countries (e.g. China, Thailand, Argentina, Brazil) points to the importance of copying in developing technological capabilities. In many instances, local technological capability managed to produce main parts of capital goods, reduce cost and successfully compete in the international market. In none of these cases was there an already developed technological and industrial base such as in Japan, nor did they need to start with a "high-technology" industry such as petrochemicals to be able to develop their technological capabilities, What these countries did, however, was to utilize what already existed and use it to service a need or a demand that existed in the local economy. In doing that, they also persistently introduced modifications and innovations which helped to reduce cost and increase efficiency. This earned them an advantage in the marketplace. Another factor which has been essential in the success stories has been the role of organization and leadership in responding to challenges and turning difficulties into opportunities.[1/]

Table 2 below is an approximate map of the institutions that are closely involved in providing endogenous technological capabilities; it shows the capabilities they produce and the type of technological functions performed. The information in this table will serve as a point of reference for further review.

1/ N. Girvan, "Working notes on technology capability", paper presented to the Caribbean Technology Policy Studies, Phase II (CIPS II) Workshop, held in Port-of-Spain, Trinidad, 5-9 May 1981, pp. 26-29.

Table 2. Constituents of a technological capability at the national level

INSTITUTIONS/SYSTEMS	OUTPUT	TECHNOLOGICAL FUNCTIONS
(1) Educational system		
Primary and secondary education	Personnel with basic education of absorbing formal or on-the-job training in technology-related skills.	Provision of basic infrastructure to support functions below
Technical, vocational and industrial training	Skilled technicians, workers, craftsmen and artisans.	Absorption, modification and adaptation of techniques and process; fabrication of specialist tools equipment and instruments.
University and higher education	Scientists (natural, agricultural, medical, etc.), engineers, researchers, consultants.	Research and development, design, engineering consultancy, management, absorption, adaptation modification, and innovation of technique, process and systems.
(2) Research and development establishment		
Research laboratories/stations/facilities	Basic scientific knowledge, applied scientific knowledge of potential use.	Basic research, applied research on techniques processes and systems.
Pilot plants/experimental stations etc.	Economically useful knowledge.	Testing and development of techniques, processes and systems.
Producing enterprises	Absorption of economically useful knowledge and generation of of experience.	Incorporation of technical change into production and "feedback" to research and development
(3) Specialist workshops and facilities		
Medical, metal-working, repair and maintenance workshops and facilities, attached to enterprises or independent	Hardware maintenance and repair, fabrication of tools and equipment including prototypes, fabrication of components and spares, assembly of components into machinery and equipment.	Repair, maintenance, modification and adaptation of hardware; fabrication of components, tools, equipment and plant incorporating results of technical change from other functions.
(4) Engineering and consultancy		
Consultant firms	Problem-related knowledge and advice of specialist or a general nature.	Technology search, selection and evaluation; dissemination of technical knowledge.
Engineering (design and building) firms	Project and plant design and construction.	Technology search, selection, evaluation and disaggregation, design, modification, adaptation of systems, incorporation of technical change.

Table 2 (continued)

(5) Information systems and mechanisms		
Research units in institutions, research institutions, survey departments, libraries publications, etc.	Access to general and specific.	Importation of knowledge, generation of local knowledge, dissemination of foreign and local knowledge to technology users to support (1) to (4) above.
(6) Management, planning and financing		
Management of science and technology	Financing, directives and guidelines for (1) to (5) above.	Rationalization, co-ordination, integration and implementation of functions amd activities involved in (1) to (5) above.
Planning of science and technology	Formulation of programme of activities and elaboration of projects for (1) to (5) above.	Orientation of science and technology towards goals and strategies of development; rationalization, co-ordination and integration of technology functions and activities (1) to (5) above with development policy, planning and projects.

Annex I to chapter I

THE JAPANESE EXAMPLE

The Japanese petrochemical industry has been cited as one of the post-war industrial "miracles". Based entirely on imported petroleum and natural gas, the industry is virtually a post-war creation dating from around the late 1940s. After the end of the war, during which the Japanese chemical industry production facilities were almost completely destroyed, chemical fertilizers were the first to be restored; this led to increased production of lime nitrogen which was linked with carbide and acetylene. Acetylene, therefore, was the chemical industry's early building block, based on the traditional coal and limestone and therefore not dissimilar to the situation in many countries of Western Europe. The synthetic textile industry, based on "vinylon", a product developed in Japan in the 1930s, also was rehabilitated almost independently of foreign technology.

The period following this, say, the early 1950s, represented an almost complete switch in Japanese petrochemical technological policy in which a deliberate strategy was followed of negotiating with foreign corporations for the licensing of their latest petrochemical processes for production in Japan. This led to a decade, starting around 1955, during which new Japanese capacity was almost entirely but discriminately dependent on importation of technology. It was during this period that imported technology was first assimilated, adapted and later modified to enable a new phase to emerge after 1965, when the first Japanese petrochemical technologies began to emerge from this policy.

Before we analyse in some detail the Japanese experience, we must draw attention to the all-encompassing role of MITI, the Japanese Ministry of Foreign Trade, in this development. For although there was obviously participation in this process by the private sector through its co-ordinating and executing organizations, it is difficult to disentangle where the dividing line between public sector and private sector initiative really lies in this context. This is a general problem with all late industrializers which claim some formal adherence to a partial or complete capitalist approach to economic development.

We shall divide our discussion of the policies into three parts, corresponding roughly to the three phases in the eventual development of an indigenous Japanese petrochemical technology: (1) Policies on Imports of Technology and Petrochemical Products; (2) Policies on Assimilation and Adaptation of Imported Technology, and (3) Policies for generating New Technology.

Policies on imports of technoloty and petrochemical products in Japan

Any study of the transfer of Western technology to Japan must come to grips with one amazing phenomenon - the relatively limited number of personnel who actually came into direct contact with Western institutions, literature, etc. since the Meiji Restoration. For example, Masaru Saito quotes data to show that the maximum number of students sent abroad annually for study by the

Ministry of Education between 1875 and 1940 never exceeded 200. Similarly, the number of foreign personnel in Japan, "hired foreigners" as they were called, in the period from the 1870s to the 1890s, never exceeded 6,500 persons.

This phenomenon is repeated in the petrochemicals field in the post-war period. In the early 1950s, when the emphasis was on search, selection, negotiation and acquisition of imported technology, a resolution of MITI required the Japanese firm chosen to carry out these tasks to employ 8 to 10 professionals whose sole task was to find four to five "basic technologies" required for initial production by the firm. And these firms were relatively few: for example, in the production of basics, only four "pole" firms were chosen for this purpose.

The next phenomenon which is outstanding is the emphasis right from the beginning on disaggregation of the technological package, through the application of laws by MITI during the study and approval of licences for contracts for foreign technology. For example, a 1950 Foreign Investment Law required that any contract involving outflows of foreign exchange for technology must be approved by an inter-ministerial committee, which, in the case of petrochemicals, was a sectoral department of MITI, the Japanese Agency for Industrial Science and Technology (AIST).

The criterion used for deciding on approval or otherwise of such contracts was first that maximum use must have been made of the internal resources of the country. For example, the only foreign purchase usually approved would be for modular technology and the detailed engineering services required for incorporating the imported component would be handed over to Japanese engineering firms. These latter firms had been created in the post-war period from the construction departments of petroleum and chemical firms with experience in setting up and constructing traditional petroleum and chemical plants.

As a result of this policy, there are today in petrochemicals in Japan three or four main independent engineering companies with between less than 50 and over 1,000 professionals with the ability to compete in international markets for contracts. These provide engineering services around processes originating in Japan, but also act as intermediaries for countries importing technology from sources other than Japan. A study by Freeman for the period 1960-1966 produces data which do not support these assertions, and claimed that Japanese and French contractors were the least successful at winning export contracts: We suspect that it is because the period chosen for the study, 1960-1966, was one of continuing assimilation by Japanese firms.

It should be pointed out that this policy was not one of complete autarky. In the last decade, for example, over 400 contracts for importing petrochemical technology were approved by MITI and, in fact, it is envisaged that the Japanese Government will soon no longer need to approve these contracts, since the judgements of the firms themselves can now be relied on.

Annex II to chapter I

POLICIES ON ASSIMILATION AND ADAPTATION OF IMPORTED TECHNOLOGY AND POLICIES FOR GENERATING NEW TECHNOLOGIES

Policies on Assimilation and Adaptation of Imported Technology

The main direction of the Japanese Government's policy was to allow to emerge an initial cartel of only 4 petrochemical complexes with a minimum of 20,000 tpy of each basic product. These were decided on from an estimate of the minimum volume of production required for minimal efficiency based on costs of production.

In order to allow this cartel to emerge, a major policy was to suspend the intervention of Anti-Trust legislation which meant that these 4 were able to sell basics only to their subsidiaries and affiliates. Other devices were the granting of subsidies and incentives and various mechanisms for encouraging exports to markets in third countries. In effect, the only competition which was encouraged was in finished products such as plastic resins, detergents, and intermediate materials for synthetic fibres.

These 4 firms were required to set up laboratories and pilot plants on the sites of the complexes in order to incorporate improvements in any expansion in capacity which may be envisaged. It turned out that most of these improvements were to tertiary products where most of the competition was felt.

In return for these extra costs incurred by the firms, MITI applied a protectionist policy through the establishment of import quotas. Customs tariffs were avoided, as for basic and intermediate products at least, these would add to the production costs of the final products. Further, there were temporary eliminations of income taxes and taxes on certain inputs and assets. And finally, long term lines of credit (8-10 years) at low interest were recommended by the Government from the financial cartel – the zaibatsu; for it must be realized that as much as 80 per cent of a petrochemical project is financed by debt rather than equity.

In the particular case of the basics, such as ethylene, the policy was to depend on foreign technology and to encourage the interchange of experiences in the 4 'pole' firms, to provide a common front with the foreign owners of the technologies. This pooling of information led to a situation where 3 or 4 apparently separate Japanese companies would be negotiating at the same time with the same foreign firms for the same initial technology.

Policies for Generating New Technology

Whereas during the early 1960s the R & D in all sectors was done within the firms themselves, and in the case of petrochemicals, through their own central laboratories, in 1966 a national programme of R & D was launched. By 1971 there were 9 national projects of which 2 were in petrochemicals. The project attempted to find new processes for desulphurisation of fuels and combustion gases while the other worked on the basic petrochemicals. We pointed out previously that most of the *private* R & D was on tertiary plants, so that this was an obvious attempt to correct at a national level, the biases of the private sector.

Some idea of the costs of this research effort can be gleaned from the fact that Japanese petrochemical firms spent on average about 3.5 per cent of their annual sales on R & D during the 1960s, and there was even a case of one firm where the figure reached 7 per cent. Contrary to what may be expected, the cost per researcher in petrochemical firms was much lower than the national average – $12,000 compared to $24,000 per year. The two national petrochemical projects cost around $22 million over a period of 6 to 7 years [11].

In addition to these national projects, MITI sponsors annually about 50 R & D projects in all industries including petrochemicals. Further, it grants special credits, incentives and accelerated depreciation to certain plants which are based on indigenous Japanese technology. MITI's policy of disaggregation of imported technology led Japanese firms to acquire experience in design, detailed engineering and construction. Personnel benefited from on site training and from movement from the central laboratories to the actual complexes.

Although the Japanese Centre for Information for Science and Technology was set up at an early stage, it seems that this provided only secondary sources of information. The primary sources remained contacts with foreign personnel through trips abroad and attendance at international congresses and the access to foreign journal articles through translations.

Source: S. DeCostra, "A technological policy for petrochemicals in CARICOM", Science and Technology Policy in the Caribbean. A special issue of Social and Economic Studies, vol. 28, No. 1, March 1979.

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II. THE ANATOMY OF ENDOGENOUS TECHNOLOGICAL CAPABILITY AT THE ENTERPRISE LEVEL

In chapter I, endogenous technological capability was considered from the economic point of view. In this chapter, it will be considered from the micro-economic point of view, i.e. at the level of the firm or the enterprise (henceforth production unit).

The chapter is composed of three sections. The first section reviews what constitutes endogenous capability at the level of the production unit; the second section deals with how development of endogenous technological capability can be dealt with in investment project evaluation; and the third section is a brief review of project evaluation methods in industrial banks in the region.

A. Endogenous technological capability at the level of production units*

Most of the industrial technology in the region is imported. These technologies are acquired in association with investment projects either to set up new industries or expand, diversify, improve and utilize new raw materials in industries already established. The region acquires technology also through the usual indirect channels, e.g. training abroad, scholarships, publications, consulting organizations, data banks, information centres and joint research activities. The direct flow of technology through investment in new production facilities, however, is by far the most important channel of technology acquisition in the region. It would be useful for the purpose of this study to differentiate between three components of technology capabilities in the technology flow:

Flow A, to include capital goods and technological services;
Flow B, to include operating skills and know-how;
Flow C, to include knowledge and expertise for implementing technical change.

Although this separation between the various composite elements of technology serves the purpose of the study, it is nonetheless a deviation from the strict definition of technology. According to this definition, it is not the goods and services which constitute technology but the knowledge and expertise which is used to produce them.

The importance of the above classification, however, is not only in its analytical usefulness but in the fact that the decision-making processes regarding investment in each category tend to be significantly different. In the following, the differences are examined. First the components of each group are specified.

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* A thorough discussion of this subject can be found in the ESCWA publication The Acquisition of Imported Technology for Industrial Development: Problems of Strategy And Management in the Arab Region (E/ESCWA/NR/85/16), part 1, chapter 1. The discussion in this section draws heavily on the material in this publication, especially chapter 1.

The components in flow A include all machinery and equipment or hardware technology (capital-embodied technology) and the technology services studies, techno-economic feasibility studies, design engineering, construction and installation services, plant commissioning, start-up services, training services and so on.

These capital goods and technological services relate to the new production facilities established by the investment projects. They contribute to the industrial production capacity of the country.

The technology components in the second flow (flow B) relate to those necessary expertise and skills needed to operate and maintain new production facilities at the designed level of efficiency. These necessary expertise and skills usually have two sources: either they already exist in the local economy, hence, they will be relocated to new facilities and be augmented through training programmes and experience; or they are imported from foreign sources as expatriate staff. The latter components will, of course, be excluded when leaving the country.

Generally, therefore, the two main components of flow B are information and training.

Information will be contained in the manuals, schedules, charts, diagrams, etc., which will usually be supplied with the production facilities. They will include specified operating procedures and routines for the facility as a whole and for individual activities within it; the specifications for the output to be produced and for the inputs of materials, and components to be used; the procedures for maintenance, repair, quality control and instructions for marketing output, purchasing inputs and so on.

Training includes various forms of training and instruction which contribute to generating the necessary skills for carrying out the tasks of running the production facility, familiarization with the procedures, routines, specifications, organizations, etc.

If flow B is concerned with the skills and knowledge that relate to operating the new facility, the technology in flow C is concerned with the technical knowledge and expertise needed for implementing technical change.

Technical change may involve adaptations or improvements in the production facilities that have been set up. These changes and improvements may take the form of changing products, processes, materials, procedures and organizations. They may also be realized through creating subsequent new production units of similar or related type through new investment.

This distinction between skills and know-how involved in operating and maintaining a production facility and those involved in generating technical change in the same facility or in a new facility is, as will be seen, of capital importance to the main thesis of this study.

Admittedly these two types of technology components tend to overlap and the distinction may appear artificial, "One can seldom design and create changes or new production systems unless one has the know-how concerned with their efficient operation."1/

"But the knowledge and expertise required to generate technical change is usually additional to, and significantly different from the knowledge and skills required to operate given facilities: one may will have the latter, without having very much of the former. Thus, although the two bodies of knowledge and skill overlap and although the borderline between them is blurred, the distinction is nonetheless clear enough in principle and ... it has considerable importance in practice."2/

For technological decision-making purposes it is essential to assess accurately the relative importance of the various components within flow C. Two categories are generally classified within this flow: system-specific knowledge and expertise needed to generate technical change to use and transform it into new or changed production systems.2/

The system-specific technology is usually "deeper" than the technology involved in operating the system. It consists of technical knowledge about the principles and material properties and principles incorporated in the production, material, etc. "This deeper body of knowledge and principle is sometimes described as "know-why" in contrast to the know-how that is required for ongoing operation of a production system."2/

The second category, i.e. the knowledge and expertise needed to create new production systems includes (for example) the expertise required to carry out various types of engineering, planning and design, to conduct technical and techno-economic evaluation of alternative plans and designs and to transform designs into hardware incorporated in new or changed systems.2/

Thus it is clear, first, that the latter kind of expertise is not the type needed to carry out individual tasks in an ongoing or new production facility: it is the techno-managerial capabilities that are needed to co-ordinate those various technical tasks; to acquire the needed goods and services from various sources; and to formulate work programmes which go into creating efficient new industrial facilities.2/

Secondly, part of this expertise relates to the specific skills required to generate new knowledge about production systems. These skills more or less correspond to the expertise required to carry out technological research and experimental development that generate new system-specific knowledge to be incorporated in the new or changed production facility.

1/ United Nations Economic and Social Commission for Western Asia, The Acquisition of Imported Technology for Industrial Development: Problems of Strategy and Management in the Arab Region (E/ESCWA/NR/85/16), pp. 17-18.

2/ Ibid., p.18.

It may be useful to mention that the above expertise could be further sub-categorized depending on the objective of the analysis.

How does the above analysis relate to the subject of this study?

The hypothesis in this study is that the overwhelming concern in the region generally and the industrial banks particularly, has been with the development of technological capabilities in flows A and B., i.e. the focus has been on importing technology for expanding industrial production capacity. Although these technologies add to the country's stock of physical and human resources for producing industrial goods, the additional production capacity according to the above analysis is inherently technologically static.1/ In other words, while the acquired technology constitutes a capacity for producing industrial goods, it does not constitute a capacity for producing the technology for industrial production. Only investment in flow C leads to augmenting the technological creative capability of the economy and makes it possible to develop resources capable of generating their own technological dynamism.

To recapitulate: there are two distinct aspects of imported technology with regard to development of endogenous technological capabilities. One aspect has a short-time horizon and is concerned with the immediate expansion of industrial facilities; the other has a long-time horizon and is concerned with the overall process of accumulating the creative technological capabilities to control and direct future expansion.

This fundamental difference, which was reflected in the nature of the components of flows A and B, on the one hand, and flow C on the other, has important policy implications. It gives rise to at least two dichotomies which will have to be dealt with if the functions of the industrial banks are to be reoriented to nurture technological changes. To explain these two dichotomies within the context of ESCWA countries, the first dichotomy lies in the fact that investment in the component of flow C will mainly have long-term returns, whereas the objectives and the operations of the industrial banks are tailored to short-term returns. The objectives and operations of the industrial banks in most ESCWA counties, as will be seen in section C of this chapter, stem from the countries' overall industrial strategy. Those objectives and operations, more often than not, are oriented toward those investment activities which expand immediate production capacity, and are made on the basis of short-term returns and benefits accruing to the production unit concerned. Investments in the technologically creative capability (i.e., investment in the components of flow C), however, would generate changes and improvements that might not necessarily accrue entirely to the production unit immediately concerned, but accumulate over the whole lifetime of the production unit. Furthermore, the benefits of the investments in technologically creative components accrue to more than just the production unit which initiates the investment: the production unit itself, the industry and the whole economy benefit from the development of capabilities which can generate new production systems.

1/ United Nations Economic and Social Commission for Western Asia, The Acquisition of Imported Technology for Industrial Development: Problems of Strategy and Management in the Arab Region (E/ESCWA/NR/85/16), pp. 20-21.

There are also two other aspects to the technologically creative capability which have important policy implications.

First, while the sources of changes in the production capacity could be import-based, development in technologically creative capability is more likely to be in the form of locally supplied technological inputs. Secondly, for the imported components of technologically creative components to be effective in augmenting technological capability, they must be considered an integral part of a broad strategy for the development of domestic technological capabilities. This is because, as noted in chapter I, in the context of a technology-importing economy, the development of endogenous technological capability is the result of cumulative interaction between existing technological capabilities and the addition to these capabilities through flow C components.

What these points underline is that reorientation of the industrial banks' objectives and operations can only be done within the framework of an overall technology development strategy for the industrial sector and the economy, a subject examined in the following section.

B. Development of endogenous technological capabilities and project evaluation methods in the industrial banks

Bearing in mind the characteristics and the particularities of the endogenous technological capabilities, which have just been reviewed, especially those which relate to components of flow C, can the process of building technological capability be incorporated in the present standard decision-making procedure employed by the industrial banks in the region? If not, what alternative solution is there?

As will be shown in section C of this chapter, most of the industrial banks in the region apply some form of project evaluation methods in making their investment decisions. It would, therefore, be useful to examine how the project evaluation methods deal with the issue of technological capability development. It is often claimed, according to the UNCTAD Handbook on the Acquisition of Technology by Developing Countries, that a proper preparation or appraisal of a project "is the essential first step before there can be meaningful negotiation on the transfer of technology ... (or) meaningful development plan."1/ Yet there has not been a meaningful technology development plan, nor has the treatment of technology in project appraisal methods been anywhere near satisfactory and "... none of the techniques recently worked out deal effectively with the transfer of commercial technology from abroad. From this background it follows that the viewpoint of those who prepare project(s) with the intention of providing a loan and/or selling technology, and that of the government official in a developing country, are likely to be quite different"2/.

1/ UNCTAD, Handbook on the Acquisition of Technology by Developing Countries, Annex, "Project preparation and cost-benefit analysis" (UNCTAD/TT/AS/5), United Nations publication, Sales No. E.78.11.D.15, p. 59, para. 1.

2/ Ibid. p. 59, para. 2.

These statements, which were made more than a decade ago, still hold true. Although a proper project evaluation is essential both for public and private sector projects, the methodologies used, particularly in relation to technology capability development, suffer from serious limitations. In addition there are often a large number of 'unmeasurable' effects, so that there is danger of spurious precision. There should always be a qualitative appraisal in parallel with such calculations.

The following section contains a brief review of how technology capability development is dealt with in the project evaluation methods, together with some suggestions, and a review of the state of application of methods of project evaluation in some industrial banks in the region.

Project evaluation is basically a method for selecting the best between alternative uses of resources. Benefits and costs are all assessed and evaluated. The best project would be the one whose benefits most exceed the costs. Costs are opportunity costs, the benefits foregone by not employing the resources required for the next best project. The project evaluation exercise begins when the economic and technical feasibility studies of a project or a series of alternative projects are completed and the financial statement concerning each is clearly outlined. These financial statements would then be subjected to adjustments to allow for the "unmeasurables". It may be necessary to include or exclude, or revalue some of the initial costs and benefits. Some inputs and outputs may have to be revalued for differences between the market and shadow prices. The latter is defined as "the increase in welfare resulting from any marginal change in the availability of commodities or factors of production."1/ Within the context of developing countries, the concept of shadow prices derives from the fact that capital may be undervalued, and unskilled labour and exchange rates overvalued, a phenomenon which may encourage importation of technology at the expense of developing it locally. A shadow price which attempts to give a more accurate evaluation of the country's inputs and outputs is called an efficiency price.2/

The project may also entail consequences which are neither costs nor benefits to the project itself. These are known as externalities and linkage effects. Both are hard to measure, but they should be assessed as far as possible as they may be significant for the development objectives of the country. The endogenous technology capability development aspects of a project are very likely to fall in the externality category.

Bearing in mind what was reviewed above in this chapter, it could be argued that only under one condition could the technology transfer process create measurable externalities for the benefit of the economy; under two conditions the transfer process would be unable to create any such benefits; the two unfavourable conditions are considered below.

1/ UNCTAD, Handbook on the Acquisition of Technology by Developing Countries, p. 61, para. 21.

2/ Ibid., p. 62, para. 23.

To begin with, the externalities would have to be viewed from the point of view of the overall development objectives. All projects which introduce something new for those engaged in them must transfer some technology. The range, however, is very wide. An investment project which has been implemented on the basis of a "product-in-hand" contract will familiarize management, engineering and skilled labour with a series of new skills; however, based on the experience of the countries in the region, it would not bring the country any closer to the objective of self-reliance in technology. Therefore, the endogenous technology-capability-building aspect of such a transfer process would be negligible. The same holds true for a technology licensing agreement which imposes restrictions on the use of local inputs and prohibits any diffusion of the technology acquired.

On the other hand, a technology transfer process which emphasizes: development of endogenous technological capabilities by including significant training components; participation of local capabilities in the design and engineering work with the supplier of the technology; acquiring substantial local inputs and involving local research and development in the production process; and other components which will enable the country to carry out future expansion and adaptation using more endogenous capabilities will have important favourable externalities. Most of these externalities lend themselves to numerical evaluation. The cost-benefit analysis of a project, therefore, should consider these externalities. The question is how.

There tends to be widespread agreement that, for a number of reasons, there should not be, in applying project evaluation methods, a numerical result to indicate the balance of costs and benefits relating to endogenous technological capability development objectives. Instead, there should be an iterative generation of information for the improvement of the project proposal.1/

The underlying suggestion here is that the role of project evaluation in the development of endogenous technological capability would not be to select between alternative projects, but within the selected project to improve on the formulation of the project so that technology development aspects are well considered.

There are many reasons for this suggestion. Some of them relate to the nature of the development of technological capability and some to the nature of the project evaluation methods themselves.

On the project evaluation side, the state-of-the-art of the techniques applied does not favour selection of projects which have technology capability development implications on the basis of single numerical results. The reasons here relate to: (a) the type of data needed; (b) the administrative cost involved; (c) the inherent weakness in the project evaluation methods; and finally (d) the possibility that imprecise measurements may lead to compounded mistakes.

1/ United Nations Economic Commission for Western Asia, Technology Policy Criteria and Project Evaluation Procedures (E/ECWA/NR/85/4), April 1985, p. 39, para. 4.

The data required for project evaluation methods are usually of two types: the "basic" or "project specific" data, and the "national parameters". The latter, which include information on development objectives, resources and policies, would be provided from the national policy level to the project evaluation level. The more sophisticated the project evaluation method, the greater would be the need for refined data. Unavailability of refined data in the region has been one of the main reasons for developing the simple UNIDO/IDCAS (Industrial Development Centre for Arab States, now AIDO) approach for project evaluation; which is a value-added approach with some extensions.1/

There may also be formidable administrative costs to gap the bridge between the socio-economic desirability of a project and the market evaluation.

> "The critical question ... is the capacity of the government to use the tax-subsidy instrument effectively in all cases. The social cost-benefit analysis implicitly assumes that the government has this capacity... It is unlikely in a large number of LDCs that this capacity to tax would match the need for subsidies."2/

Even when the iterative method of project evaluation is used as against the "straightforward" method, the method is still criticized for being "static" at the point of selecting the projects. It diverts attention away from such factors as learning, managerial efficiency, entrepreneurial dynamism and strategic planning.3/

It has been pointed out that political pressure may make any inconsistency between the national development objectives and the private objectives set for the project evaluation irreconcilable.

> "Practitioners try to select the quantifiable, identify it with the important and happily proceed to suboptimize. The result may be the worst of all possible worlds. Rationality about a subsystem can be worse than subrationality about the whole... Cost-benefit analysis has a tendency to convert political, social and moral choices into pseudo-technical ones... A decomposed set of indices will lead to better decision than a composite index"4/

1/ United Nations Economic Commission for Western Asia, Technology Policy Criteria and Project Evaluation Procedures (E/ECWA/NR/85/4), April 1985, pp. 38-45.

2/ United Nations Economic Commission for Western Asia, "Project evaluation criteria and technology policy" a paper prepared by V. V. Bhatt for the Seminar on Technology Policies in the Arab States held in Paris 14-18 December 1981, p. 5.

3/ Frances Stewart, "Social-cost analysis in practice", World Development, vol. 6, No. 2, 1978.

4/ P. P. Streeten, "Cost benefit and other problems of method". Bulletin of Oxford University Institute of Economics and Statistics, 1976, p. 2.

For these reasons, it has been argued that the project evaluation methods would serve the purpose better by generating a set of indices and qualifications instead of one numerical result:

> "One of the principal benefits from cost-benefit analysis was not the numbers at the end but the external benefits of having gone through the process of asking questions that cost-benefit analysis raised and addressing oneself distinctly to the issues that had to be tackled."1/

Thus a set of questions relating to each capability component can be raised in connection with each project. The information would assist the project evaluator in evaluating the project and the project formulator in incorporating elements of the technology capability development in the formulation of the project.

The UNIDO Guide to Practical Project Appraisal helps to give an illustration. It develops what it calls a "project summary matrix". The evaluation process in this approach is conducted in stages. The first stage deals with financial analysis and price distortion; the second stage deals with saving impact; the third with income distribution impact, and so on. The information on the results at each stage is presented in a summary graph depicting the calculated net present value at different rates of discount. These quantitative results are accompanied by a brief qualitative description. The project summary matrix referred to above contains the quantitative and qualitative descriptions.

The specific qualitative aspects of the technological capability development could be added to contain qualitative statements. No numerical adjustment to the current value would be warranted, nor, for the reasons mentioned above, could it be justified.2/

From the technological capability side, there are the following arguments. (a) Components of technological capability may be sector-specific; therefore, evaluation decisions may only be made at the sectoral level. In some complex sectors the development of some of the components may take decades. (b) Development of technological capability is not a free or automatic by-product of a capacity expansion activity: it requires deliberate policies and planning: in other words, technological capabilities would not be acquired by basing the project selection on a project evaluation method but through formulating and planning projects in a way which makes it possible to optimize development of technological capabilities. (c) Finally, an important element in technology capability development is the capability to improve established facilities; adapt them to changing conditions; and increase their productivity and efficiency. This capability, it has been argued, requires a

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1/ John McArthur, "Contribution to symposium on cost-benefit analysis and income distribution in developing countries", World Development, vol. 6, No. 2 (February 1978), p. 231.

2/ UNIDO, Guide to Practical Project Appraisal, Social Benefit - Cost Analysis in Developing Countries, Project Formulation and Evaluation Series, No. 3 (ID/SER/K/3), United Nations, New York, 1978, p. 79.

dynamic perspective of things different from the predominantly static questions addressed by project evaluation methods which are concerned with establishing new production facilities and making proper selection of projects and industries.1/

C. Methods of project evaluation in industrial banks in the ESCWA region

What methods of project evaluation are used by the industrial banks in the ESCWA region?

The review below is based on the findings in a number of ESCWA countries divided in three groups: the diversified economies, which are Egypt, Jordan, Iraq and the Syrian Arab Republic; the Gulf Co-operation Council (GCC) countries, among which are Kuwait, Qatar, Oman and the United Arab Emirates; and the Yemen Arab Republic. The period covered is up to 1985, and the observations are based on information compiled in a field visit carried out in that year.2/ Finally, the answer to the question posed at the outset is given in general terms. A more up-to-date and detailed treatment of the subject will be provided on the basis of the country case-studies which are being prepared for this study and which will be presented in the November meeting.

In the diversified economies, despite some differences in the economic system, the decision-making processes generally tend to be somewhat similar. Project evaluation, by and large, is based on a mixture of economic, technical and non-economic factors. A combination of common sense and common practice, rule of thumb and some notion of concepts such as shadow prices is discernable in the operations of the industrial banks. Generally, however, the thoroughness and accuracy of the feasibility studies tend to vary from one case to another, and the methodologies applied are not always consistent with the well-known methodologies in the field. Availability of data, uncertainties, and in some cases lack of expertise appear to have been the main hindrance to proper application of evaluation procedures. Distortions in prices, interest rates, and exchange are not adequately treated.3/

There is also a uniformity in the procedures for obtaining industrial loans. It usually begins with the obtention of a licence from the Ministry of Industry followed by a feasibility study or submission of relevant data for such a study to be conducted by the Ministry or the industrial banks themselves.

The feasibility studies would, in addition to sale value, costs, and profitability of the project, contain information on the following: prices and competitiveness of the product in the local markets; availability of local raw materials; local capital inputs, technicians, skilled and unskilled workers;

1/ Economic Commission for Western Asia, Technology Policy Criteria and Project Evaluation Procedures (E/ECWA/NR/85/4), April 1985, pp. 44 and 46.

2/ Ibid., p. 51.

3/ Ibid., pp. 52-53.

managerial talents; import requirements of foreign technology; forward and backward linkages; transport facilities and amenities and foreign sources of technology. But how did the feasibility studies treat the development of technological capabilities? "In many meetings with officials it became clear that this issue has not received much thought, at least not at the general level."1/ In certain projects, the problems of shortages of experienced and well-trained staff were acknowledged, and the possibility and the necessity of providing training and gaining experience in a project were taken as evidence indicating that development of skills and capabilities through various forms of training was a prerequisite to operating the project and not just a benefit or an aim to be appraised on its own.

The situation in the GCC countries is not much better. There are, however, some notable differences although not so much in relation to project evaluation procedures.

The decision-making procedure is becoming increasingly formalized in these countries. Just as in the former group, the Ministries of Planning and Finance provide guidelines and the Ministries of Economy or Industry and Commerce evaluate applications for licences by private enterprises. The tendency in all the countries considered is towards encouraging private enterprises. There is also an emerging trend in some of the GCC countries, notably Kuwait, to promote industrial activities across the border. The main constraint facing industrial expansion in this group of countries is, in addition to the relatively small market, lack of indigenous expertise and skills. Extensive educational and training schemes are being sponsored to remedy this problem. The policy of replacing expatriate skills with nationals is gaining momentum. Training programmes for new industries are included as part of the investment contract by foreign suppliers, or partners in joint venture companies.

Joint venture partnership as a method for developing experience and acquiring technology is especially encouraged for new industries which cater for the export market, but is still not a widespread practice.

Most of the feasibility studies for large projects are still carried out by foreign consultants. The industrial banks, however, have increased their effort in this sphere with respect to small manufacturing projects. More project identification, pre-feasibility studies, supervision of feasibility studies and monitoring project implementation are now carried out by the industrial banks (more on this in the following chapter).

In the Yemen Arab Republic, the Ministry of Industry and Economy issues industrial licences and requests industrial projects with a capital of 5 million Yemeni rials (YRls) to submit a feasibility study. Generally, however, because of shortage of projects most projects get approved except when there is duplication. Once a licence is issued, a request may be made for loans from the industrial banks.

1/ Economic Commission for Western Asia, Technology Policy Criteria and Project Evaluation Procedures (E/ECWA/NR/85/4), April 1985, pp. 52-53.

The banks have their own, albeit limited, in-house capability for conducting feasibility studies. They also assist applicants with technical matters. Yemen, nevertheless faces a serious shortage of trained officials. The shortage is both in the number and level of expertise available. Yemen has been experimenting with a number of remedies to deal with these shortages, including pairing local counterparts to foreign experts in executing projects. The staff of the industrial bank seemed to be familiar with the UNIDO Manual for Feasibility Analysis, and applied it to some extent. But the UNIDO/IDCAS Manual on Project Evaluation was considered "too sophisticated."[1/] The concept of shadow prices has been regarded with suspicion and generally the country suffers from lack of local technological capability to conduct technology negotiations. As a result, Yemen is still heavily dependent on foreign experts and advice for technology transfer.

1/ Economic Commission for Western Asia, Technology Policy Criteria and Project Evaluation Procedures (E/ECWA/NR/85/4), April 1985, p. 56, para. 9

III. THE MANUFACTURING SECTOR AND THE INDUSTRIAL BANKS IN THE ESCWA COUNTRIES: REVIEW AND APPRAISAL*

This chapter will be in two parts. The first part will review government policies concerning financing private manufacturing industries; and the second will deal with the industrial banks; their finance, operations, and non-financial activities. The chapter, however, begins with a brief description of the manufacturing sector in the economies of the ESCWA countries.

A. The manufacturing sector and its importance in the ESCWA region

The growth rate in the manufacturing sector compares favourably to the growth rates in the other economic sectors during 1980-1985. During this period, investment allocations for industrial development in the region increased by around 23 per cent over the allocation during 1970-1980. The increase in the allocation was both in absolute and relative terms. It exceeded the share of investment in other sectors in the total investment. Among the three groups the highest increase in the share of investment in industry was recorded for the GCC countries. Their share in the total planned regional investment in industry increased from 39 per cent during the 1970s to 78 per cent during 1981-1985.

The actual investment in industry in each of the countries covered, however, tells a different story. It was generally well below the planned investment. Part of this discrepancy was externally caused by the deterioration in the general economic performance in the region which was brought about by the near collapse of oil revenues. Nevertheless, based on data available for some of the countries considered, the absolute and relative importance of actual investment in manufacturing was still high during 1981-1985, compared with other sectors and with investment in manufacturing in other developing countries.

Table 3. Gross fixed capital formation (GFCF) in manufacturing of selected ESCWA countries in 1975 and 1985

(Millions in national currency)

Countries	Value of GFCF		% in Total GFCF	
	1975	1985	1975	1985
Egypt *	2356.0	6970.0	19.5	23.4
Syrian Arab Republic	2340.0	4306.0	45.0	24.1
United Arab Emirates	286.8	1444.7	22.7	26.7
Yemen Arab Republic	35.0	168.0	6.1	4.4

Source: See document (E/ESCWA/10/87/14), p. 15.

* Including mining.

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* This chapter relies mainly on the information provided in the ESCWA publication Industrial Financing in the ESCWA Region, Industrial Development Series No.6 (E/ESCWA/ID/87/14).

The second half of the 1980s saw marked changes in government economic policies, particularly in the diversified economies. Investment in manufacturing was reduced both in absolute and relative terms. Although data are not available for all the countries covered, the information for planned public sector investment in a number of countries show that there was appreciable reduction: in Egypt from 7 billion to 5.8 billion Egyption pounds (LE); in Jordan from 23 per cent to 12 per cent of total planned investment. The policy change was also marked with regard to the role of the private sector; it was given a much grater role to play in industrial development.

B. Government policies to encourage manufacturing industries

Generally four sets of policy measures are involved in encouraging the development of the private manufacturing sector in the ESCWA countries: (1) government monetary and fiscal policies; (2) infrastructural support; (3) foreign investment; and (4) technical support.

Infrastructural and technical support are not specifically provided for the development of the private manufacturing sector; they are usually there to support the economic activities of the various sectors. Each sector can make use of them according to its needs. This is not to undervalue the importance of these facilities. On the contrary, unavailability or limitation of the infrastructural and technical facilities could be a severe constraint on the development of industry and industrial technological capabilities. Indeed, part of the reason in the developing countries for linking the operations of the specialized financial institutions with technological capability-building arises particularly because of the limitation of the existing infrastructural and technical support. These aspects will be referred to in another chapter. The review here will be confined to the monetary and fiscal policies and the foreign investment facilities that are directed specifically to assisting private industrial investment.

1. Government monetary and fiscal policies towards manufacturing

The central banks in the region exercise their promotion of manufacturing industries through policy measures directed at encouraging domestic investment in manufacturing. These measures usually include lowering the legal reserve ratios on saving deposits, and on inter-bank deposits in activities related to manufacturing; exempting manufacturing loans from the required credit deposit ratio and providing government guarantees on such loans; exempting long-term loans of commercial banks from credit deposit ratio when the loans are for development projects; offering soft loan facilities for export of manufactured goods, and a number of other similar facilities,

In some countries, notably Egypt and Yemen, the preferential interest rate has been the main monetary policy tool to promote industrial investment. In Egypt, for example, in 1983 a maximum ceiling of 13 per cent was imposed on loans for industrial projects.

In addition to the monetary policy measures, Governments also apply a number of fiscal policy measures to stimulate the private manufacturing sector. These measures have generally been of two types: (a) low rates or exemption from custom duties; and (b) exemption of industrial revenues from income tax. There are, however, marked variations between the three groups of countries considered in the application of these incentives. There are also some differences between the countries in each group.

Kuwait, Qatar, Saudi Arabia and the United Arab Emirates exempt fully from customs duties all imports of capital goods, intermediate goods and raw materials used in manufacturing and without any time limit. Some of the GCC countries have conditions attached for granting the exemption; the conditions may relate to the overall industrial development objective of the country. In the meantime, there are efforts to standardize exemption procedures among the GCC countries.

In Jordan the level of incentives is linked to the size of the project and to the geographic location. Moreover, they tend to be more favourable to medium- and large-scale industries than to small and cottage industries. No such differentiation is made in the Syrian Arab Republic or Iraq. In Egypt, in addition to the privileges and exemptions given to Egyptian, Arab and foreign investors in manufacturing, concessions in the form of 5 per cent reductions in custom duties on manufacturing machinery and equipment are granted to investors in six depressed regions.

Most of the concessions are given to both industrial expansion and to new projects. This, however, is not the case in tax holidays, where in the majority of cases a time limit is imposed. Export of manufactured goods is also encouraged through exclusion of export tax and a number of other taxes such as production tax, municipal fees, as well as through refund of tax on imported contents.

In almost all the countries concerned, the exemptions referred to are part of a package for industrial promotion. This package, in addition to the exemptions, also includes provisions for the size of the project, use of locally supplied raw materials, contribution to import substitutions, export promotion and use of modern technology. Nowhere in these packages is there a reference to the development of technological capabilities, nor is there any provision for them. There is also no reference to the pattern of the technology transfer process.

2. Encouragement of Arab and foreign investment in manufacturing

All ESCWA countries encourage Arab and foreign investments in their manufacturing industries. Differences in emphasis of course exist. In most cases, the privileges and facilities offered tend to be similar to those given to the nationals of the country. Generally, however, Arab investors are given more privileges than foreigners. In most GCC countries foreign capital must be either associated with national capital or be a part of a joint venture. In some GCC countries the foreign capital participation in the project cannot exceed 49 per cent of the capital. There are also sectoral and size restrictions on the projects. In other ESCWA countries, while there are preferences concerning the manufacturing industries where Arab and foreign investment are encouraged, there are no ownership restrictions. The incentives in the non-oil producing countries include permission to repatriate capital after a specific period of time. In the Syrian Arab Republic there is no general rule governing foreign investment. Each case is treated on its own merits. Bilateral agreements however, once approved, are protected against nationalization. Iraq does not permit foreign investment, but offers Arab investment the same treatment reserved for nationals.

C. The industrial banks in the ESCWA region

1. Financial resources of the industrial banks in the region

Most of the industrial banks in the region were established in the 1970s, except for Iraq, Jordan and the Syrian Arab Republic, where they were established in the 1960s. The total resources available to industrial banks increased considerably in the period 1975 to 1987. The sources of finance of these banks also changed and tend to be different among the groups and within each group.

The paid-up capital taken in four countries as an example either doubled or increased many times over during the period 1975-1984. In Jordan it increased from 4.5 million to 8.6 million Jordanian dinars (JD). In Egypt, it increased from LE 7.4 million to LE 33.3 million, and in the Yemen Arab Republic from YRls 62 million to YRls 150.5 million. Table 4 shows that the total resources of the industrial banks in the countries considered also increased substantially, in Egypt, for example, from LE 113 million to LE 477.1 million.

Table 4. Total resources available to industrial banks in selected ESCWA countries, 1975 and 1985

(In millions of local currency units)

	Egypt		Jordan		Kuwait		YAR	
	1975	1985	1975	1985	1975	1985	1975	1985
Total Liabilities Share and holders equity	113.0	477.1	20.3	55.9	69.4	586.0	96.6	226.5

Source: Document (E/ESCWA/ID/87/14), pp. 111-114.

In Jordan and Yemen rates more than doubled, but the greatest increase was recorded in Kuwait, where they increased by more than eightfold. There has been significant change also in the source of finance of the industrial banks. In Kuwait, for example, the relative importance of the paid-up capital in the total resources of the banks declined from 14.4 per cent in 1975 to 3.4 per cent in 1985. The share of deposit and long-term borrowing increased from 48.4 per cent to 60.0 per cent of the total liability in the years mentioned. A similar trend is discernible in the case of the other three countries considered. The importance of the government paid-up capital in Egypt, Jordan and Yemen has markedly declined in relative terms, that of public shareholding, long-term loans and international financial institutions increased. The importance of each of the latter also tends to be different from one country to another. For example, in Egypt the share of long-term borrowing increased from 73 per cent in 1980, to nearly 82 per cent in 1985. The greatest share of the latter (nearly 40 per cent) was financed by international financial institutions and foreign bankers. Local commercial banks represented 27.2 per cent, foreign long-term loans, which were supplied mainly by the World Bank, the African Development Bank and European Investment Bank, represented the rest. The share of private deposits in the total resources, although increased by many times still remained around 6 per cent in the two years mentioned. In Jordan more than half of the bank's resources originated in long-term loans provided mainly by the Central Banks, the Kuwait Fund for Arab Economic and Social Development and foreign institutions. The share of the (government) paid-up capital declined from nearly 22 to 15.4 per cent between 1981 and 1985. In Yemen on the other hand, the changes in the source of finance were not marked. The Government remained the holder of the largest share, 70 per cent of the paid-up capital, which was the banks' main source of finance. The rest was supplied by the German Company for Development of Yemen, the Yemen Bank for Reconstruction and Development and local private investors. In 1986, the Industrial Bank of Yemen increased its long-term loans from foreign sources significantly. These sources represented nearly 32 per cent of the Bank's total resources. They were supplied mainly by the International Development Agency and the Kuwait Fund for Arab Economic and Social Development.

These changes indicate increased confidence in the operations of the industrial banks and appreciation of their importance. At the same time the increase in the share of long-term loans and external financing should have enabled the banks to enter into more intensive industrialization processes. Whether this has happened will be seen in the following sections.

2. The operation of industrial banks in the region

This section will discuss the ownership and the type of activities financed by the industrial banks and how they changed over time; what type of preferential treatment the industrial banks provide; and what non-financial services the Industrial banks perform for the manufacturing sector.

In almost all the countries considered the industrial banks engage in promoting private industrial investment. In some countries, they may also provide soft loans to some activities outside manufacturing: for example, tourism in Egypt and Jordan, industrial services in Kuwait, and agricultural in Oman. However, the bulk of the bank's resources (on average nearly 85 per cent of the total loans), go to the manufacturing sector.

Within the industrial banks loans to the manufacturing sector, two important trends are noticeable. The first, a positive one, the percentage in the total loans, of loans given for expanding existing production capacity, increased appreciably between 1980 and 1985. This trend was recorded for Jordan, Egypt and some of the GCC countries. In Yemen, the proportions of loans for new industries and existing ones remained almost the same. The second, a negative trend, which occurred particularly in non-oil producing countries, is that the proportion of Banks loans directed to purchasing raw materials and funding working capital also increased. For example, in Jordan, the share of machinery and equipment in the total financing declined from nearly 85 per cent, during 1975-1979, to about 54 per cent during

1980-1985. In Egypt loans for working capital amounted to nearly 37 per cent of the industrial banks total loans during 1983-1985. In the Syrian Arab Republic, beginning in 1984, the industrial banks have been providing only working capital for the public enterprises, although they continued to finance fixed and working capital for private enterprises. In addition the operation of the industrial bank in the Syrian Arab Republic has become dominated by short-term loans during the period 1981-1985, representing 58.0 per cent of the bank's total loans compared with about 30 per cent during 1976-1980. In the GCC countries, the industrial banks provide loans for the working capital of the manufacturing project only at the initial stage. For the rest of the project life they finance fixed assets.

It is interesting to note that loans for working capital are not only short-term loans but they are also provided in local currency, whereas medium or long-term loans are given mostly in convertible currency for acquiring machinery and equipment. Expansion in short-term loans indicates failure of the commercial banking system to meet the requirements of the manufacturing activities; expansion in long-term loans on the other hand, although it is advantageous from the economic point of view, indicates absence of capital market.

In most cases industrial loans are provided at favourable interest rates, which are often below the rates charged by commercial banks. The loan periods tend to differ from one country to another. In Jordan and Saudi Arabia long-term loans extend from 10 to 15 years. The period for most of the other loans ranges from 3 to 7 years. In most cases loans do not exceed a maximum ceiling, which is often around 50 to 60 per cent of the total cost of the project or 15 to 20 per cent of the paid-up capital and reserve of the bank.

What type of manufacturing industries do the industrial banks finance: Are there preferential treatment and priorities in granting loans?

Had development of industrial technology been one of the objectives of the operations of the industrial banks, this section would have dealt with the problems of the technological capability-building referred to in the above chapters. As it is, those issues are more present here by their absence. The issues discussed here are more in the realm of the conventional industrial development strategy than the dynamics of industrial technology development strategy.

The preferential treatment given by the industrial banks would be for import substitution industries; industries aiming at the expert markets; or located in disadvantaged regions. These preferential treatments have been in the form of lower interest rates and longer debt maturity periods. Judging by the reports available for Egypt, Jordan, Kuwait, the Syrian Arab Republic, Saudi Arabia and Yemen, a measure of success seems to have been achieved in this regard. In Egypt, there is a preferential interest rate of 6 per cent, as against 11 to 13 per cent, for projects in areas of food security, construction for low and medium-cost houses and handicraft and small-scale industries. The list in the case of the Syrian Arab Republic, includes, in addition, capital goods and engineering industries. The closest the industrial banks come to encouraging industrial technological capability development is when they encourage exporting manufacturers, insist when granting loans that building materials and equipment needed for the project are locally produced whenever possible; that feasibility studies, engineering work, design and supervision of project construction must be carried out by national firms in conjunction with foreign firms if needed. However, even granting some measure of success with these activities they constitute but rudiments of the requirements of technology development. They have also been conceived in a partial manner and lack interconnection. Moreover, in at least one country, Egypt, the success of the incentive is debatable. During the period 1976-1985, nearly 53 per cent of the loans approved by the industrial bank were for projects located in the Cairo area, and most of the projects approved were serving the local market. These observation could well apply to the other countries in the region.1/

3. Distribution of loans among manufacturing industries

Regarding allocation of loans among the various manufacturing industries, there are some common features in the pattern of industrial loan distribution between the diversified economies and the GCC countries, but there are also some differences.

Generally speaking the predominant feature in both types of countries is the high share of loans for light consumer goods industries. A slow increase in the share of loans to metallic and engineering industries is also discernible. In both groups of countries, a significant portion of the industrial loans were allocated to food, beverage and tobacco industries, followed by chemicals, petroleum, rubber and plastic products. Building materials industries also accounted for a sizeable percentage, but their share was much greater in the GCC countries than in the diversified economies. Textiles assumes greater importance in the latter.

At the individual country level, the development has been as follows: in Egypt, during the period 1982-1985, the larger shares in the industrial loans went to textiles (29.4 per cent), foodstuffs (18 per cent), chemicals (17 per cent), basic metal industries (17 per cent) and building materials 12 per cent).

In Jordan, during the years 1982-1985, chemicals (pharmaceuticals, detergents, plastic and paints) represented 39 per cent, food 21.4 per cent and building materials 15 per cent of industrial loans. In the Syrian Arab Republic, during 1981-1985, the textile industries represented about 46 per cent of the total industrial loans; 40.0 per cent went to handicrafts industries. In Kuwait, Oman and Saudi Arabia, three groups of manufacturing industries attracted between 70 to 80 per cent of the total loans by the industrial banks; these were, building materials, chemicals and foodstuffs; chemicals in the case of Kuwait, and metallic industries in the case of Saudi Arabia recorded a marked increase in the amount of loans received. In Yemen during the period 1982-1985, nearly one third of the industrial bank's loan went to food industries, followed by building materials and chemicals.

1/ See document E/ESCWA/ID/87/14.

Thus, it can be seen that the pattern of the distribution of industrial loans is to a great extent influenced by the industrial development strategy and the stage of the countries development in the industrialization process.

First the pattern revealed from the above review is one of dominance by loans to the light consumer industries. This is because in almost all ESCWA countries development of heavy industries is in the hands of the public sector. Governments in certain ESCWA countries have also intruded into the field of light consumer goods industries, but there are still more opportunities for the private sector in this field.

Secondly, except for non-metallic and basic metal industries, which produce for intermediate goods, very few of the industries supported by the industrial banks are in the linkage industries which produce complementary goods or intermediate industrial products.

Finally, almost all the loans granted were on the basis of a one to one arrangement. Very few of the industrial banks in the region were engaged in syndicated loans, usually an effective method to mobilize large resources. The only example available so far is the industrial bank of Jordan. In the period 1978-1985, this bank managed 14 syndicated loans. Almost 10 of them were related to manufacturing. The loans involved ranged in value from JD 200,000 to JD 7.5 million. The share of the Bank ranged from 5.8 per cent in the Jordan Phosphate Company to 63 per cent in Jordan Ceramic Industries. On average the bank represented about 16 per cent of the syndicated loans arranged during the period 1979-1983.[1/]

4. Non-financial activities of the industrial banks

The industrial banks usually carry out a number of technical activities which are complementary to their money-lending operations. These activities include identification of new projects, preparation of technical studies, provision of technical assistance for projects in the implementation stage and so on.

Data on the size, qualifications, training, and responsibilities of the technical staff in the industrial banks and the staff who are in charge of the non-financial activities are very scant. More information would be needed to conduct an analysis of this very significant aspect of the industrial banks' operations especially if these operations are to be extended to technology development activities. The information available shows that, out of the seven industrial banks reviewed, only the industrial bank of the Syrian Arab Republic did not, at the time of the review, either conduct project evaluation exercises or carry out feasibility studies for projects submitted by investors. However, some of the industrial banks, notably in Jordan and Oman, conduct feasibility studies for a small fee. Recently two new developments have taken place in the non-financial activities of the industrial banks. First, in a number of industrial banks, new departments have been established for technical assistance to projects at the stage of implementation and for projects facing problems; Secondly, many banks developed their own in-house capabilities to monitor project implementation. What skills this monitoring involves is not clear.

1/ See document E/ESCWA/ID/87/14, p. 32, para 3.

From the information provided, the industrial bank in Jordan established the Technical Assistance Fund in 1983, and the Risk-Capital Fund in 1989. The first is to finance the preparation of technical studies for industrial projects faced with difficulties. A technical unit has recently been established in the bank to provide technical expertise for projects in need of such assistance. The second Fund assists innovative projects or those which introduce hitherto unused technology in the country.1/

The technical assistance unit in the industrial banks of Egypt, Kuwait and Saudi Arabia provide assistance to projects at the implementation stage. In Egypt these services include financial, technical and marketing expertise.

Another development, is the establishment in many industrial banks in the region of units to identify new industrial investment opportunities. More information is expected from the Meeting on these functions.

D. Arab regional financial institutions

There are a number of Arab regional commercial banks, and regional investment institutions as well as subregional investment institutions in the ESCWA region. Almost all these institutions were established in the 1970s and 1980s. Below is a brief review of a sample of these institutions to show the extent and the pattern of their operations with regard to the manufacturing sector. More information on these financial institutions can be found in the ESCWA publication on industrial financing in the ESCWA region, which, as mentioned above, constituted the main source of data and information for this chapter.

1. Regional commercial banks

The Gulf International Bank (GIB) and the Arab Banking Corporation (ABC) are two major regional banks in the ESCWA region. Of the two, the former is more involved in industrial activities. The latter, which has a paid-up capital of $US 750 million, owned with equal shares by three Arab Governments, is primarily concerned with investment overseas. The GIB, which is owned by the GCC countries and Iraq, has a paid-up capital of $US 530.5 million. Its total deposits in 1985 amounted to $US 6.5 billion. Lending is the main activity of this bank. In 1985, loans represented more than 53.0 per cent of the bank's asset. Nearly 25 per cent of the total loans were directed to industries. But a small number of large industries and joint ventures in the GCC countries claimed the greatest share of these loans. These industries included the petrochemical complexes in Bahrain, Qatar, Saudi Arabia and the United Arab Emirates, and the Aluminium Industry in Bahrain. The financing pattern of this Bank, however, is not very different from that of the national banks: most of the loans went to finance the working capital and imports of equipment. The interest rate charged was at the prevailing commercial market rate.

1/ Jordan Industrial Bank, "Risk Capital", Conditions for financing innovative risk-capital (in Arabic) (pamphlet), Amman, Jordan, 1989.

2. Regional investment institutions

The Arab Industrial Investment Company (AIIC) and the Arab Mining Company are two examples of regional investment institutions which are exclusively concerned with industrial development. The former , which was established in 1979, is mandated to set up and finance industrial projects particularly in engineering industries including mechanical, electrical and electronic industries. At the end of 1985, the paid-up capital of AIIC amounted to only $US 53 million, which was 20 per cent of the subscribed capital and contributed mainly by Iraq and Saudi Arabia. There were only three manufacturing projects implemented by AIIC to the ESCWA region by the end of 1985. These were the Arab Axles Manufacturing Company. The Arab Engineering Industries Company and the Arab Engineering Systems and Control Company. The main contribution of AIIC to these industries has been to carry out techno-economic feasibility studies and raise funds by participating in their equity capital. There are, however, a number of manufacturing projects which are being studied by AIIC. How much local technological capability is involved in the implementation of these projects is not known.

The Arab Mining Company (ARMICO), which was established in 1974, has a paid-up capital of nearly $US 380 million. It is mandated to carry out industrial, technical and commercial operations relating to mining industries, including: exploration, extraction, processing, manufacturing, transporting, and marketing. Here again, the main contribution has been in providing paid-up capital rather than developing technological capabilities. ARAMIC total participation in the Arab region amounted, by the end of 1986, to about $US 200 million, out of which nearly $US 50 million was in the countries of the ESCWA region.

3. Subregional investment institutions

The Gulf Investment Corporation (GIC) is a well known establishment in this category of institutions in the region. GIC had a capital of $US 2.1 billion in 1984, paid by the GCC Governments . Its activities had been in funding various companies inside and outside the region; investment of funds in international financial markets; and investment in projects which enhance integration between the GCC countries. Among the five manufacturing projects which GIC has financed by the end of 1985 were the two phase modernization scheme for Aluminium Bahrain to extend the operation of the Gulf Aluminium Rolling Mill Company into aluminium foil as well as equity participation for the National Wire Drawing and Products Company (ASLAC) in Saudi Arabia with a number of European partners.

Chapter IV. DEVELOPMENT OF ENDOGENOUS INDUSTRIAL TECHNOLOGICAL CAPABILITIES

This chapter will deal with the following questions: Is there a need for an industrial technology capability development strategy? Is there a need to integrate such strategy in industrial development and business strategy? And how can this integration be done?

The review will deal with the type of new institutions, technology policy measures and mechanisms, financial institutions and new financial functions, etc., which would be needed to foster and develop industrial technological capabilities and integrate them in the industrial development effort.

If industrial banks, for example, are to be given the new responsibility of developing technological capabilities they would have to perform two new sets of functions. The first set would include: (a) searching and selecting suitable technologies; (b) negotiating and obtaining reasonable prices for the technologies procured; and (c) ensuring the efficient utilization of the project once installed. The second set of responsibilities would involve continuously supporting technical changes and improving the technology installed.

Each of these functions has its own requirements and mechanisms which the banks should facilitate, and for which they have to be given support and equipped. For example, supporting technological improvement involves setting up R and D units, carrying out engineering studies and establishing pilot plants. Whether or not the industrial banks would be capable of undertaking such responsibilities or there would be a need for a new institution to encompass the new functions should be considered in the light of the following review.

The experiences of the newly industrialized countries, however, reveal that implementation of these new functions requires two sets of policies. The first set includes broad micro-economic policies designed to safeguard the fundamental impetus of industrial firms to introduce continuously improvements in productivity, quality, and to introduce new ideas and products. The second set includes policies which help to cushion the effects of risks and uncertainties and cater for externalities, scale economies, infrastructural deficiences, etc., in relation to industrial firms.

Below, these two sets of policies are discussed in detail. But first a brief examination of the main characteristics of the present day technological development would a provide useful framework for the discussion.

Three characteristics are relevant to our discussion: (a) the high rate of technological advance; (b) the incremental nature of the technological development; and (c) the existence of a product cycle.

Technological changes both in the frontier industries and traditional industries have accelerated at an unprecedented pace during the last decades. For example, the development of new materials and rapid advances in scientific instrumentation, microelectronics, and biotechnology has led to new industrial products and processes, and to the creation of new markets. In the traditional industries, application of process control equipment and computer-guided designs, engineering and manufacturing is gradually taking away the comparative advantage of the developing countries. The ESCWA region lacks the required dynamic technological capacity to adjust to these new developments and faces the danger of being left further behind. This is despite the fact that a reasonable measure of success has been achieved in developing human resources and science and technology infrastructure in the last two decades.

In the above chapters it was seen that development of endogenous technological capability refers to capabilities to search, select, import, absorb, adapt and develop new technolgies for existing and new production facilities. At the firm level, as it was pointed out, technological capability, not only relates to technical and managerial skills, but also to the availability and accessibility to information and know-how which are essential for technological development. The example of Japanese petrochemical industries and the other examples shown above showed that industrial technology development is not synonymous with building "high technology" industries nor with invention of a new product or process. Although inventions certainly create great technological impact, what is of equal if not greater importance in the developing countries is the small but continuous technical changes introduced into the products, the production, organization and processes. It was also shown that industrial technology development involves a mix of technology transfer and generation of domestic value-added. Within the context of the developing countries, the country's ability to generate value added increases the better technology selection it makes and the more adaptation and improvement it introduces to the imported industrial plans, equipment and intermediate goods. The experience of the newly industrialized countries has shown that the chances for making these improvements and adaptations are greater the more use is made of local design, engineering and quality control services, R and D organizations and higher education centres. The experiences have also shown that the technological capabilities so accumulated were gradually disseminated through subcontractors, personnel mobility, provision of technical services and participation in higher education. It was through this process that technology trade imbalances and dependence were reduced.

Understanding the product cycle is important both for local innovative technologies and imported technology. With regard to local innovation, the phases of the product cycle each involve different problems and different financing patterns; regarding technology suppliers, they tend to pursue different strategies according to the state of the product cycle. The concern here is primarily with the financial implications of the product cycle.

Generally a product cycle (or technology innovation cycle) is divided into four phases. Each phase is characterized by certain risks and uncertainties and has a special financing requirement. There are also specific considerations to be noted for each phase. The four phases are: start-up, precommercial, expansion and maturity.

The start-up phase comprises idea generation feasibility studies and technical R and D.

The precommercial phase involves the development of prototypes and pilot plants, preliminary production and test marketing;

The expansion and maturity phase includes the mass production and eventually production contraction.

During the start-up, the uncertainties involved relate to the availability of technical capabilities; would it pay to develop or improve the technologies needed? The cost, the time schedule and the prospect for commercializing the technology would be the questions of concern. The financial commitment during this phase is generally initially small but increases gradually. The finance is often provided from private savings but in the case of established firms they rely on internal savings, government R and D grants and long-term loans.

In the precommercial phase, the nature of the technical risks gradually changes and the questions raised relate to how to expand the pilot-scale operation into commercial scale production, and how to minimize the cost of development and production. Commercial and market risks assume greater importance during this phase and time becomes a critical element. For financing, firms in this phase tend to rely on internal savings and venture capital as the main source. During the expansion and maturity phases, the risks involved relate to commercial and market uncertainties. The firm's strategy would be to expand quickly, penetrate new markets and prolong the product's life span. This phase is normally financed through a combination of sources which include self-generated funds, investment and commercial banks and when necessary government incentives such as preferential interest rates and tax incentives.

Commercial and development banks normally are interested in financing firms only at the latter stage, i.e. when the technology developed is tested and proven and when marketability and returns are relatively assured.

The result, therefore, is that there is an institutional gap to cater for the risks and uncertainties involved in financing the first two phases of technology development. This gap in the developing countries is not conducive to the development of market capital which can adequately meet the specific financing requirements for the start-up and commercial phases of the product cycle. It is therefore useful to examine the factors which discourage the traditional financial institutions from playing their role.

The World Bank identified the following three factors which are common to many developing countries. These are: (a) lack of technical and market expertise to evaluate the risk element properly; (b) lack of organizational and managerial tradition to include higher-risk loans in the traditional banks portfolio; and (c) lack of viable collateral due to the intensity of the software used and low collateral value since the R and D equipment is highly specialized.

As a result, there is a specific need to develop financial intermediaries who can step in to fill this gap. The question is: can the industrial banks in the region be developed to take such responsibility? Or should a new institution be established to perform the required new functions?

The creation of intermediary financial institution, however, is only one prerequisite. There are also others. Among them are the macro-economic policies which are necessary to induce firms to make sustained commitment to technical changes and improvements and to introduce new products. These policies include industrial, trade and foreign investment policies. Typically these policies will be greatly influenced by the type of economic system that exist in the country. Therefore, it would not be possible to deal with these policies at the individual country level or the country group level. Only the general aspects of these policies will be reviewed here.

The macro-economic policies concern interest rates, exchange rate, credit facility, inflation rate, price control, market protection mechanisms, etc. The policies with regard to these variables should be conducive to encouraging long-term investment in technology and must be stable and consistent to encourage firms to make a sustained commitment to industrial technology development. There are several examples where volatility or inflexibility had hampered technological development and dislocated the capital goods industry.

Regarding industrial policies, as mentioned above, development of industrial technological capabilities is inconceivable without a carefully worked out technology development strategy. It was also emphasized that lack of competition, presence of cumbersome bureaucratic procedures, weak linkages between the production sectors and the R and D institutions, and inadequate information facilities, could seriously discourage firms from making efforts to develop technologies. The example of India cited in this study is a case in point. Restrictions on new firms entering the market and regulations restricting expansion of existing firms resulted in obsolete technologies in a number of industrial subsectors in India which in turn severely reduced India's international competitive position in a number of industries.

Regarding trade policies, the country capacity to export and the development of endogenous technological capabilities have worked hand in hand in many newly industrialized countries. Granted, protection for an infant industry is necessary and has been used by nearly all developing countries, especially at the stage of mastering new technologies and attaining competitive production levels. The evidence emerging from the newly industrialized countries, however, indicates that rigidity and excessive protectionsim have often discouraged industrial technology, especially in industries which are open to rapid technical changes.

With respect to foreign investment policies, there are now examples where some countries used direct foreign investment strategically to encourage competition and industrial technology development through maintaining standards for productivity growth. Therefore, foreign investment could be an avenue for acquiring foreign technology and for diffusing technology. Joint ventures also, as one form of direct foreign investment, can contribute to developing endogenous technological capability. The rules and regulations governing repatriation of profits and access to foreign exchange would be the means for encouraging joint ventures in the technology transfer process. Generally, however, the role of direct foreign investment in the transfer of technology and development of industrial technological capability should be considered from a much wider perspective.

The policies mentioned above are necessary to create the conducive environment for generating and sustaining commitment to industrial technological development. For these policies to produce the expected impact, however, they must be combined with a set of policy measures that aim directly at developing technological capabilities at the firm level. Some of these measures are reviewed below. They have been instrumental in the success of the newly industrialized countries and Governments played a crucial role in their formulation and application.

Government intervention was necessary because development of technological capabilities, as noted above, is tied to externalities, scale economies and capital market deficiencies. Moreover, the state of the technological infrastructure in the country has a direct bearing on the industrial firms' capacity to make technical changes and innovations.

Below, the discussion of these interlinkages sheds more light on why Government has to play an important role in developing a technology development strategy.

First, because of the economies of scale in technology capability building, small firms may not be able to invest individually in the type of infrastructure and equipment required to ensure adequate product quality or carry out R and D needed for making technical changes and improvements. Thus, availability of effective public sector technology services, and government supplied industrial research programmes, are prerequisites to individual firms' efforts to acquire technological capability.

Secondly, investments in technological capability building may, at a cost to the investing firm, have externalities and spillover effects which would be quite beneficial from a social point of view, i.e. they may be contributing to the efforts of other firms and improve the general technological condition in the country. At the same time, investments in technological capabilities are often risky. Therefore, although the investment may be desirable to the society, the cost may not be acceptable to the individual firm unless a compensatory element is offered.

Thirdly, as noted in the review of the product cycle, commercial and development banks in the developing countries are only interested in financing the expansion and maturity phase of product development. In the case of industrial banks, their loans are specifically for acquiring new production facilities and expanding existing facilities. There are virtually no provisions in those banks for fostering start-up and precommercial phases of the technology development process. These phases, as noted above, contain major risks which are not acceptable to the commercial and industrial banks. In addition, the weak capital market and the existence of more lucrative and secure opportunities make it very difficult to mobilize funds to support the risky phases of technology development. Government intervention, therefore, becomes necessary to fill the gap in the capital market.

Finally, as pointed out above, a minimum amount of critical technology resources in the form of skilled manpower, information, technology infrastructure and related elements is necessary for industrial firms to be able to initiate activities leading to technical change and improvements. In most cases deficiencies exist in these areas. Government intervention would be necessary to strengthen the basic science and technology infrastructure for technological capability development.

A. Financing mechanisms for developing industrial technological capabiities

Commercial and development banks are not, as pointed out above, oriented to take the risks involved in technology capability development prior to the stage of expansion and maturity of the technology, i.e. before the technology has proved its marketability. As a result, industrial firms, especially small and medium-sized firms, face severe difficulty in raising the required funds to finance technology development. Two main reasons have been advanced for this: (a) the existing financial institutions lack the financial instruments to compensate for the higher risk inherent in technology loans; and (b) they suffer from a shortage of technical capability to identify and prepare technology projects which they can finance, knowing that such projects by nature involve risk, have long-term gestation periods, are hard to assess and not easily collateralized. As a result, there is an apparent need to establish a technology financing programme to provide financing for the development and commercialization of technology. In a number of newly industrialized countries, specialized financing agencies have been established to fill this gap. In addition, some countries have also introduced fiscal incentives to support the technology development efforts of their industrial firms. The World Bank has monitored these developments extensively. Below, the reasons and the mechanisms applied as monitored by the World Bank are presented for the consideration of the Meeting.

To promote effective financing for industrial technology development, several newly industrialized countries have established financial intermediaries equipped with appropriate risk-sharing instruments. These instruments include conditional loans repaid through royalties if the project succeeds, and entirely or largely forgiven should the project fail. At the same time, the agencies are also given incentives to be aggressive in their portfolio of riskless loans to large firms with collateral. These agencies also play an important role:

(a) As a body of expertise on technology to advise on government policies;

(b) As a means of raising awareness of industrial technology development issues;

(c) As a means of industrial extension through the advice provided to firms during project preparation and appraisal.

The promotion of these agencies (and their instruments) is regarded as part of a comprehensive approach to developing capital. There are also suggestions to develop competitive sources for financing technology development. This stems from the fear that in the absence of such competition, specialized industrial technology development agencies may become slow, bureaucratic and unwilling to assume the required degree of risk.

It has also been suggested that the emerging venture capital funds should be encouraged. The drawback with these funds, however, has been in their tendency to finance companies once the technology is well established rather than at the start-up stage or for developing prototypes and pilot plants. These firms have been seeking rapid appreciation of capital and therefore prefer equity in less risky investments.

Another form of support for technology development has been governments concessionary financing, including grants, at the start-up phase.

Regarding fiscal incentives they apparently have had an important impact on the promotion of industrial innovations in several developed and developing countries. Most of the newly industrialized countries have some form of tax incentives for R and D. But several reasons have been given for caution in using such incentives. Among them are the problems of tax evasion, and the limits to how much can be done with tax credits; the fact that linking incentives to R and D expenditure does not necessarily capture most technology development; and the built-in bias in favour of large firms which would conduct R and D activities. For all these reasons, fiscal incentives, it has been argued, may have only a limited effect in promoting incremental technical change. A more effective mechanism would be to provide third parties with fiscal incentives, i.e. the incentive should be channelled to technology venture funds and specialized technology development agencies.

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B. Educational and training programmes

All levels of education are important for industrial development. Judging from the experience of the newly industrilized countries, special attention however, must be given to middle and higher-level technical skills. The educational policy in the region, therefore, must identify appropriate ways of producing an educated work-force with the type of technical, professional and managerial skills needed to absorb, adapt, improve and develop technology. The education programme should also aim at strengthening the advanced degree programmes in universities and overseas as well as support vocational training, especially training for specialized technicians. In addition, overseas high-level scientific and engineering education, together with on-the-job training, can be very profitable for preparing industry for introducing new technologies. In Brazil, for example, the development of high-level training at two university campuses and a research institute together with a specially developed training programme for higher-level engineers and scientists overseas, have contributed significantly to the rapid development of the aviation, telecommunications and electronics sectors.

C. Research and design centres

Research centres usually serve the purpose of giving technical assistance to firms, providing a training ground for R and D personnel in private industry, engaging in technology adaptation and useful research activities. These institutions palyed a significant role in the industrial technology development in the newly industrialized countries. This is indicated by the bourgeoning expenditure on R and D activities in these countries. It can also be noted that R and D centres in these countries often engaged in providing technological information about possibilities of adaptation and scanning development at the technological frontier internationally. In the ESCWA region, a number of research centres and R and D units in the production ministries have been established. Generally, however, allocations to R and D in the region are well below the mark. Nevertheless, in some ESCWA countires the research centers are well provided with technological capabilities in the form of skilled personnel and equipment. The performance of these centres tends to be different from one country to another. Based on the findings of a recent ESCWA study,[1/] the interfaces between the research centres and industry have been very weak; and there tends to be more emphasis on basic research rather than on technological development and commercial application. Moreover, there are severe shortages in the technological services required to transfer research results to production.

The following are some suggestions to improve the performance of the R and D centres and bring them more in line with the requirements of technology development. The managerial skills in government industrial laboratories need to be upgraded and refocussed. This could be achieved by the following measures:

(a) Making research institutions more self-financing to ensure responsiveness to the needs of the industry;

(b) Increasing industry representatives on the governing boards of research centres;

(c) Granting these boards greater responsibility and authority;

(d) Encouraging industry to enter into partnership and management of the R and D centres.

A recent experiment in a Latin American country is worth reporting. An international financing institution is now supporting a Latin American country in a project which is essentially to co-ordinate the research programmes of several closely related R and D centres with the aim of developing an investment plan which would be in harmony with the research requirements of related industries. The project would provide financing for loans to the industries concerned for equity investment in the research centres. Thus, the necessary funds would be injected for the execution of the centres' investment plan and at the same time a sizeable control given to their industrial clients.

1/ Proceedings of an Expert Group Meeting on Strengthening Research and Development Capacity and Linkages with the Production Sectors in the Countries of the ESCWA Region (E/ESCWA/NR/87/23), December 1987.

D. Technology extension and information services

These are the types of services which are most needed by industries involved in technical changes and improvements. They are in short supply in the ESCWA region. They include skills, standards and methods of organizing production and its various inputs. Industrial firms need access to information, training and advice on how to upgrade their technology. Technological extension services and information supply firms with the knowledge on how to improve production, on new technological developments and on how best to obtain assistance from consulting engineering services. Recently, the Industrial Bank of Jordan made use of this approach. It would be interesting to see the results. The Republic of Korea's approach is also worth mentioning. The Republic of Korea has a well-developed separate technology extension system which was initially supported by the World Bank. It uses a core of engineers who specialized in particular subsectors as the extension agents. They are backed up, when needed, by local and international consultants for solving particular problems of upgrading the skills of the core engineers.

E. Standard and metrology services

Standard and quality controls are instrumental in improving productivity at the firm level and increasing the technical efficiency of the economy as a whole. Within the firm, standardization sets benchmarks for judging the acceptability of products within specified tolerance levels. At the economy-wide level, adherence to standards facilitates specialization, promotes adaptability, reduces risk of product failure and decreases users' perception of risk. Standards and metrology institutions are, therefore, essential for improving the technological performance of the industrial sector and promoting exports. In the ESCWA countries, as in most developing counties, the level of standard and metrology services is well below the mark, especially in comparison with international standards. Any strategy for technological development will have to begin by introducing effective co-ordination among programmes for technology diffusion, standards and quality control.

F. Regulations affecting imports of technology

Different policies have been used by the newly industrialized countries in regulating technology imports. They included controls on licensing, technical assistance, and direct invetments, and restrictions on imports of capital goods. The main emerging lesson is that the technology import policy must be flexible and compatible with the requirements of serving the objective of technological development. It should also be combined with the development of local capabilities to search and bargain effectively for the most appropriate technology package. Such package should aim at minimizing the volume of proprietary imports from the technological suppliers, ensuring multi-sourcing, and competitive pricing. The experiences of the newly industrialized countries suggest that the import Policies should be designed to make foreign suppliers interested in effective transfer and continuously upgrading the technology. Joint ventures, coproduction and licensing agreements should include clauses for R and D collaboration and upgrading of the technology by the suppliers. At the same time the mechanisms for regulating technology imports must be simplified and facilitate the transfer process.

The Republic of Korea used various sources of foreign technology imports to develop its technological capabilities: capital equipment imports, licensing, technical assistance; and direct foreign investment. Different methods (including import restrictions) were used for different branches of industry, and even within the same branch, depending on the technology development strategy. This was quite in contrast to India's broad sectorial restrictions which resulted in technological stagnation in some sectors.

Finally a technology strategy should also be concerned with patent legislation and copyright laws. They serve the developing countries interest as a means for getting access to foreign technology if the transfer of the technology concerned requires patent protection in the recipient country to prevent transfer to a third party, and when there is important inventive activity taking place locally.

V. DEVELOPMENT OF INDUSTRIAL TECHNOLOGICAL CAPABILITIES: EXAMPLES FROM OTHER DEVELOPING COUNTRIES

In a recent study on the "Financing of Technological Development" published in Spanish by the Junta del Acuerdo de Cartagena in Lima, Peru, in January 1989, there is a summary of the experience of a number of developing countries in financing industrial technological development. The following text contains a brief review of these experiences with regard to what other countries have been doing to finance development of their endogenous industrial technological capability.

The examples presented in this chapter are by no means exhaustive. They cover only India, Brazil, and the Republic of Korea. The first two case are based on the source mentioned above. The case of the Republic of Korea is based on various sources.

The cases of India and Brazil are covered in detail. The new role played by international financial organizations in the development of technological development is also reviewed in the countries covered.

The experience of each country undoubtedly is closely related to prevailing economic circumstances, pattern of development, size of the population, and the level of technological capability. Bearing this in mind, the discussion is centred around: financing the acceleration of the process of technological modernization in the industrial sector; promotion of internal technological innovation; and adaptation and improvement of imported technology. Finally, it will be noted that the involvement of the international financial organizations has generally taken on two forms: either the form of non-repayable financing for technical assistance; or the form of financing the execution of specific projects with some explicit or implicit technological development.

1. India

There are a number of financial institutions in India dedicated to industrial development. Below they are presented according to the date of their establishment. The oldest of these institution is the Industrial Financial Corporation of India (IFCI), which was founded in 1948. About half of the funds operated by this institution are self-generated. The Government contributes 10 per cent and the rest is raised from other bodies. The second oldest institution is the Indian Corporation of Industrial Credit and Investment (ICICI), which was established in 1955. Private enterprises, private foreign and national banks provide the bulk of the capital of this institution. After the nationalization of the banks in India, the share of the private sector in the capital of ICICI declined considerably, but it still remains the main source of financing. This institution is the main source of financing for private enterprises and for the modern industries such as chemical products, electronics and electronic equipment. The third national institution is the Industrial Development Bank of India (IDBI). It was established in 1964, but it is the largest financial institution concerned with the promotion of industry. Finally, there is the Industrial Reconstruction Corporation of India (IRCI), which was established in 1971, with the specific aim of financing programmes for the rehabilitation of "sick" industries. The Industrial Development Bank of India provides 50 per cent of its capital. The rest is supplied by the Industrial Financial Corporation, the State Bank of India and a number of commercial banks. The State Bank of India also engages in technological development programmes, including importation of technological packages and specialized machinery. Some of the State and regional banks in India also support industrial investment. The table below shows the annual capital of those five main banks engaged in industrial development in India in 1985. The table also shows the approved and the used capital for 1985 together with accumulated approved and used funds up to 1985. The information in the table shows that the Industrial Development Bank of India contributed the largest share in industrial development loans; nearly 50 per cent of the total loans in 1985, amounting to nearly $10 billion.

Table 5. Resources of main industrial financial development banks in India (1985) approved and utilized

(In millions of Indian rupees)

	Finance Approved	Finance Utilized	Accumulated resources up to 1985	
			Approved	Utilized
Industrial Development Bank of India	26.5	14.3	108.1	76.9
Indian Corporation of Industrial Credit and Investment	5.1	3.4	31.7	23.3
Industrial Financial Corporation of India	4.2	2.7	24.0	17.1
Other institutions	7.1	21.0	50.5	
Total	44.0	21.0	217.7	119.7

Source: Translated from the "Financing of technological development" published in Spanish by the Junta del Acuerdo de Cartagena, Lima, Peru, January 1989, p. 23, table 4.

The principal government organization responsible for technology development is the Directorate General of Technology Development in the Ministry of Industry. This Directorate essentially has a consultative role regarding the technological aspects in the activities of other ministries and government agencies. It also has an executive role in some of the decisions taken by the Ministry of Industry. With regard to technological development, it formulates appropriate procedures for the acquisition of capital goods and services; allocates the scarce human resources and external financing available; and monitors the application of the government strategy to attain self-reliance in technology. In 1983, this Directorate had under its command 110 engineers and technicians formed in several technical groups with extensive links with outside experts. One of the preoccupations of these groups has been to prepare technological forecasts regarding future development in technology world-wide, study their implications and make appropriate policy recommendations. It also has committees for technical evaluation of industrial projects which decide on the choice of technology and define the technologies that should not be imported.

The experience of India until very recently shows that cumbersome bureaucratic procedure could impede technological progress and cause inefficiency in services and loss of resources. For example, approval for importing the technology, which included know-how, design, engineering and consultancy, was the responsibility of the Technical Evaluation Committee which included representatives of the Directorate General of the Ministry of Industry, the Department of Science and Technology, the National Research and Development Corporation and the Scientific and Industrial Research Council. When contracts for the purchase of foreign technology and payment of royalties were involved the Committee would examine availability of counterpart indigenous technology; the scale of the proposed technology on the priority list; the competence of the foreign suppliers or collaborators and the guarantees offered by them; the efficiency of the industrial processes; the quality of the product, and the labour forces required. In addition, the Directorate General of Technology Development would ensure that the capital goods, involved were locally unavailable, and provide advice on their specifications. Recently these cumbersome procedures, which often resulted in the import of obsolete technology, have been extensively revised. The Government of India now follows an industrial technology development strategy which sees technological self-reliance not in terms of exclusive use of national technologies but in terms of developing capacities to analyse technological variables and make the best use of technology whether locally supplied or imported.

However, in a recent study on the role of national technology development banks in India, it was noted that there was as yet no clear policy regarding the role of financial institutions in relation to the technological aspects of projects. Often, when projects are at the stage of requiring financing, the main parameters concerning production scale, location and technology have been already decided upon. The Industrial Development Bank of India and other institutions exert very little influence on the technical matters. At the same time, the development banks still tend to prefer financing projects that are based on known technologies and tested machinery and avoid risks involved in highly innovative projects. It was also noted that India still suffers from lack of venture capital. Only very recently some tentative measures were taken in this regard. Development in this direction included the special credit line the State Bank of India has created for financing the state-of-the-art industries that need to import and develop the latest technology; the World Bank's feasibility study for setting up a system through which venture capital can be provided to individual enterprises and new concerns dedicated to the commercial development of new products and processes. Finally, there has also been some direct involvement by the World Bank to support local programmes to develop endogenous technology. The nitrogen fertilizer plant below is given as an example. This is a large plant jointly owned by the State and corporations. When this plant introduced modern technology to manufacture ammonia and urea within the framework of an integral financing arrangement, the World Bank granted a loan of $US 109 million, which included $US 11.4 million for technology and engineering. The establishment of this industry had a significant impact on the development of mechanical industries in India. These industries participated in supplying the machinery for the fertilizer plant. This was the first time the World Bank had supported the local manufacturing of high-power and high-pressure centrifugal compressors. Until that time these machines were purchased from suppliers in industrial countries.

2. Brazil

Industrial development in Brazil dates back to 1920. Since 1967, the industrial development has been such that the proportion of imports to meet the supply of industrial demand in Brazil has ranged between 6 and 10 per cent. The country's concern with industrial technological development also dates to the 1920s, when the National Institute of Technology was established in 1920. This Institute is responsible for the development of infrastructure, human resources and policies needed for building technological capability. Between 1921 and 1951, new institutions concerned with science and technology were created: the Institute of Technological Investigation of Sao Paulo (1934); the National Council of Investigation (CNPQ) (1951), and the Aerospace Technical Centre (1954). During 1964-1965, two financial institutions were set up to be specifically concerned with financing technological development. The first was the Fund for Techno-Scientific Development (FUNTEC) and the second was the Fund for Technical Assistance in the National Institute of Technology. The Financiadora de Estudios y Proyectos (FINEP), formed in the Ministry of Planning in 1967, became an autonomous public enterprise. Other important institutional changes included the creation of the National Scientific and Technological Development Fund (FUNDT) in 1969, and the Industrial Technology Secretariat in the Ministry of Industry and Commerce (MIC). Policy changes included incorporation of the Science and Technology policies in the Country Strategic Development Programme which was formulated in 1968.

In addition to these organizational and institutional developments, Brazil also introduced several policy measures to support its technological development. This included: (a) establishment of the National Institute of Industrial Property for registering and regulating the use of patents and know-how; (b) the establishment of the National Metrology, Norms and Quality Control; (c) regulations concerning importation of technology; (d) policies for development of technological capability through FUNTEC; and (e) measures to stimulate the capital goods industry, including exemption of industrial goods from tax, refunding of taxes paid for intermediate inputs, interest-free loans for production of capital goods and grants for financing acquisition of industrial machines and equipment (FINAME), this last established in 1964.

3. Financing technological development

Financial allocations to R and D by the major federal institutions (FUNTEC, FINEP, FUNDT and CNPQ) amounted to 0.5 per cent of GDP. It is not possible to calculate the amount given by the private sector and by educational, regional and governmental institutions at the State level, but estimates put it at over 1 per cent of GDP.

(a) FUNTEC

In the first 10 years of its operation, FUNTEC concentrated on strengthening human resources in science and technology in an effort to reverse the overwhelming dependence on foreign technologies for the design and quality of products. This was achieved largely through supporting the development of post-graduate studies for scientists and engineers. Since 1974, this Institution has given priority to programmes aimed at strengthening the technological activities of local firms by trying to establish the conditions required to encourage Brazilian enterprises to take an interest in the study and application of renewable technology. FUNTEC has also established a Programme for the Generation and Provision of Technology, to support links with the Brazilian enterprises producing goods and services.

The subsectors which received the greatest part of FUNTEC financing were mechanical industries and the electrical and electronic industries (80 per cent of the total in 1975-1979). FUNTEC operations, however, declined rapidly after 1973 when FNDT increased its funding.

(b) FUNDT

FUNDT, as mentioned above, was established in 1969. Since 1971, the resources of the Fund have been administered by FINEP. Between 1984 and 1985, the number of its operations increased from an annual average of 569, with a value of $US 1,125 million, to 673 operations, with a value of $US 1,373 million. Until 1986, FUNDT funds were used mainly to develop human resources and science and technology infrastructure in universities and research centres as well as private enterprises. Nearly 13 per cent of its funds were transferred to the FINEP programme for the projects described below. In 1984, nearly 36 per cent of its funds went to FINEP.

(c) FINEP

This institution is organized like a company. Its management is composed of representatives of the Secretary of Planning (SEPLAN), MIC, BNDES, CNPQ, the Special Secretary of Informatics, the Brazilian Association of Development Banks, the Association of Technological Research Institutions, the Association of Engineering Consultants, the Association of Industrial Engineering, the National Association of Research and Development for Industrial Companies and members of the scientific community of the country. The total value of its operations in the period from 1980 to 1987, excluding the funds administered on behalf of FUNDT, was 75,052 million cruzeiros at constant December 1987 prices (equal to $US 1,039 million). In 1987, FINEP agreed to finance an operation valued at 21,800 million cruzeiros, of which 7,784 million cruzeiros were from FUNDT. In the same year, the amount actually paid was 17,654 million cruzeiros ($US 450 million), of which 6,283 million cruzeiros were from FUNDT. In other words, the payments from FINEP funds alone rose to more than 11,371 million cruzeiros ($US 290 million).

Measured in terms of expenditure, the most important line of action carried out by FINEP was related to the Support of Users of Consulting Services. This was established in 1976 to finance organizations and public and private enterprises that needed to employ the services of national consulting firms. These activities represented 46 per cent of the total FINEP expenditures between 1970 and 1984. In 1981-1987, the share declined to 18 per cent.

A second activity with similar objectives was Support for National Consulting, created in 1973. This fund represented 5.2 per cent of the total amount paid from FINEP funds between 1970 and 1984. Support for the technological development of national companies, which represented 40.8 per cent of the amount paid out by FINEP in the period 1970-1984, has increased to 58.5 per cent in the last seven years.

The sectors which benefited most from the Support of Users of Consulting Services were energy, chemicals and petrochemicals. Activities which are eligible to receive financing from FINEP through these support programmes for consulting were as follows:

(a) Support of Users of Consulting Services

- Executive plans and sectorial studies within national and regional programmes
- Feasibility studies
- Basic projects carried out in the country
- Final projects
- Studies and projects aimed at expanding technical, administrative productive or operational capabilities

(b) Support for National Consulting

- The export of services (market surveys and project formulations)
- Internal investment (improvement in the technical capacity of consulting firms).
- Preparation of technical manuals and training of personnel.

Another important FINEP programme is entitled "Support for the Technological Development of National Companies" which began operating in August 1976. The main activities supported by this programme included:

- Research and development of new products and processes
- Research to adapt imported technologies
- The purchase of foreign technology packages
- The strengthening of machinery for the establishment of enterprises dedicated to the development and commercialization of technological products, processes or services
- Participation in those stages of the production process required to produce inventions or for the adaptation of existing technologies
- The introduction of quality control systems
- The establishment of technological research centres
- The study and development of managing systems and procedures.

Table 6. Support for the technological development of national companies in Brazil: source and values (1987)

(In United States dollars, converted from Brazilian cruzeiros)

	1985-1987	1973-1987
Transfers of FUNDT	10.2	185.3
External credit sources	41.1	145.4
Financial grants	60.1	391.5
Government contributions made to FINEP capital resources	39.0	350.0
Loans	126.4	126.4
Total	276.8	1,126.6

The sectors which benefited most from the Support for the Technological Development of National Companies programme of FINEP were, until 1984, mining and metallurgy; from 1985 onwards this changed to the electrical and electronics sectors. FINEP conducts its activities through a large number of projects or specific programmes, including the following:

- Virology, in conjunction with CNPQ;
- Integrated project for rural development;
- PROINFORMA, for the diffusion of technological information;
- Support for the preparation of software for computers;
- Support for micro-electronics;
- Automation in the manufacture and control of processes (CAM), designs (CAD) and robotics, in conjunction with CNPQ, including contracts with COMSIP ENGENHARIA S.A. and the Foundation for the Expansion of Research and Industrial Perfection (FIPAI);
- Electronic microscopes;
- Technological support for small enterprises;
- Fine chemicals, including in 1987 a project for the installation of a multi-purpose pilot plant for chemical synthesis and pharmaceutical products, developed by Quimica del Nordeste S.A.;
- Research on and production of new ceramic materials using high technology, with the University of Sao Paulo and the Technological Centre of General Mines;
- Precision mechanics;
- Special activities for the modernization of the Centre for the Launching of Research Balloons;
- Energy, including a project for the production of ethyl alcohol using immobile and floating cells in highly productive and stable reactors.

(c) Industrial Technology Secretariat

Although this is a ministerial division, it also functions as a financing organization by underwriting technological research and development contracts for universities and other federal and State organizations, as well as private enterprises. An example of its activities is the work carried out for the PRO-ALCOHOL Programme for the development of the technology required for the most efficient and economical production of ethanol (ethyl alcohol) and its use as an automobile fuel, as well its activities in other similar fields. The following are examples of some of the contracts of the Secretariat

- FIPAI: conversion of diesel engines for use with ethanol;
- Institute of Biosciences of the University of Sao Paulo: selection and cultivation of varieties of yeast; Luis de Oliveira Techno-Scientific Association: analysis of the effect of water content in alcohol in the functioning of internal combustion engines;
- CODEAMA: research on the oleaginous species of Amazonia;
- COPERSUCAR: peeling systems for sugar cane husks;
- FTI: laboratory to test alcohol engines;
- LPAE/HC/University of Sao Paulo: study on the toxicity of engine exhaust;
- Institute of Technological Research of Sao Paulo (IPT): construction and operation of three digesters with different designs for the anaerobic processing of wine drawn from the lees (the liquid residue resulting from the fermentation of alcohol);
- RIOCELL: development of technology for the impregnation of wood shavings to improve the yield and reduce the cost of boiling wood to obtain cellulose pulp;
- IAC: study on the interaction of the liquid residue of the sugar alcohol industry with the physical, chemical and biological properties of soils

VI. SUMMARY AND CONCLUSIONS

1. Endogenous technological capability is the corner-stone for attaining self-reliance in the developing countries. There are, however, still many ideas and hypotheses in technology capability-building that need to be empirically tested.

2. Technological capability may be defined as the ability to carry out certain tasks and activities. These in turn may be grouped according to functional areas (from initiation to innovation), and according to the level of aggregation (product, industry, national).

3. Certain kinds of resources are necessary to be able to acquire technological capability. These are management, skilled personnel, tools and instruments, and organization.

4. Accumulated experience of people and organization through learning-by-doing is the most critical resource among the required resources for building technological capability.

5. The national technological capability is the sum total of the capabilities acquired by individual producers and producing enterprises in the economy.

6. There are a number of technological capabilities that can be used across products, processes and industries. Therefore, in some areas, the national technological capability requirements are less than the sum of the requirements at the level of individual products, enterprises and industries.

7. Building technological capability requires not only availability of resources but also the ability to identify a path or sequence through which the process of "learning-by-doing" can take place. This in turn requires formulating a suitable implementable strategy.

8. The technology transfer process must be used as a means for creating opportunities for learning-by-doing. Other equally important means include motivation, creative management and leadership at the level of organization, and appropriate government policy

9. A clear distinction should be made between technological capabilities needed for industrial development and those needed for technological development. The policies and strategies involved in developing each tend to be quite different.

10. Development of technological capability is not a free or automatic by-product of capacity expansion. It requires deliberate policies and strategies. Also technological capability would not be acquired by basing technology development aspects on project evaluation methods, but through formulating investment projects in a way which would make it possible to optimize development of technological capabilities.

11. An important element in technology capability development is the capability to improve established facilities and adapt them to changing circumstances to increase productivity. This capability has a dynamic perspective different from the static orientation of project evaluation methods.

12. Prospects for enhancing endogenous technological capabilities would increase with the degree of participation by the local capability in the process of design engineering etc. These prospects are actually built into the project at the stage of project formulation. Therefore, project formulation has a significant impact on the project performance and on enhancing technological capabilities.

13. The effectiveness of industrial banks in the region is measured exclusively in terms of mobilizing financial resources for th expansion of the manufacturing sector. Most of the Banks are by-and-large under government ownership with the share of the private deposits and equity-holding rapidly increasing. Their activities are concentrated in light consumer industries and building materials. The technical staff of these banks are small, but the banks have recently been moving towards undertaking more technical functions.

14. Investments in manufacturing activities by regional commercial banks and investment institutions have been, relative to the funds available, very small. The funds available to the regional institutions concerned exclusively with regional industrial development have been even smaller. The objective and the pattern of industrial investment by these institutions tend to be similar to that of the national banks, namely mobilization of funds for industrial expansion with little emphasis, if any, on the development of endogenous technological capabilities.

15. Industrial firms must develop capabilities, or have access to capabilities, to search, select, import, absorb, adapt and develop new technologies. They must also have accessibility to technological information and be provided with financial facilities which cushion against risks and uncertainty. These conditions are prerequistes for firms to introduce technical changes and improvements into their operations.

16. Any strategy for industrial technological capability development must recognize three important characteristics of modern technology: first, that they advance very rapidly; secondly, that investment and marketing decisions in technology are influenced by the technology product cycle; and thirdly, that technological changes have an incremental, continuous and cumulative nature.

17. The aim of the economic policy must be to secure the fundamental incentives for firms to improve productivity and quality and to introduce new products. Therefore, two sets of policy measures would be needed to sustain firms commitment to technical changes and improvements. One set would be consistent with trade, industry and foreign investment policies which can induce firms to make the investment in industrial technology. The other is

the set of policies which enables firms to carry out the changes required. This relates to provision of financial support and availability of the essential scientific and technological infrastructure and facilities reviewed in chapter IV.

18. For the reasons mentioned above and because of the fact that industrial technology development is by its nature prone to high risks and uncertainties, on the one hand is affected by scale economies, externalities and deficiency in infrastructure, on the other government intervention in the technology development effort is inevitable. This intervention, however, should be indirect at "arms length", and within a well-studied strategy approach.

19. If the financial institutions become responsible for technology development as well as for industrial development, their functions would include provision of facilities for searching and selecting technologies, negotiating and obtaining reasonable terms and prices for the technology imported, ensuring efficient utilization of technology installed and supporting the effort of the industrial firms to introduce technical changes, improvements and new products. All these functions require new methods of financing; availability of commensurate resources to match responsibilities, and different work mandates.