MANUFACTURING ORGANISATION IN DEVELOPING COUNTRIES WITH PARTICULAR REFERENCE TO IRAQ

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S U M M A R Y

Industrially developed countries are able to absorb modern techniques of science and technology quite readily; this is not the case for less-developed countries.

Attempts made by developing countries have been ineffective due to factors not readily admitted.

This thesis highlights the areas that need to be developed by under-developed countries, and covers economic, scientific and technological, and social aspects as well as technology transfer.

Economic areas considered acknowledge that within any one country there should be proper procedures for planning economic and industrial projects (plant design) supported by efficient economic development strategy.

Scientific and technological factors considered include the major areas that need to be developed in order to produce and/or deal with scientific and technological issues for the interest of the national development.

Technology transfer areas considered include the necessity of building up a national body (system) responsible for dealing with activities and tasks of transferring foreign-made technology so that it can be employed effectively within the environment of the country.

Social factors considered include the need to develop human resources which can be employed efficiently into the whole process of development, and particularly for the above proposed systems. Education and training are the major elements that ought to be tackled to produce skilled manpower and to overcome the social and cultural values and traditions that are inherited by the society.

This thesis highlights the above areas in an attempt to plan and organise the development of science and technology, and their implementation into the development as a whole. Whilst recognising the problems of creating this sort of development in developing countries, the author considers the benefits to be obtained are much greater in the long run.

Key Words - Developing countries
Manufacturing
Technology organisation
Industrial development

CONTENTS

LIST OF FIGURES

DECLARATION

No part of the work described in this Thesis has been submitted in support of an application for another degree or qualification of this or any other University or other institute of learning.

No part of the work described in this Thesis has been done in collaboration with any other person.

K M AL-SHAGHANA

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CHAPTER 1

Introduction

Recognition of technology's role in development does not imply that only alternative products and methods be chosen, but also recognises the wider effects of these choices which depend strongly on the political, economic and social environment in which they are implemented. Technology, therefore, is embodied not only in aggregate capital, but in the whole economic process that extends from supplies on one hand to the marketing outlets on the other. It implies an inter-relationship not only within a firm but between firms, and even between industries. This makes technological transfer and diffusion a function of the ability to change processes that require system adaptation.

Conventional development strategies consist of importing the most traditional technologies of the industrialised countries in an attempt to increase GNP. But development strategies based on increase in GNP have failed to provide the progress as two-thirds of the world's nations, containing 70% of the population, still have a GNP per capita of less than $500[1]. The enormous export of technology has been accompanied by a remarkable lack of development, by growing unemployment in the cities, disruption in rural areas,

and a widening gulf between the wealth of a few and the poverty of the rest.

Some developing countries have turned away from traditional strategy of development. They seek other lines of development to help and strengthen their independence and improve the welfare of their societies. Appropriate technology has become the main topic towards their development. As a result, they are facing new kinds of problems consisting of - what is the appropriate technology? how can it be defined? what requirements are needed? how can it be transferred? These questions are as yet difficult to answer as a variety of factors, such as culture, political, social economic and other infrastructure conditions are yet to be considered in suggesting the appropriate technology.

Nevertheless, there are some specific criteria of appropriate technology choice which are consequently the criteria of development, such as maximisation output and consumption of goods, increase rate of growth, reduction in unemployment, equity in distribution of income, promotion of political and social systems, and exploiting the available resources. Technological decisions and the pace of technological change affect all the above criteria and, in turn, are affected by them. The definition and achievement of these criteria is associated with the application of science and technology which are borrowed or imitated from

industrialised countries.

Technological choices and decisions in developing countries are made by a number of different types of decision-makers and under a variety of sources of influence. They will not all necessarily have the same objectives or conform to the same ideas of what is appropriate technology.

According to a 1970 United Nations report[2] "the process of economic development consists largely of organising the development and production exploitation of national resources in the interest of the whole community". But before a nation can move effectively in this direction, it must know what resources it has and where they are. The knowledge in less-developed nations of the extent, location, and state of their own resources is limited, fragmentary and on the whole less than adequate for the process of sound national development.

In most industrialised countries, science and technology have evolved over the years in a manner similar to the creation of ideal technology. For example, in the 18th century, cheap labour was plentiful and mechanisation was not fully developed. As time went by, labour became more costly and relative to labour capital became cheaper. This caused the development of technology which replaced man by machines. This has

resulted in highly specialised, capital-intensive, mass production of goods. Concurrent with technology, industrialised countries evolved a supportive infrastructure and components, which include marketing, transportation and communication, and education systems.

The process of creating science and technology capacity in developed countries has grown by historical factors, sometimes natural and slow, sometimes planned and even forced, often aided from abroad. Developing countries should appreciate that this sort of development occupies time and cannot happen overnight. Less developed countries have been seeking to acquire a variety of technologies ever since the beginning of the 19th century. Over this long period of time, the intensity and scale with which technology was sought varied enormously. A large number of programmes in exploration and exploitation of natural resources, in the erection of civil works and industrial plants and in the construction of roads, and irrigation systems, have substantially altered the face of developing nations. This sort of alteration arose through the aid of foreign countries linked with the transfer of technology by turn-key licence and know-how agreements (3). This type of development has increased the volume of production, but has not made changes, nor improved the capacity to produce growth.

From this stand point, developing countries have not mobilised and promoted their scientific and techno-

logical resources, nor properly oriented their potential for effective use with the national development process. It seems that this strategy of development which developing countries adopted for a long time has ignored the realistic outlook on the role of science and technology, consequently ignored the socio-economic demands on it.

Studies made by the United Nations Conference on Trade and Development (UNCTAD) (4) in 1972, and confirmed by Al-Kanny (5) estimated that the direct annual foreign exchange payments by developing countries, $1,500 million in 1968, would rise to $9,000 million by 1980. It also adds that the technologies transferred to developing nations are themselves inappropriate both as to the factor use and product type.

Analysis of the transfer of technology processes in developing countries indicates that the forms employed as well as the terms and conditions on which the transfer takes place, have had serious debilitating effects on the economies of these countries. The disadvantages arise not so much from the transfer of technology which has many beneficial features, but from the fact that they are technologically dependent on advanced countries and obtain their technologies from a weak bargaining position. This dependence has resulted in restrictive practices on resources of inputs, access to market out-

lets, reducing the freedom of choice on the purchase plus export restrictions. Loss of control over critical decisions affecting the national economy is another consequence of the present technology transfer, as decisions concerning investment, employment, pricing, marketing, and profit remittance may be made outside the country, by the donor of the technology.

The foregoing disadvantages of technology transfer are the result which can be contributed to the lack of an effective capability of science and technology in less developed countries. The atmosphere in these countries has shown strong preference for foreign engineers and contractors. The firms have been unwilling or overtly cautious about using local expertise which they usually seem to regard as inadequately experienced. Foreign contractors have also shown little willingness to use local capacity of developing countries even where they are available. Finally, foreign brand names have been regarded by these countries as a sure way to capture a large share of the market.

Since science and technology are just like the blood in the human body which is working within a system, the author believes that to tackle the problems of technology transfer it is required to set up a system whereby science and technology activities can be planned, organised and controlled through a long term plan and as a part of a national development plan in developing

countries. This system will include :

a. central body - to plan and organise the full process of science and technology issues in a systematic manner throughout the country

b. routes - to ensure that science and technology can be transferred to the whole body

c. stations - which indicate the areas and fields that need science and technology, Fig. 1.

This system aims to achieve :

1. building up the indigenous capacity of science and technology to meet the requirements of development

2. organising foreign-made technology transfer in a manner to suit local capacity of science and technology.

Finally, this sort of work would definitely require long term planning and full government involvement.

CHAPTER 2

Structure and Dimension of the Iraqi Economy

It was stated in the introduction that the aim of this work is to explore the possibility of building up local capacity of science and technology in developing countries. The prerequisite of this task, however, is to conduct a survey analysis for the present picture of the economy in these countries.

The survey analysis in this chapter will be focused on the Iraqi economy due to the fact that the information is more readily available to the author than any other developing countries.

The survey analysis will include :

1. Economic planning, ideology and objectives
2. Investment programmes
3. Agricultural development
4. Oil development
5. Industrial development
6. Commerce and markets
7. Human resource development
8. Raw materials and natural resources
9. Planning of economic projects and technology transfer

These items will be considered respectively.

2.1 Economic planning, ideology and objectives

The socialist planning is the doctrine of the present Iraqi government as the practical means of employing scientifically and effectively all material and human resources to achieve economic and social development. The most important guideline of this ideology is to transfer to public ownership all major sectors of production, large-scale landholdings, foreign trade and the basic sectors of domestic trade. Therefore, centralised planning and decentralised execution are the basic ideals and principles which guide the planning organisation.

The economic planning is aiming to achieve the following objectives (6) :

a. The creation of an economic surplus to enable the industrial sector and especially manufacturing industries to play an effective role in financing the investment of the development plans.

b. Provision of the needs of agricultural expansion with tools, machines and fertilisers, and also supply irrigation and drainage projects with their requirements of industrial materials.

c. Developing industries to process raw materials and agricultural products and participation in the diversification of the structure of output and exports.

d. Fulfilling the growing needs of the local market for industrial goods for both production and consumption in all sectors and aiming for the local industrial production to replace goods imported from abroad.

e. The absorption of the surplus of labour in all sectors through the change effected by the development plans in technical standards.

2.2 Investment programmes

The available financial resources, especially oil revenue, have been directed towards comprehensive economic and social development. The total investment in development plan of 1970-80 amounted to ID 10,207 million (Iraqi dinar). In comparison, the total investment in all the development plans before 1970, i.e. over a period of about 20 years, amounted to ID 1,896 million, (7,8), (Fig. 2).

The allocations distributed between the economic sectors in these figures show a great leap forward was made to achieve economic and social development, especially industrial and agricultural sectors.

Accordingly, the national income rose from ID 905.3 million in 1970 up to ID 8,000 million in 1980. Consequently, the income per-capita also rose from ID 95.3 to ID 600.5 as the population increased from 11 million to 13 million for the same period.

The feature of the investment programmes during the 1970's is that the allocations are not based on the available and likely absorption capacity in the country. The large allocations in fact have resulted in substantial short-falls in implementation. What is required is that each project and each sector's programme should be thoroughly considered so that the allocations match the capacity of the outlay by the project or sector.

2.3 Agricultural development

The total area of Iraq is 438,000 sq.kms, which equals approximately 181 million donums, out of which 48 million donums (12 million hectors) are suitable for agriculture. However, the actual cultivatable area is estimated at 23 million donums (4 million hectors) (6).

The agricultural sector is of special importance to Iraqi economy due to its contribution to the formation of the national economy and its supply of raw materials to the domestic industry. In addition, its products

constitute the biggest proportion of Iraqi exports (excluding oil). Around 38.5% of Iraq's population live in rural areas and depend on agriculture and raising of livestock.

Despite the abundance of water resources in Iraq, there is still a noticeable shortage in irrigation water at particular seasons of the year due to the lack of sufficient potentials for water storage during the flood seasons. Iraq's lands are divided into two types with regard to methods of irrigation. First, the lands that depend on the rainfall (North), second, the lands depending on water pumping (South).

Machines and agricultural equipment such as tractors, harvesters, pumps, vehicles, and other implements, play an important part in the development of the agricultural sector. The basic agricultural goods are produced in Iraq, such as animal resources (meat, eggs, fish, chicken) and vegetable production (wheat, barley, paddy, rice, tobacco, cotton, dates). The production of these goods is not enough to satisfy the local markets.

The prevalent production pattern is made up of co-operative, collective and state farms, besides the private sector. The Agrarian Reform Law has been in application since 1970, when the lands were distributed to farmers, with no less than 242,975 families benefitting thereby in 1980.

The main problems that the agricultural sector faces are :

1. The spread of salinity in the soil in central and southern parts of the country

2. The lack of maintenance processes of the imported agricultural machines and equipment. This problem, in fact, cannot be isolated from the whole capability of human resources in the country.

2.4 Oil development

Iraq is one of the main oil producing countries in the world. Despite the fact that Iraq did not benefit much from this wealth owing to the domination of oil monopolies through unjust concessions that controlled production, marketing, and pricing. The nationalisation of Iraqi Petroleum Company (I.P.C.) in June 1972 was a success followed by a series of nationalisation acts until Iraq was able to control 100% of its national oil wealth, including exploration, transport, marketing, refining and processing.

The oil sector has accomplished great strides within the Iraqi economy. The following are the most important fields : (9)

1. Oil refinery was constructed to meet the Iraqi demand on oil by-products and export the surplus to

foreign markets. The refinery produces improved benzine, kerosene, aviation spirit, gas oil, diesel oil, and fuel oil.

2. Natural and liquid gas pipelines were put into operation to supply the demands.

3. Oil gas factory was set up to comprise refining unit for liquid gas, filling unit to fill cylinders, and finally, natural gas station.

4. Kerosene/hydrogen treated unit was constructed to get rid of the harmful sulphur material in kerosene and improve its type for marketing.

5. Iraqi Oil Tanker Company was also enacted to conduct the transport of crude oil and natural hydrocarbon materials, shipping, loading, unloading, insurance, and storage operations.

It is fair to mention that this sector has been very well established and improved through the last decade and has generated very good base of skills and knowledge regarding production, refining, and marketing.

2.5 Industrial development

The period of the 1950's marked the beginning of industrial development in Iraq. Industrialisation was confined to basic consumer industries such as grain-milling, textiles, bricks, utensils, and other commodities of day-to-day use. The increase in oil production during the last two decades, particularly during the 1970's, has made good efforts towards emerging new industries. During the 1970's, Iraq has achieved initial success in establishing large scale industries particularly agro-industries, namely grain-milling, fruit preservation and canning, vegetable oils, date processing, sugar, cigarettes, cement and textiles. Iraq also established glass, oil refineries, sulphur acid, caustic soda, fertiliser industries, which are based on locally available resources and raw materials (10).

Lately, the country is anticipating entering into the secondary stage of its industrialisation programme when it proposes to establish industrial projects based on imported raw materials and technology, like iron and steel, engineering industries, bauxite, and mechanical industries, in order to manufacture capital goods as well as intermediates and semies.

Industrial policy is now aiming to set up industrial projects with the most modern and appropriate technology suitable for the climate and economic

conditions in Iraq. But so far the transferred technologies have not met the requirements of industrial development due to the absence of a proper system of technology transfer in the country.

2.6 Commerce and markets

There has been a great advance in this field both in the volume and the type of goods exported and imported. Imports have been directed to meet domestic needs for consumer goods, for the requirements of investment, and for the implementation of the development projects.

The value of imports has increased from ID 199 million in 1968 to ID 3000 million in 1980 (6). The increase in the volume of capital goods, semi-manufactured and raw material has been approximately ten fold, while the increase in imports of food products and consumer goods has been about five times.

The exports have also increased, especially oil exports, which increased from ID 343 million in 1968 to ID 12,000 million in 1980, while other commodity exports increased from ID 22 million to ID 170 million for the same period. Fertilisers, cement and dates are the main non-oil exporting products, and the Arab countries and some developing countries are the main markets for these goods. Since the industrial development in Iraq has so far been largely consumer-orientated, a major part

of industrial output is being utilised for internal consumption. Therefore, in recent years, efforts have been concentrated on organising and developing the net work for the distribution and sale of food products, essential consumer goods, and intermediate goods at domestic level. Co-operative consumer societies have been developed and strengthened and their services expanded with due attention to their geographical distribution.

It is obvious from the figures above, that oil is the main export product that the Iraqi economy relies very much upon. As oil is estimated to be over by the year 2000, it is required to pay special attention to :

a. Industries which have the capability to satisfy the society's needs of various products

b. Non-oil exporting industries to find their way to the outside markets, particularly Arab countries

These sort of industries might relatively replace the oil export products next century.

2.7 Human resources development

It is pointed out that the industrial growth is a recent phenomenon in Iraq. Lack of properly qualified human skills with requisite experience has no doubt been the main constraint in the speed of

industrialisation.

The country is in the process of building up the requisite manpower which is required for the future industrialisation programmes. Iraq has yet set up six universities and about twenty technical institutions in different fields, management and administration, technology, engineering, medicine, agriculture, accounting, petroleum, wire-nonwire communication, and teaching. These organisations are distributed all over the country (11) (Fig. 3).

The young graduates emerging from these institutes have yet to get sufficient experience and skills to fulfil the requirements of the skilled workers, supervisors and middle management cadre. Most of the technical personnel working in different industries have to be built up locally with the help of in-plant training. This is to say that the nature and content of the education system needs to be developed to produce human resources to feed the national development requirements.

2.8 Raw materials

Iraq has abundant natural resources which give it a great potential for development. The two major rivers, Tigris and Euphrates (Fig. 2) - flowing through the country provide water facilities to a vast expanse of

land and this gives Iraq a distinct advantage over other countries in West Asia.

Iraq possesses good mineral resources. It has an abundantly rich supply of mineral oils and natural gas. Proved reserves of oil are estimated at 4.7 billion metric tons and those of gas at 38 x 10 billion cubic ft. (6).

Apart from the oil and gas resources, mineral deposits, such as sulphur, phosphates, salt, limestone, gypsum, marble, bentonite, sand, stones and other non-metallic minerals exist in abundant quantities. There is a possibility of the occurrence of metallic minerals also like iron ore, copper, chrome, zinc, and bauxite, for which geological surveys are in progress.

The industrial development of Iraq has therefore to be primarily based either on oil or on non-metallic minerals which are available. Mechanical and electrical industries, which require iron and steel and other metals, can at present be developed with the help of imported raw materials. These important facts determine the structure of industrial programming for Iraq.

2.9 Planning of economic projects and technology transfer (TT)

It has been stated that Iraq assigned a large proportion

of its income to the investment programmes, particularly for the plan of 1976-80. Most of these allocations were for the import of foreign-made technologies. These technologies are transferred in terms of machines, equipment, skills, knowledge, consultance, patent, and technical information. The cost of these items (excluding machines and equipment) has increased from ID 122.2 million in 1973 to ID 1,465 million in 1980 (12). At the present time, there is no proper system for dealing with transferring foreign-made technologies to Iraq. In fact, these technologies are being transferred merely through the system of foreign trade as other imported commodities.

The process of planning of economic and industrial projects in Iraq takes place through a chain of economic and technical feasibility studies at different levels of the organisations concerned. These studies start off from small units upwards to specialised ministry, to planning ministry, and then to the Planning Board (particularly for heavy and strategic projects). After decisions are made, small units will undertake the execution operations, starting with finding the contractor (donor of the technology) regarding connection with technology markets, setting up tenders, choosing the contractor, and setting up the contractual agreements. This is what is called technology transfer.

The well known types of technology transfer are either

turn-key (package) or licence agreement (unpackage). Under the first one, the external contractor establishes a project for the recipient and supplies the necessary requirements. On completion, the project should be handed over to the recipient authority. The contractor's responsibility will be over, and he will leave the country, except that the relationship between the contractor and the recipient would remain for the necessary training and maintenance according to the contract terms. The advantage of this type lies in the fact that this sort of investment is necessary for the major and strategic industries such as chemicals, petro-chemicals, iron and steel and electronic and electric industries. These types of industries are essential for the economy and cannot be developed by other methods within the present circumstances of developing countries. Establishing turn-key projects has been found to be the quickest and easiest path towards industrialisation and has created a big leap in the economic development of these countries. The disadvantages of this sort of arrangement are very high cost, ineffective contribution of the local resources and very restricted conditions regarding production quantity and quality, technology choice, and the difficulties of running the project that are faced after the departure of the contractor.

The second type of technology transfer (licence agreement) is different from the previous one in that the right is given to the recipient to use and exploit

the patent and know-how of the donor. Developing countries under this type of TT are paying royalties which add considerably to the initial cost of transferred technology. Moreover, licence agreement, often includes very restricted terms regarding sales, purchasing, markets, production volume, and the choice of technology. On the other hand, under this type there is a good opportunity for local resources to participate in the technology transfer process by getting involved in the choice, adaptation and development of the technologies needed.

At the present time Iraq prefers the first type (turn-key) especially for heavy industries to achieve quicker industrial development.

2.10 Summary and conclusion

Iraq is presently at a very crucial stage of its industrial development. It possesses the resources which can be most profitably invested in large industrial projects. The country must endeavour to have a well conceived industrial development programme so as to build up projects which can subscribe to the country attaining a self-reliant status during the next twenty years. One of the typical difficulties of most developing countries is generally the absence of adequate resources for their speedy development. This is not one of the handicaps in the case of Iraq. Therefore, it is very necessary to develop and make

full use of the available resources to change the pattern of trade from the export of mineral oil to that of intermediates and manufactured products and, on the other hand, to meet the consumer and developmental needs of the society. This is required however to develop the basic consumer industries, industrial raw materials, projects, engineering, electrical, metallurgical, chemical and petro-chemical industries, which can help the country to be more or less self-contained for meeting the consumer goods as well as for supply of a major portion of capital equipment and machine tools for Iraq's future development. To achieve this dream, it is required that the oil revenue must be directed and fully used for the development of these industries for the next two decades. As these industries will require technological inputs, Iraq will witness a large scale of technology transfer from different sources of the world market. Therefore, a serious attempt must be made to develop and improve the present local environment and conditions which can be summarised as follows :

a. The shortage of skills of specialists and technicians among labour to meet and operate the foreign-made technology

b. The lack of women participation in development

c. The poor exploiting and development of available natural resources to meet the needs of the industry

d. The lack of economical and industrial co-operation and co-ordination among Arab countries, which is resulting in limiting the expansion of the market

e. The poor supporting establishments of science and technology and those working with them

f. The poor transferring and employing of foreign-made technology in harmony with the nature and towards the aspiration of national development

g. Absence of planning,organisation, and controlling of the scientific and technological issues in the country.

It is necessary to say that this is not only the case of the Iraqi situation, but in fact it is a common state in most developing countries. The solution therefore should be directed towards planning the domestic capability of science and technology whereby it becomes a proper source for the technological input of the national development plans. The author believes that Iraq is now at the best situation in comparison with other developing countries regarding the planning of its capability of science and technology than ever before. This is basically due to the improvements of its economic and social development and also due to the availability of financial resources.

CHAPTER 3

The Need for Planning of Science and Technology (S & T) in Less-developed Countries (LDC's)

The planning of science and technology issues in less-developed countries is very necessary, but more difficult than it was for developed countries when they started their development. This necessity and difficulty emerge from the following :

1. The nature of technologies, which have been transferred to LDC's can be characterised as :

a. Outdated and obsolete technology which developed countries (DC's) would otherwise have to scrap to make room for new ones.

b. Labour-intensive technology, in which developed countries can no longer compete in the world market because of its high labour cost.

c. Extractive technology, where industrialised countries need raw materials for their own industry.

d. Environmentally polluting technology, that has been banned in developed countries.

2. The continuous desire of LDC's to speed their economic growth, especially in the industrial sector. This desire resulted in large scale transferring of foreign-made technology in order to achieve in one generation that which took industrialised countries a long time. At the same time, this desire has not been associated with domestic invention, innovation and development of these technologies as it was in the case of developed countries.

3. The complexity of science and technology issues at the present time, in terms of their direction, choice, influence, content, functions, and the way they operate. Developing countries, in fact, are facing these complicated elements of science and technology more than developed countries when they initiated their economic and social infrastructures. In addition, developed countries have faced this complexity gradually which gave them time to absorb it and for the society to utilise it.

4. Market mechanism; the system of economic development in industrialised countries has shown the capability of the market mechanism to regulate their economy, this being the responsibility of the private enterprises. Therefore, market and competition forces have become the main factors for creating new inventions and regulating the application of new technologies without comprehensive planning. However, in less-developed countries the market lacks the capacity to

regulate economic development due to the weakness of the private enterprises on one hand, and the development of the public sector on the other.

5. Finally, the gap between developed and developing countries in terms of science and technology and other economic factors has increased widely during the 1970's (13), (Fig. 4). This gap should receive urgent attention by developing countries' decision-makers to speed up economic growth and catch up relatively advanced countries.

In the light of what has been pointed out, the existence of contradiction among the mentioned parameters, (Fig. 5), must be recognised by developing countries and impose a very urgent need to establish a system whereby planning of science and technology issues at national level would play an important role towards the industrial development. In other words, leaving these parameters working in an arbitrary manner, as they are now, developing countries will never be able to deal properly with foreign-designed technology nor will they be able to produce their own capacity of science and technology.

The forthcoming analysis will be devoted to developing a systematic approach towards tackling the issues of science and technology at national level of these countries. This approach will cover :

1. How to plan economic and industrial projects which are proposed to be established in the country. Besides the procedures of approval by the government (Planning Board).

2. For implementation, the proposal, if approved, goes to the Science and Technology System for consideration regarding :

a. Engineering and design of the proposal to find out what is required.

b. Consultancy services offers advice to feed the proposal.

c. Information services to gather information on products, processes, etc., analysis and distribution to feed the proposal.

d. Research and development, to organise R & D activities to serve the proposal.

3. The proposal then goes to the technology transfer system to evaluate the requirements of the proposal, whether existing capabilities or imported, then institute the execution of the proposal.

This analysis will take place through the following chapters :

Chapter 4 : Economic infrastructure

Chapter 5 : Scientific and Technological infrastructure

Chapter 6 : Technology Transfer infrastructure

Chapter 7 : Social infrastructure

CHAPTER 4

Economic Infrastructures of S & T Planning in LDC's

The successful planning of science and technology depends upon the type and nature of the existing economic conditions in the country. The available economic infrastructures in any society therefore form the basic foundation upon which can be decided whether or not to absorb and employ a new pattern of development in terms of quantity, quality, and requirements. In other words, the national investment in terms of economic and industrial projects that need to be set up in the country play a major role towards expanding the scale of the economy by opening the door for the useful inflow of science, technology, and other productive phenomena. This is to say that the efficient planning and execution of the proposed economic projects (project design) at national level will involve the exploration of the routes, mechanism and areas within the development structure by creating new demands for using, assimilating and modifying the updated issues of modern life, particularly science and technology.

The poor economic infrastructures in LDC's result basically from the lack of planning and execution of the economic projects. This planning in fact has not been able to expand, enrich, consolidate, and diversify the development process as a whole. The function of this planning has been, and still is, carried out by

different ministries and organisations with very poor links of co-operation and co-ordination between them. In other words, decision-making is being practiced by various bodies without a specific line of strategy.

This chapter will consider two points :

1. Economic structure : ingredients and infrastructures
2. Planning of economic projects : approach and procedures

4.1 Proposed Economic Structure

It is mentioned that the efficient application of the modern pattern of science and technology in any environment requires an effective economic structure which is capable of interacting and assimilating these issues. In other words, the changeability in modern life, particularly in science and technology, necessitates a well-established economic infrastructure, capable of adding and absorbing new tools and components into the process of development.

The ingredients of the economic structure that are proposed in this chapter are : (Fig. 6)

1. Development strategy
2. Hardware components
3. Software components

These items will be discussed respectively.

4.1.1. Development strategy

There should be a development strategy which indicates the principles of the total economic activities in the country. The strategy includes : (14)

a. The objectives of the development

The aims of the total economic activities should be clear to everybody concerned in planning and implementation levels, as well as by the society as a whole in order to achieve successful participation. These objectives are as follows :

- to achieve full utilisation of natural resources available
- to achieve full employment
- to produce the basic needs of the society
- to employ a new pattern of science and technology
- to build up a high level of skill
- to achieve efficient education and literacy
- to achieve the prosperity and equal income distribution

b. Economic policies

The strategy of national development should adopt clear official policies to regulate and carry out all

the economic activities. These policies would show the dimensions, direction, and methods that achieve the objectives in the shortest time, at the least cost, but with the highest quality. The policies should include investment, employment, training, education, industrialisation, finance, imports and exports, production and consumption, savings, technology transfer, agriculture, extraction, and science and technology.

The achievement of the policies and objectives depends very much on the political system which should be clear and drawn within the economic strategy in order to avoid the damage and disruption which might arise from the many and varied beliefs of the policy-makers in the country.

4.1.2. Hardware components

Setting up the economic strategy in the country requires certain people to plan, operate and organise the economic activities. The work of these people should be carried out in terms of organisations and bodies as responsible for putting the objectives and policies into operation.

Such organisations are :

- production organisations such as firms and plants to produce material and non-material goods throughout the country

- education and training to recruit and supply efficient human resources
- energy and power to produce and distribute energy and power for the production organisations
- building and construction
- transport and communication
- social and welfare
- natural resources
- planning and statistical
- laboratories and specialised centres
- research and development
- technology transfer

4.1.3. Software components

The mentioned hardware components require controlling and monitoring processes in order to make sure that the work is being done properly according to the strategy of development. The process of control and monitor consist in systems, regulations and laws carried out by relevant organisations, such as :

- legislations and laws
- environment control system
- specification and standardisation
- financial system
- work system
- markets and prices
- international and regional co-operation

Finally, having this sort of economic structure in a developing country will make the planning of economic projects both possible and successful.

4.2 Planning of Economic Projects : Approach and Procedures

The National Investment Plans in developing countries are set up by top authority of the government department, usually by Planning Ministry or Planning Board. These plans contain a list of economic projects that may be established during the period of the plan. The number of these projects and their efficiency show the ingredients of the national economy. The proper planning and designing of these projects, therefore, will create a strong economic infrastructure for the country.

Most developing countries are, in fact, still using traditional techniques for planning and implementation of the economic projects. These techniques indicate the inappropriate economic and technical feasibility studies which inevitably result in establishing traditional industries. Accordingly, developing countries face profound difficulties in injecting a new pattern of science and technology into the poor economy. Sometimes, the inefficient and forceful insertion of this pattern creates bad disruption throughout the whole development. Developing countries therefore should pay more attention to the process of planning of economic projects as the key to building up a strong

economy capable of absorbing effectively the elements of science and technology.

The following section will propose a systematic procedure of planning economic projects for developing countries.

4.3. Systematic Procedures of the Economic Projects Planning in LDC's.

The planning of the economic and industrial projects in this section will take place through a chain of systematic approaches in order to justify economically and technically the need and importance of the proposed project to the whole economy. These procedures are :

4.3.1. Preliminary analysis (project idea)

There are certain considerations that precede the actual investment which lead to the creation of the idea for a project that need to be established in the country. These considerations are : (15)

a. supply and demand : the imbalance between supply and demand for any product in the market is a factor that encourages planners, industrialists and economists to think about the possibility of establishing a project which will be able to meet the present unsatisfied demand.

b. import lists : show the quantity of a certain

product that is imported from abroad to meet the local needs. This factor will give an indication to those people concerned with thinking about building up a project which would be capable of producing the product locally and therefore stop importation.

c. local resources : the availability of certain resources locally indicates the possibility of establishing a project that is able to utilise and exploit these resources to a relevant industry to produce useful goods. For instance, the availability of oil resources will encourage chemical and petro-chemical industries to be set up and so on.

d. national development plan : the nature, policies and objectives of the national development plan will outline and help people concerned with the way in which they should think about the establishment of the economic projects. For example, the thought should be directed to those projects that produce the basic needs and intermediate goods to meet both society and industries.

e. production pattern and techniques : it is necessary to employ and utilise new patterns of manufacturing methods from time to time in order to renew the economic picture of the country. This encourages those people concerned to insert these new patterns and techniques in terms of the establishment of new economic and industrial projects that will be able to diversify the economy.

f. the status at international level : the world markets regarding international production and consumption are other factors which might indicate the potential for establishing a project at national level. They will also indicate the size of the proposed project and the volume of production that needs to be produced to meet local consumption and export.

The above factors jointly will produce a project idea that needs to be set up; this idea can be given as a preliminary report illustrating the following :

- name of the project
- sector
- kind of activities
- products
- location
- demand satisfied by it

4.3.2. Feasibility analysis

Once the idea of the project has been put forward, the next step is to describe the idea in more detail in terms of economic and technical feasibility analysis.

A. Economic feasibility analysis

The economic feasibility analysis will cover the following aspects of the proposed project :

1. Size of the project : the size of any project can be defined by an analysis of the factors that might affect it, such as :

- product size and nature
- capital equipment
- production volume
- production methods and processes
- nature of raw materials
- market size
- land available
- expansion that might occur in the future

2. Location and site : to define the geographical site of any project requires to consider the following :

- weather, climate, and environment
- geographical analysis
- raw material and spare parts resources
- supply resources and transport
- market outlets
- income distribution and balance of development amongst regions

3. Construction and building, includes :

- resources of the construction materials
- techniques used for building
- machines and equipment required and layout
- building layout

- land survey, maps and drawings
- skilled manpower for construction
- consultancy services

4. Market supply and demand : the survey of the local market is a vital process for defining the necessity of the project regarding size and capacity. This includes :

- analysis of the present supply and demand. This can be defined by : present volume of production for certain products + imports = consumption - export. Information therefore can be collected for 5 or 10 years in the past to indicate the future direction of the demand
- forecasting of new demands which might be emerged by being aware of past trends of the demand, unsatisfied demand, fluctuations in price, local production, economic and social needs, export capacity, income increase and alternative products. These parameters will give an idea about the future trends of the demand for the proposed project.

5. Investment Capital : the cost of investment capital can be analysed according to the following categories :

a. Fixed capital, includes land and civil work such as :

- survey, maps and drawings
- railways, roads, gas, electricity
- project buildings
- houses, schools, hospitals
- other public services
- machines and equipment such as assembly, erection and test machines

b. Working capital, such as :

- raw materials
- energy and power
- spare parts
- wages and salaries
- overheads

These costs can be either direct or indirect depending on the degree of their relationship to the production process.

6. Raw materials and fuel : the raw materials and fuel that the proposed project requires should be considered to cover the following aspects :

- resources and supplies
- specification and quality
- purity and characteristics
- cost and reliability
- alternatives
- containers and variation

- creation and development

7. International trade : the trade at international level is required to be considered for the product that will be produced by the proposed project. Considering the volume of production and the main exporting countries of certain products, besides, consumption volume and the importing countries for the same product, will give an idea about the trade movement of the product internationally. Consequently, it will help the decision-makers to estimate and define the capacity of the proposed project to meet local demands and export.

8. Side effects : the influence of the proposed project on the whole process of development should be known and measured in order to have a balance of development in the country. It is necessary therefore to estimate the side effects in the following fields :

- balance of payments
- industries in the same sector and other sectors
- education system
- research and development
- training schemes

B. Technical feasibility analysis

The previous analysis was about the economic aspects of the proposed project which show the economic dimensions and capabilities that are needed to establish a project.

This section will consider the technical and technological aspects of the project in order to justify the sort of capability which the proposed project requires. These aspects are :

1. Production functions : production functions can be defined by production flow analysis which vary according to the type and nature of the industry and the product. For example, the production functions of the electrical manufacturing industry will include :

a. main production processes, such as casting, pressing, moulding, winding and insulation, coating, cutting and welding, painting, assembly, milling, turning, grinding, and threading

b. secondary functions, such as design and drawings, testing and inspection, maintenance, plant layout, controlling and planning

c. service functions : include purchasing, training, storing, cost, and industrial relations

2. Production techniques : the choice of production techniques will depend very much upon :

- kind of industry
- type of product
- nature of production processes
- machine tools

- management and skills

The consideration of these factors will help to choose one or more of the following techniques :

a. line production (functional layout)

b. group production (product layout)

c. group technology (G.T.) - mixture

3. Production machine and equipment : the following aspects should be analysed in choosing the machines and equipment for the proposed project :

- number and type of machines and equipment required
- life and obsolescence
- supply resources
- capacity and utilisation
- maintenance facilities
- specification and standardisation

The analysis of the above aspects depends on :

- type of industry
- type of product
- raw materials used
- skills available
- type and nature of processes required

4. Design and engineering : this includes the technical and technological elements of the production

system required, starting with :

- process design and engineering
- product design and engineering
- component design and engineering
- production techniques design and engineering
- workshop design and layout
- machines and equipment design and building

5. Human aspects : the number and type of manpower that is needed for the proposed project should be considered separately and jointly for the following issues :

- skills for process
- skills for product
- skills for production methods
- skills for machines and equipment
- skills for planning, monitoring and management

To sum up, the mentioned analysis of the economic and industrial projects (economically and technically) within the strategy of the national development will lead to establishing an effective economic base in the country. Consequently, it creates further demands for science and technology issues at national level and forms the major part of the National Economic Development by continuously feeding its projects with necessary resources of science and technology.

CHAPTER 5

Scientific and Technological Infrastructures for S & T Planning in LDC's

This chapter considers the scientific and technological areas that need to be developed as major infrastructures for industrial development in developing countries. These areas are :

1. Engineering and Design
2. Consultancy
3. Information
4. Research and Development

5.1 Engineering and Design (E & D)

Engineering and design have been found useful elements in the productive operations, particularly in the industrialisation, as a path or a system which makes things work together technically. Most developing countries lack actual engineering and design processes as separate bodies to tackle manufacturing facilities regarding product, production processes, manufacturing techniques and other services. It is necessary for LDC's therefore to plan and organise E & D processes systematically as an important component for planning S & T. This applies to all kinds of industries and all sorts of manufacturing facilities in the country.

5.1.1 Objectives of organising Engineering and Design

Organising and planning the national process of engineering and design can achieve the following goals :

1. Create awareness about the status of science and technology in the country at different levels; technically, technologically, economically, organisationally and planning. All these levels would indicate the skills, knowledge, and technical know how available in the country regarding engineering and design processes.

2. Notify the standardisations, specifications, and quality regarding process, product, and manufacturing techniques used abroad and create efficient links.

3. Advise local manufacturing organisations of the relevant type of industry, process, product, and production techniques which can be beneficially used in the country.

5.1.2 Tasks of Engineering and Design System

A system for engineering and design can be proposed to carry out the following tasks :

1. Defining the areas of E & D

In order to propose a system for E & D, it is important

to define the main areas that E & D services can be injected or worked into, particularly in industrial fields. These areas will include as follows :

- E & D for components
- E & D for processes
- E & D for products
- E & D for production
- E & D for manufacturing techniques
- E & D for technology and tools
- E & D for machines and equipment
- E & D for workshop system
- E & D for raw materials
- E & D for supporting services

The above areas are the most needy for engineering and design services, and having been defined, efforts can be made to tackle each in a specialised manner by local resources.

2. Considering the interrelations amongst E & D areas.

Each of the mentioned areas of E & D should be considered in relation to others. For example, the analysis of the first area "E & D for components" can be done as follows :

- creating the idea of the component
- designing a manufacturing process for the component
- designing the product that the component is required for
- defining the type of production the component needs

- defining the manufacturing techniques the component needs
- defining the raw materials that are needed to produce the component/product
- designing the supporting services required
- designing the workshop system for the production

This sort of analysis of each area of E & D would link and work with others simultaneously and also would help to realise the impact and the relationship between them in an integrated manner.

3. Providing necessary requirements

The consideration of each area of E & D requires description and specifications of the requirements that should be provided. Therefore, the system should deal with the following facilities :

- drawings and maps, showing specifications of the area design
- skills and knowledge, show types, degrees and resources
- flow chart, shows the way that work can be done
- information to feed manufacturing facilities
- research and development, shows how any area of E & D can be developed
- maintenance, shows the maintenance scheme needed
- resources, show the type, nature, quality and quantity of resources needed
- training, shows the training programmes required

- other facilities and services which might solve problems and risks that emerge from :
  - overloading, i.e. machinery being subject to demands greater than their capacity
  - the problem of the obsolescence of the stock of equipment
  - the problem arising from the use of the space, for example, movement and handling of equipment, machine lay-out, etc.

5.1.3 How does the E & D system operate

Engineering and design system receives requests from a variety of public and private organisations, such as :Fig.7

- national development plan "policy-makers"
- industries in the various sectors of the economy
- production units
- organisations and groups in the private sector

Each order received should be classified and analysed into :

1. Entry reference, indicates the number of orders according to the date of receipt.

2. Sources, indicate the source which the demand comes from.

3. Areas that need E & D, component, product,

production, techniques, etc.

4. Analyse each area of E & D in order to find out whether the area requires :

- new product "new design"
- development of existing one
- transferring the foreign-made product

5. E & D services can be provided to meet the requests by the following techniques :

- design model
- full engineering specifications
- investment data, cost, buildings, machines
- manufacturing requirements, skill and training, plant layout, material production facilities.

Finally, it is necessary to mention that engineering and design system should have connection and relations with :

- all units of S & T system in the country
- regional and international organisation of E & D
- small units in production systems all over the country

The establishment of a special body for engineering and design is suggested for LDC's in order to meet the technical needs of the production system as a whole.

A training scheme is also suggested to produce capable staff within the system.

5.2 Consultancy Services System

Consultancy is an advice service in the form of knowledge, know-how, applied skills, scientific experience, and experimental work that is given to an individual organisation or government department which use it to help them to carry out their work and achieve their goals.

The need for consultancy services has appeared in the industrialised countries after the second World War as a result of the requirements of the modern age which can be described as follows :

- high economic development
- acceleration of industrialisation process
- evolution of science and technology

These features require :

- modern direction of development
- high technical and technological tools
- scientific programmes and policies

The above features and requirements have led to the appearance of industrial consultancy services as important factors towards the achievement of economic

objectives.

Through the past two decades a variety of individuals, offices and organisations have emerged to produce and provide consultancy services to the users, particularly industrialists who have been the greatest need of consultancy services. What is more, the consultancy services have become a commodity in the world market supplied and demanded by different groups and agencies throughout the world.

Recently, LDC's have realised the need for consultancy services to speed their economic growth. Therefore, they started to demand this sort of commodity from the resources abroad. Usually, the demand for the consultancy services by developing countries is associated with planning of economic and industrial projects that need to be established. In other words, the consultancy services are demanded within contractual agreements which indicate that the donor of technology should supply the necessary consultancy to the recipient regarding technical and economical services, design and engineering, production, and maintenance. These sort of services are usually costly and associated with restricted conditions.

The time has come for LDC's to look at consultancy services as a productive element,not an unfair process as it has been before. Therefore, it is necessary to establish a consultancy system that is able to produce

and provide required services for the economic and industrial organisations at national and international levels.

5.2.1 Consultancy System Structure

The structure of the proposed system for consultancy services contains the following : (Fig. 8)

1. Projects : each demand for consultancy services will be classified into project number for identification purposes, as many different requests from various sources in the country come into the system.

2. Sources : refers to the requests sources, i.e. which individuals and organisations the demands come from.

3. Fields : refers to the sector to which the demand for consultancy can be classified - industrial, agricultural, social, transport, etc.

4. Areas : indicates the content of each field that needs consultancy services - environment, machines and equipment, labour reltions, training, management, raw materials, maintenance, etc.

5.2.2 How does Consultancy System operate

The consultancy system operates by receiving requests

from different sources in the country. These sources are :

- planning organisations of the economic and industrial projects
- scientific and technological organisations
- individuals at public level (students and professionals)

These sources are regarded as imputs for consultancy system. At the present time, developing countries need this service most for planning and designing of their economic and industrial projects, as the most sensitive field within the whole economic development. Therefore, the consultancy system should pay more attention to this field and provide efficient services throughout the life of the project from the beginning as an idea until completion. Other sources do require consultancy services but in low demand and have less priority at the present time, but in the long term the demand of these sources will be increased and will have the same degree of importance due to the close links between them in economic development.

In the light of the importance of proper planning and establishment of the economic and industrial projects to the economies of developing countries, the following demonstrates the duty of the consultancy system towards this field.

The duty of the system is constituted in a chain of

consideration and studies go side by side through the project life, from original conception to final completion.

The consideration will include the following functions at different stages : (16, 17)

Stage 1 : Preliminary Study and Research

This function will analyse the idea of the proposed project (pre-investment) and will include its economical and technical requirements, such as human resources, energy, supply and demand, cost, location and natural resources. The purpose of this study is to determine whether or not the idea of establishment (investment) of the project will be economically profitable. The other purpose will show the type of consultancy services required and where and how they can be of value.

Stage 2 : Planning and Designing

This function indicates the technical and technological areas of the project in depth, regarding training and skills, process/product technology and manufacturing facilities. The purpose of this analysis is to ensure the reliability of the project technically and technologically .

Stage 3 : Construction and Building

This function deals with analysis of the construction and building areas, including materials, construction machines and equipment, maps and drawings, workshop layout, machine layout, hardware technology, and other requirements. The system will look into these areas and provide the necessary help and advice.

Stage 4 : Implementation and Control

This function will consider the areas that arise after the project has been established including management, training and skills, production planning, maintenance, production quantity and quality, budget and finance, marketing, business forecasting, working conditions and industrial relations. The system will look into these areas and ensure the provision of necessary services.

5.2.3 Consultancy Service, Supply Resources and Techniques

After the fields and areas have been defined and classified, i.e. the type and nature of the consultancy service needed has been determined, the next step is to define the supply (suppliers) and supply methods to provide the consultancy services wherever they are needed. Consultancy system should make every effort to produce locally the services needed and also make effective communications and relationships with the consultancy organisations abroad. This will enable

the system to know the specialisations of each body abroad and will help to ask precisely for a certain piece of consultance from a certain organisation to satisfy the certain need of the country.

Consultancy services however can be provided in different ways, such as market survey, technical reports, experimental work, model, prototype, pilot project, feasibility study, and visits. The application of these techniques usually depends on the type, nature and objectives of the consultancy services. Fig. 9 shows the whole process of consultancy system functions and supply.

5.3 Information System

The scientific and technological revolution has been associated with what is called "Information Explosion" needed by people who are working in different kinds of economic activities, such as scientists, technologists, economists, researchers, and other specialists.

During the last two decades a variety of international information centres and organisations have been established, especially in the industrialised world. These bodies have specialised in producing certain knowledge and know-how information and make it available for the users as a commodity in the world market. The area of specialisation has become known as "Information Science" which has its own principles,

objectives and has adopted a proper methodology of gathering and disseminating information throughout the world.

Recently, this commodity "Information" has become very important for the interest of the economic development of developing countries. The need for scientific and technological information increases year after year for the people who are involved in the areas of research and development, science, technology, industrial, social and others.

At the present time, developing countries are satisfying their need for information from the industrialised countries and through the contractual agreements of technology transfer, where the contractor provides limited information for particular areas of manufacturing facilities with high cost and restricted conditions. Regrettably researchers in developing countries spend most of their time looking for the sources of information rather than doing real research and often do not know what kind of information they need for their research.

Therefore, the time has come for less-developed countries to establish a communication and information system in order to produce and supply updated and relevant information to various manufacturing organisations and others at national level in these countries. The system would undertake the responsibility of planning

and organising the inflow and outflow of the scientific and industrial information throughout the country. This can be done by bringing the requirements of industrial projects that are planned by the government to the attention of the people who are working in the information operations, and providing them with the relevant information.

5.3.1 Tasks of Information System

The tasks of the information system can be accomplished at the following stages : (18,19)

Stage 1 : Definition of the local need of information.

This taks can be carried out by :

a. Analysing continuously the requirements of the economic and industrial projects which have been proposed by the planning board.

b. Analysing the needs of scientific and technological organisations in the country.

c. Conducting surveys at public level to determine the need of the masses of the people in the country to information.

d. Analysing the needs of research and development bodies and their evolution in the country.

e. Making forecasts for the scientific and technological information trends that will be needed in the future on the basis of the present direction of the economy and the foreseeable changes, both locally and abroad.

The above analysis can be achieved by interviews, questionnaires, survey visits, and research for the people and organisations concerned. To do so, classification according to age, education, and qualification and professional level will be needed for the purposes of accuracy.

Stage 2 : Collection of information.

In this stage the system deals with the collection of scientific and industrial information from various sources to satisfy the needs which appeared in the first stage. To carry out this task, it is required that :

a. Information system should make sure whether the information required can be produced locally or satisfied by import in order to make it available to the users.

b. Sources of information should be known and effective relationships established with them.

c. Information agencies should be established both

nationally and internationally to carry out the collection and sifting of information.

d. Progress, or lack of progress, should be monitored and evaluated.

Stage 3 : Classification of information.

The collected information from different sources requires analysis and compilation as usually the scientific and industrial information is given in the form of certificates. Each certificate contains various categories of information. Therefore, it is the task of this system to analyse and classify the ingredients of each group according to :

- sources of information - local, regional, international
- type of information - social, economic, industrial professional, commercial, etc.
- date of information
- cost of information
- media - journals, books, abstracts, analytical reviews, documents, prototype, etc.
- nature of information - specification, alternatives, performance, obsolescence, reliability, etc.
- users of information - researchers, scientists, engineers, managers, people who work in national economy, students, technicians, etc.

Stage 4 : Documentation of information.

This task can be carried out by storing and documenting the analysed information in carriers, files, microfilm, magnetic tape, computer or data bank. In this way the display and retrieval of the information will be possible and effective whenever it will be needed in the future.

Stage 5 : Dissemination of information.

The purpose of this task is to make the scientific and industrial information which has been collected, analysed and stored, available to the users at different levels of the country. The other purpose is to show how to disseminate and exploit information effectively amongst the nation.

The information system can use various techniques to supply its services such as :

- status report
- statistical survey
- films and cameras
- radio programmes
- slide projectors
- seminars
- courses
- television programmes

The use of one or more of the above techniques will definitely depend on the nature and content of the information required.

5.3.2 How the information system operates.

Information system should operate in two dimensions :

1. To satisfy the demands which come from individuals, groups and organisations in the country.

2. To supply the necessary information and make it available without previous demands, especially for the governmental departments.

Wherever the demands emerge from, information system should act and operate as follows : (Fig. 10)

- fixing entry reference, which indicates the number or code is given to each request according to the advent date.
- defining sources, which refers to the individuals, units and organisations that the requests emerge from.
- classifying into divisions, which refer to the sectors that the demands can be classified into, industry, social, agricultural, etc.
- defining sub-divisions, which refer to the areas that each sector (division) is dealing with. For example, the information regarding the industrial sector can be classified and defined as follows :

1. Industrial Sector : I

2. Industrial fields are :

I/F Food industry

I/E Electrical industry

I/P Plastic

I/N Engineering

I/T Timber

I/S Shoes

I/D Drink

I/C Cloth

I/M Mechanical

I/O Oil

I/R Natural resources

and so on.

3. Industrial areas in each field.

For instance, the areas in the electrical industry field include :

I/E-P Process

I/E-T Product

I/E-Q Manufacturing techniques

I/E-M Machines and equipment

I/E-C Maintenance

I/E-D Engineering and design

I/E-W Work system

and so on.

This sort of classification and definition can be used for other sectors in the same manner. The purpose is to help the users by providing them with specific information and also make it easy and possible to be obtained.

5.4 Research and Development (R & D)

Research and development is a high level activity of work showing the society's understanding, talent and absorbtion of the present and future dimensions of economic, social, and technological phenomena, and also shows the will and capability to create new knowledge and concepts and develop the existing ones.

Industrialised countries under many circumstances have realised the real values of R & D which have been applied to many aspects of their economy; production, education, work system, space, military, chemical, pharmacy, etc. The successful implementation of R & D results in these fields has enhanced and encouraged governments, industrial organisations, and social organisations at public and private level to go ahead with this process. For this reason, industrialised countries have come to spend between 2% and 4% of GNP on R & D yearly.

R & D in less-developed countries is a new field of economic activity; so far it has not been put into efficient operation in the same manner as in industrialised countries. Developing countries, in fact, have not

yet carried out R & D created and developed by local resources. On the contrary, R & D is being practiced in a naive manner by imitating the same activities of industrialised countries in order to reach the same results. Most of R & D activities in LDC's are focused on academic sciences carried out by the universities and colleges, while technological development research is being neglected due to the lack of local resources to produce knowledge and technical know-how. This also is due to the nature of technology transfer process which operates in a way that does not motivate and encourage indigenous resources to practice this sort of research properly. As a result, most LDC's have become dependent upon industrialised world and this has led to a distrust of the capabilities of the domestic human resources to produce useful knowledge and know-how to their economy.

The time has come to look seriously into these areas of R & D as a major component for S & T structure, and consequently for the whole process of development. In other words, the time has come to plan and organise R & D activities at national level, and make it a productive process towards achieving the objectives of the LDC's economy.

5.4.1 R & D : Types and definition.

Research and development can be classified into three main categories : (20,21)

1. Basic research : work directed towards creating understanding in a specific area, i.e. a process of seeking out uncertainties in order to produce new ideas and concepts. This process can be carried out by the following procedures :

a. Idea imagination
b. Collection of some facts relevant to the idea
c. Review and preliminary analysis
d. Application of experience
e. Development and conclusion

Basic research is characterised as follows :

a. It has a high cost
b. It often produces intangible results
c. It is carried out mostly by government departments
d. It is difficult for it to be planned and controlled
e. It is usually working separately from other research activities

2. Applied research : work focused on the preliminary exploration of an idea created by basic research with some known useful implementation. In other words, applied research is the intermediate process between discovery and the generation of a final product as a prototype. This type of research is characterised as follows : (22)

a. It is carried out mostly by industrial organisations

b. It has lower cost than basic research

c. It is followed by a feasibility study of the intended application of basic research

d. It requires proper links and co-operation with the production system

e. It can be planned and organised

f. It is associated with technical and mechanical application

g. It is usually specific, through basic research.

3. Technological development research : work directed to the exploration of the results of research effort in terms of technical and technological improvement converted into a financially viable proposition. In other words, it is a process of creating or improving production methodology. This research is characterised as follows :

a. It is more predictable

b. It can be planned and controlled

c. It requests market survey

d. It usually requires a short term

e. It is usually carried out by industrial organisations

f. The main areas of technological development research are :

- product area
- manufacturing process
- services and manufacturing facilities
- organisational and management
- marketing

5.4.2 How R & D System operates.

The main objective of R & D system is to meet the requirements of the national development by bringing these requirements to the attention of the people who are working in R & D operations. This, however, requires analysing the inputs of the economical and industrial projects which are planned by the government departments (Planning Board) and that need to be established in the country.

The system will proceed by the following approach : (Fig.11)

1. Analysis and classification of the inputs (requests) into the research project: i.e. each request (input) received by the system should be analysed and classified into relevant research projects, such projects -

- academic research projects
- applied research projects
- development research projects

2. Analysis and classification of the projects into research areas : i.e. each project should be analysed and defined into the area it belongs, such as :

- industrial areas
- agricultural areas
- education areas

- transport areas
- oil areas, etc.

3. Analysis and definition of the areas into research activities : i.e. each defined area should be analysed to find its relevant activities. For instance, industrial areas include various activities, such as process/product, maintenance, manufacturing techniques, skills and resources, production facilities, raw materials, etc.

The analysis and classification of the requests (inputs) received by the system according to the procedures mentioned will make the system capable to explore :

- type of R & D required
- where abouts R & D needed
- how can R & D be provided

5.4.3 R & D System : Supply techniques and requirements.

It is obvious that R & D system produces knowledge and technical know-how that is needed by various groups and organisations with or without previous requests in the country. Therefore, the results of these operations should be made available to the above users whenever they are required. There are various techniques that can be used to supply R & D services, such as :

- feasibility studies

- patents
- licences
- certificates and documents
- reports
- survey analysis

The use of one or more of the above techniques depends very much upon the nature and content of the R & D service.

R & D should be a continual process in order to provide the results at any time and to any organisation in the country. Therefore, proper facilities must be made available for the system to carry out its projects, areas, and activities of research. Such facilities :

- skilled manpower
- buildings and construction
- machines and equipment
- tools and instruments
- laboratories
- raw materials
- finance
- information and connection

Finally, effective co-operation and co-ordination with R & D organisation at national regional and international levels is very necessary to be set up in order to produce and supply updated scientific results. Fig. 12 shows the whole structure of R & D system.

5.5 Conclusion

The foregoing systems (bodies) which are proposed in this chapter (engineering and design, consultance, information, and research and development) need to be established, planned and controlled in developing countries. At the present time, these processes are being carried out by a variety of government departments, organisations and sometimes by individuals. They always show the diversity in methods and objectives and also show the absence of co-ordination among them that result in poor results towards development.

The author would like to see these systems (bodies) affiliated to the "Ministry of Technology" which is needed to be set up in developing countries. This Ministry will be responsible for planning and organising the movement of science and technology issues at national level, where each of these bodies can play major roles towards providing scientific and technological requirements for the national development, particularly the proposed economic and industrial projects.

CHAPTER 6

Technology Transfer (TT) Infrastructure of S & T Planning

6.1 Technology Transfer : History and Development

6.1.1 History of Technological Development

The history of mankind has shown remarkable changes in the development of science and technology which took place at various stages, which were :

1. The beginning of "civilisation" when farming replaced hunting.

2. The growth of science and technology in the great empires Babylon, Egypt, Greece and Rome.

3. The Renaissance, which indicates the revival of letters and arts of the 15th century as Copernicus, Keplar, Galileo, Newton and Adam Smith. All had tremendous impact in Europe.

4. The engine of industrialisation 1750 - steam, mechanisation and factory.

5. The Industrial Revolution which introduced : i) electricity ii) mass production iii) aniline dyes iv) the electronic age.

6. The development in social and economic philosophy in response to the above by Marx, Engels and Stewart Mill in the 19th century.

In some respects West Europe and North America started their technological development at about the same time (23), (Fig. 13). The major developments had been achieved between 1818 and 1900 (Fig. 14)

6.1.2 Nature of Technological Development in Europe

Technology transfer in Europe has special features due to the manner in which it was created, developed and diffused across national borders. The advancement of technology development passes through a sequence of stages as detailed below (24,25).

1. Pre-invention stage : This stage considers the current status of the society regarding arts, sciences, social values, economic and cultural values, production techniques and skills and knowledge. People in this stage work, interact, and think about principles, requirements and objectives of their own national environment. As a result, thinking elite will appear and exercise their own ways to tackle certain problems which eventually lead to invention.

2. Invention stage : The "thinking elite" of the previous stage will analyse and research the defined problem until they discover possible solutions. More

research and analysis may lead to a scientific invention.

3. Innovation stage : The scientific invention of the previous stage will be applied in practice. The first application and utilisation is required to show the reliability of the scientific invention for satisfying commercial demands. This stage, however, takes a long time and is subject to failure.

4. Diffusion stage : When the invention has proved to be technologically feasible and commercially viable, it will become available for widespread adoption.

5. After stage 4 we will be in a new situation with new arts, new production techniques, new science and new social and economic values. Soon, the situation will again be similar to the first one (pre-investment stage) and so the cycle repeats (Fig. 15).

These were the logical procedures of technological development in Europe. However, one can notice that the time interval between discovery, adoption, and diffusion was very long. For instance, Watt invented his steam engine in 1776 but it did not begin to play an important part in powering the British economy until the 1830's.(Fig. 16) shows the time interval between discovery and diffusion for some inventions in Europe. In actual fact, this time interval had remarkable benefits enabling people to become familiar with and grow and develop side by side with the development of

science and technology. At the same time, this gave the governments time for useful development and planning regarding training programmes, education, legislative steps, administrative steps and other working conditions. In other words, the change occurred in harmony with society's values and attitudes by creating the willingness and receptiveness to absorb technological changes to achieve full utilisation of human resources and increase the rate of the economic growth.

6.1.3 Nature of Technology Transfer in Europe.

There are a number of factors that played an important part towards technology transfer between countries in Europe and America. These factors are :

1. The nature of the sequence of technological development itself, (Fig. 15). The sequence shown is the systematic approach to technological development from invention and innovation to diffusion and the process can and does take place across national borders.

2. Countries in Europe had their own organised basic research and development with associated technological development.

3. These countries have the main factors of production such as land, capital, labour and markets. Therefore technology transfer became essential for competitive production so it is sold and bought in the world market

among European countries and America.

There are a number of forms in which technology transfer took place among European countries, such as :

a. In the form of capital goods and intermediary ones.

b. In the form of human labour, especially skilled.

c. In the form of technical, technological and commerical information that is needed for industrial projects, like :

- feasibility studies
- engineering and design
- plan construction
- training
- marketing
- patent and licence agreements

To sum up, the development of technology has been moving within a system -

- technology is generated within the system
- technology is transferred within the system
- technology is transplanted within the system

The total system includes production, consumption, creation, and research and development processes. The effect is that in industrialised countries there is a continuous cycle of development, and there is a living body where technology can develop and operate effectively.

6.1.4 Japan Experience with Technology Transfer.

Japan has a long history of successfully importing foreign-made technologies and adapting them to its particular needs. The transfer of technology occurred by the decision to modernise Japan which was made by the Meiji Restoration 1868-1913. This decision was accompanied by a deliberate government policy of importing foreign science and technology. The policy started by inviting foreign experts to Japan and sending students abroad. Those experts were : (26)

- Englishmen employed to design and construct railways, telephone systems and organise the navy.

- French invited to teach law and military strategy

- Americans who established postal systems and agriculture

- Germans invited to teach medicine and train medical officers.

After this initial impetus the Japanese government changed its policy and left the private sector to carry out the tasks of importing technologies into industry. In the period following the second World War, the government played an important role in the importation

of foreign-made technology. The transfer of technology in Japan occurred in three ways :

1. Imported technology in the form of machinery
2. Imported technology in the form of licencing agreements
3. Imported technology in the form of direct foreign investment.

During the period after the second World War, Japan started to buy foreign technology and make relatively cheap and often shoddy Japanese goods. The Toyota Automatic Loom was an example of Japanese technology which was exported to the United Kingdom.

In the 1950's there were greater efforts by some Japanese industrial firms to set up their own research and development laboratories.

To sum up, the Japanese government's role was crucial in making the breakthrough to modernise the country. The role was to plan and achieve the following :

1. Acquiring foreign technology
2. Establishing new industries
3. Providing substantial research and development facilities
4. Building appropriate education, transport and training systems
5. Encouraging private firms to play their part in

technology transfer

6. Inviting different scientists, engineers and technologists from various advanced countries to take part in the development.

Therefore, Japanese experience in technology transfer is successful and very rare. However, it is very difficult to repeat it in any of the developing countries at the present time, because -

a. There is no way that developing countries will find the same support that Japan had from industrialised countries, as the support for Japan was due to military presence and objectives

b. Most developing countries refuse to be dominated by the West again after they gained their political independence

c. The negative attitude of the masses in developing countries towards the imperialism of USA and some European countries.

6.2 Technology Transfer : Theories and Models

This section will discuss some models that have been proposed for technology transfer to developing countries. These models are :

6.2.1 Technology Transfer Model : by Jan Auerhan (27,28)

Auerhan has classified technological advancement according to its historical development. He stated eleven stages; these are :

0 Manual labour

1 Muscle powered tools

2 Tools driven with non-muscle power

3 Non-automatic machines

4 Semi-automatic machines

5 Semi-automatic machines linked together by automatic transfer devices

6 Automatic machines performing a fixed cycle of operations

7 Automatic machines equipped with automatic measuring devices

8 Automatic machines equipped with feedback control system

9 Automatic machines equipped with automatic recording of characteristics of the process

10 Automatic machines where the programmes for the operation of feedback devices is worked out automatically by the control system (adaptive control system, optimum control system, self-organising system etc.)

11 Automatic machines integrating process control and business data processing in one single control system.

In the light of these technological development stages,

Auerhan has defined the network of skill levels that are required to suit each stage. The network of skill level is in Fig. 17. (Stages 0, 1 and 2 have been omitted for this analysis).

Fig. 17. Auerhan's skills network.

Skill levels	Stages of technological development								
	3	4	5	6	7	8	9	10	11
Unskilled	15%	7%	-	-	-	-	-	-	-
Semi skilled	20%	65%	57%	38%	11%	3%	-	-	-
Skilled	60%	20%	33%	45%	60%	55%	40%	21%	-
Secondary education	4%	6.5%	8%	12.5%	21%	30%	40%	50%	60%
University education	1%	1.5%	2%	4%	7%	10%	17%	25%	34%
Advanced university degrees	-	-	-	0.5%	1%	2%	3%	4%	6%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Now, if in a certain country, for instance :

7% of the total workforce are unskilled

65% of the total workforce are semi-skilled

20% of the total workforce are skilled

6.5% of the total workforce have secondary education

1.5% of the total workforce have university education

and none of the workforce have higher education.

Total 100%

This means, according to Auerhan's theory, that this country is in stage 4. Therefore, this country should transfer semi-automatic machines as the only technology to suit its environment and conditions. To transfer more advanced technology than stage 4, say stage 5, will create difficulties as the local capacity is not able to absorb it and employ it in their environment.

Application of Auerhan's Model to Iraqi environment.

In an attempt to apply Auerhan's theory to Iraqi environment, the author analysed the network of skills that are required according to the National Development Plan of 1976-80 (28) as in Fig. 18.

Fig. 18 Skills network required in Iraq for the period 1976-80

Skills levels	1976 %	1977 %	1978 %	1979 %	1980 %
Unskilled	17.06	4	8	4	-
Semi skilled	35.7	38.76	44.76	48.76	52
Skilled	34.1	34.5	34	33.5	33
Secondary education	4.14	5.29	6.24	7.74	10
University education	8.94	7.45	7	6	5
Total	100	100	100	100	100

Now, looking at the network of skills required for 1980, which are :

- Nil non-skilled
- 52% semi skilled
- 33% skilled
- 10% secondary education
- 5% university education

100% Total

In comparison these figures with Auerhan's model of stage 5, which

- Nil non skilled
- 57% semi skilled
- 33% skilled
- 8% secondary education
- 2% university education

100% Total

One can see the figures are roughly similar. Therefore it can be seen that Iraq should now be in stage 5 of technological development or, to be more precise, in the beginning of stage 5. Accordingly, Iraq should transfer the technology of stage 5 which indicates the "semi-automatic machines linked together by automatic transfer advices".

Advantages of Auerhan's model

There are a number of advantages to be emerged from Auerhan's model such as :

1. The stages of technological development are well defined

2. The need for skilled workers increases according to the degree of the technological development, which is very natural phenomena.

3. Logically, the transferred technology will find a suitable environment whereby the technology can be adopted and operated.

4. Disruption, chaos, waste and weakness of the material and non-material resources which are usually associated with foreign-made technology can be avoided in advance to a reasonable degree

5. Finally, this model emphasises that local capacity should be developed first and only the type of technology to be imported should be determined.

Disadvantages of Auerhan's model

1. The structure of network of skills required for each stage is, in fact, hard to predict precisely, as the author believes that there will be need for unskilled and semi-skilled even with high level of technological development. The demand for those people will increase to support the productive workers and development staff. The model, in fact, shows that the need for these groups of workers will be diminished.

2. In practice, this model leaves developing countries very far behind developed ones regarding science and technology. In other words, it allows industrialised nations to get the benefit of the modern science and

technology and deprives developing nations from this right.

3. It is very obvious that developing countries need badly foreign-made technology in order to develop their own resources. Now, if this need is being satisfied by old and stock technologies which have been designed years ago, this indicates that developed countries will remain at the top and the gap with developing countries will always be wide.

This is to say that we just deprive poor nations of the future opportunity to catch up industrialised nations even relatively. Therefore, the author believes that this model will not remedy the present situation of developing countries. On the contrary, it will make the poor poorer and the rich richer. It also creates unequal relationships between the two groups of nations.

There are, in fact, two important points to be mentioned. First, human resources naturally can be developed wherever they are. Second, developing countries have got the choice between technologies available in the world market. Therefore, they must transfer various technologies, even the advanced ones in order to speed up the development of their economy. Developed nations, however, did not have this choice when they started their development. Developing countries must not wait until they build up their local resources in order to import certain technology. They

should carry out both processes at the same time, i.e. import advanced technology in the field required and create and develop human resources to operate this technology simultaneously. It seems a hard task with some waste; however, it should be done this way. In the long run the civilisation and modernisation will be spread all over the nations of the earth, and there will be balance and equity.

Finally, the possibility of successful application of Auerhan's model can occur if there is limit and end for technological evolution where developed countries cannot go any further. In this way, developing countries will eventually catch up. This possibility, however, is low as science and technology have no end.

6.2.2 Technology Transfer Model by Samuel N. Bar-Zakay(29)

This model (Fig.19) is divided into four stages in the direction of the flow of actions between the donor and the recipient of technology. These stages are :

1. Search stage
2. Adaptation stage
3. Implementation stage
4. Maintenance stage

At the top and bottom of the model three types of activities are listed correspondingly for the donor and the recipient :

1. Technological forecasting
2. Long-range planning
3. Project-related intelligence

The probability of success of any technology transfer project would increase if the donor and the recipient were to perform the activities or satisfy the requirements outlined above and below the horizontal central line. In all cases, however, the activities listed in the model are taking place, consciously or not, though obviously the more aware the donor and recipient are of these activities the better the chances for the success of the project.

Comments

Basically, the nature of the technology transfer requires effective co-operation and join action between the donor and the recipient of technology, as the only parties concerned in loss and profit. The model defines the jobs and the responsibilities that both parties should undertake through the various stages of the technology transfer project. In other words, this model shows logically and theoretically the way for the donor and recipient to tackle and implement a successful technology transfer project and, as such, is a hopeful outline of a theoretical solution of the problem of technology transfer between the two parties.

However, this model is not practically applicable due

to the environment of developing countries and the attitude of the donor towards the recipient. Broadly speaking this model assumes a great deal of co-operation and responsibility between the parties but this degree of responsibility and co-operation, particularly by the donor, cannot be achieved at the present time due to the following :

1. Unequal relationships between developed and developing countries regarding many aspects of life especially science and technology.

2. The recipient does not have the same capability as the donor in terms of material and non material resources.

3. The donor does not design and produce the appropriate technology which can be applied successfully to the recipient's environment.

4. The donor does not exert any effort to learn about the conditions of developing countries.

5. The donor is always seeking a strong controlling position by imposing restricted terms on the recipient.

The model, in fact, is premature for developing countries on the one hand, and on the other it is similar to the previous one in principle whereby both believe that developing countries should have a certain period to

create and develop their material and non-material capabilities first and then allow them to employ and absorb foreign-made technology.

6.2.3 Technology Transfer Model : by Jan Kmenta (30)

In this model Kmenta is trying to tackle technology transfer between developed and developing countries by defining the gap among these two parties. The gap indicates the differences between the two groups of countries in terms of science, technology, economic and social values. The gap in this model is defined by the following equation :

$$B_t = A_t - L_t$$

where :

B_t refers to the level of technology in country B at time$_t$ (backward country)

A_t refers to the level of technology in country A at time $_t$ (advanced country)

L_t refers to the number of periods by which country B lags behind country A at time t.

L_t varies in country B, and its determinates are skills, education, income, patents, communication, machines

and equipment, resources available, etc.

Each of the mentioned variables stand for Z.

Therefore :

$$L_t = f\ (Z_{1t}, Z_{2t}, Z_{3t}, \ldots\ldots Z_{nt})$$

The technological gap is therefore

$$A_t - B_t = L_t$$

Comments

1. The objective of this model in fact is to estimate the technological gap between industrialised and less industrialised countries by defining the differences among them in terms of Z_n's. In other words, to define the level of technology in developing countries in order to compare it with corresponding level in developed countries. On that basis, technology transfer takes place. Accordingly, old and stock technologies which have been designed and produced by industrialised countries should be transferred to developing countries. Simply because the level of science and technology in developing countries is lower than in developed countries.

2. The model discusses the variables of L_t in developing countries in terms of Z_n's. However, it does not take into account that L_t variables are subject to

continuous change as well as in developed countries which, in the long run, will widen the gap between them.

3. Finally, this model is very similar to the previous one, whereby all indicate that developing countries should import and employ labour-intensive and obsolete technologies, as the only ones to suit their environment. Therefore, developing countries should overcome the differences with developed countries (L_t) in order to allow themselves to transfer advanced technology.

To sum up, the author believes that we should not restrict developing countries to transfer certain types of technology because if we do so it will mean that old technologies are the only ones transferable to these countries, due to the fact that these countries are backward economically and socially. By doing so, we deliberately try to deprive them from employing advanced technology, and consequently lower their economic development. Therefore, all the doors should be opened for these countries to transfer whatever technologies (even advanced ones) which lead to speeding up economic growth. The social problems that are associated, however, can be solved by the country itself and gradually. The planning therefore becomes a major tool to overcome these problems. In other words, the time has come for less-developed countries to adopt and establish a system for planning, organising, and controlling the inflow and outflow of technologies required for their development.

6.3 Technology Transfer : Proposed System

This section will discuss a model for technology transfer system as a major component for the planning of science and technology in the developing countries.

The model is based on the fact that the donors of technology (industrialised countries) have failed to propose a system whereby their technologies can be employed and adapted to suit the local conditions of developing countries. In other words, the donors have failed to solve the problems that emerged from their technologies when brought to use in developing countries. On the contrary, the donors impose restricted terms and conditions about the type, nature and cost of technologies that developing countries need. As a result, the final decision about technology transfer has been left entirely in the hands of the donors.

The aim of the proposed system is to encourage developing countries to rely on themselves to tackle and solve the problems of transferring foreign-made technology. Therefore, a "Central National Organisation for Technology Transfer and Development" must be set up to carry out all the activities and tasks involved in technology transfer, starting from planning until execution. Accordingly, the proposed economic and industrial projects, after being studied, planned and approved, should come to this organisation for implementation.

As the technological inputs of these projects will be defined, transferred and executed at national level.

6.3.1 Structure of Technology Transfer System

The structure of the proposed system contains the following : (Fig 20)

1. Technology Transfer Council

This council is a top authority that is responsible for the whole process of technology transfer in the country. The major policies adopted by this council are :

a. Technology transfer policy : this policy indicates the importance of foreign-made technology to speed up the economic growth in the country. This implies that the country should open its doors to imported technologies from different sources in the world market. This is necessary so that the country should be in continuous process of seeking for technical and technological changes in science and technology abroad and trying to get benefit of these changes for the sake of the country. In this context, this policy will deal with the following fields :

i. Base technology

ii. Choice of technology

iii. Technology transfer techniques

iv. Contractual agreements with the suppliers

b. Adoption policy : this policy indicates the ingredients of the imported technologies and their elements which should be analysed technically and technologically. The purpose of this policy is to create understanding and awareness about the content of the imported technology in order to make it adoptable at national level, especially for the users. This is important for maintenance and for the possibility of split-up of the components of the technology. Therefore, the imported technology ought to be carefully considered so that it will benefit the future expansion of the development in the country.

The policy therefore will cover the following :

i. Effects of technology on population
ii. Consideration of markets and demand
iii. Economic considerations
iv. Local technology available
v. The effects on material and non-material resources
iv. Split-up imported technologies and consider their components in order to generate awareness about their functions.

c. Adaptation policy : this policy refers to the necessity of modifying imported technology to meet local conditions and vice-versa. The aim of this policy is to encourage local resouraes (after adoption) to adapt foreign-made technologies by creating suitable

environment for it and make it operate effectively. This is due to the fact that the technology has been basically designed to meet the conditions of the original designer and most probably would not work properly in another condition. Therefore, the modification of both technology and local environment has become vital for the recipient. In other words, this policy places emphasis on domestic capability to be more skilled, experienced and developed in order to be able to get on well with absorbing and re-designing imported technology. This can be done by analysing the content of imported technologies and by classifying their elements in order to see which ones can be developed locally, what additional requirements are needed, and which element should be imported from abroad. In the long run, this policy will create the necessary infrastructure (economically, technically and technologically) for the future piece of technology that needs to be transferred from abroad.

d. Development policy : this policy indicates that there should be a continuous process of developing existing technology by exercising research and development (Technological Development) regarding the possibilities of new invention and innovation. Technological development scheme, however, should be set up to include the types of technologies that are necessary to be developed to serve the basic industries. For instance, chemical and petrochemical industries are important to be established in Iraq at the present time.

Technological development scheme therefore should pay special attention to develop the technologies that are required by these industries, and so on for engineering and mechanical industries.

This policy, however, will cover the following :

i. Assessment of local capacity for imported technology

ii. Development of imported technology

iii. Development of new technology (invention and innovation)

Finally, the technological council should be aware about present economic development and its direction in the future, especially industrial development regarding the types and the priorities of the industries required for the country.

2. Technological Planning Committee

This committee will be responsible for the planning and controlling of the activities of the system. The major functions of this committee are :

a. Defining the technological inputs of the technology transfer project. Each demand (project) for technology transfer comes to this system and requires definition and analysis of its technological inputs, such as :

- machines and equipment
- skills and expertise
- design and engineering
- construction and building
- production techniques
- information
- environment and resources
- consultancy

The definition and analysis of the above inputs in fact depends on the nature of the technology transfer project and the type of industries to be established. Therefore these inputs might be all needed for the project or some of them only might be required.

b. Defining technological fields : the inputs to the technology transfer project should also be defined and analysed according to their particular fields. Each will tackle a wide aspect of the project. The fields are :

- nature and shape of technology
- specification and standardisation of technology
- resources required for technology
- technology forecasting
- technology assessment
- research and development

The definition of these fields will make the job easy for the executive committee whereby the people of this

committee will be aware about the nature and objective of their work.

3. Technological Executive Committee

This committee is responsible for performing the activities required for technology transfer project. The implementation of these activities requires a series of technological programmes to be developed and brought to a successful conclusion.

These programmes are :

a. Economic technology programme : this programme analyses the economic inputs of the technology transfer project which include :

i. location and size of the project
ii. construction and building
iii. energy and power
iv. resources available
v. employment opportunities

b. Human technology programme : this programme considers the human inputs of the technology transfer project which cover :

i. skills and knowledge
ii. training scheme
iii. co-operation and relations

iv. training techniques

v. supporting facilities

vi. management and organisation requirements

c. Material technology programme : to consider one of the major inputs of technology transfer project, which is the raw materials required. The programme tackles this input as follows :

i. supply and demand

ii. local raw materials available

iii. specification and quality of raw materials

iv. sources of raw materials and semi-finished product abroad

v. development of imported material

vi. information and communication

vii. cost and reliability

d. Construction technology programme : this programme considers the construction and building inputs of the technology transfer project, and covers :

i. construction procedures and plans based on factory design

ii. design and engineering required for construction operations

iii. constructions materials

iv. construction machines and equipment

v. consultance and information

vi. supply and demand for construction machines

and materials

vii. procedures for installing plant and services

viii. local capability for construction and building.

e. Manufacturing technology programme : this programme considers the manufacturing inputs of the technology transfer project, which include :

1. Process programme which covers :

i. design and development of the production process

ii. life cycle of processes

iii. process layout

iv. engineering and consultance

v. supporting facilities

2. Product programme, covers :

i. product/component design

ii. product raw material

iii. standardisation and specification of the product

iv. skills and knowledge

3. Production techniques programme, covers :

i. manual and mechanical techniques of

production

ii. semi-automatic and automatic methods

iii. skills and knowledge

iv. batch and mass production

4. Machines and equipment programme, covers :

i. type and number of machines

ii. procedures for maintenance

iii. supply and contract

iv. consultance and information

v. plan layout

vi. cost and standardisation

vii. machine tools design

5. Organisational programme, covers :

i. factory design

ii. factory layout

iii. production functions

iv. job description

v. workforce layout

vi. planning and control

vii. management and skills

viii. co-operation and information

ix. training scheme

x. cost and finance

xi. storage and insurance

xii. selling and purchasing

f. Transferring of technology programme, covers :

i. communication and relations

ii. contract and supply

iii. formate tenders

iv. transfer means

v. registration and documentation

vi. patents and licences

vii. negotiation and contractual agreement

viii. choice of technology

ix. testing and evaluation

x. controlling and monitoring procedures

6.3.2 How Technology Transfer System operates

It has been stated that the proposed economic and industrial projects which have been approved by the Planning Board should go to the TT system or organisation for execution. Each project coming to the system will be called a Technology Transfer Project (TTP). The system will consider technologically the inputs and requirements for each TTP received. The planning committee defines the main inputs, while the executive committee carries out the requirements of the inputs through its programmes and sub-programmes.

The tasks of the system towards TTP can be illustrated as follows :

1. Definition of the areas of TTP that need technology.

It is important that technology should be inserted into the right place under a suitable environment within the technology transfer project. Therefore, the key elements of the TTP should be analysed as follows :

a. Technological elements of the production process of TTP.

This analysis will cover :

- basic elements : which indicate the direct production activities regarding producing products by changing the shape from raw material and semi-finished product to finished product.

- secondary elements : which refers to the supporting production activities regarding maintenance, transport, storage, etc.

In other words, technological elements analysis shows the real manufacturing processes and also production services required which operate together to produce the product. This will discover the deficiencies and weaknesses in these activities from which might emerge a need for new technology to be introduced.

b. Technical and material elements of production process of TTP.

This analysis concentrates on the interaction between

workforce, material, and machines that the production process of the TTP needs. The weakness and deficiencies can be found whether they lie in the workforce, materials, or in the machines and equipment. Defining these shortages will create the need of new technology to be inserted to overcome the deficiencies.

c. Economical and social elements.

This analysis of the economical and social elements of the production process of TTP will show the relationships which may result from the interaction : material and machines. New technology for training and rehabilitation might be required to overcome the deficiencies of the relationships.

d. Planning and organisational elements.

This analysis will show the level of performance for a project and its relationship with other projects and other elements of TTP with respect to :

- harmony
- balance
- continuity
- suitability
- utilisation degree
- control
- wages
- relationships

- production cycle

This analysis again might create a need for technology to overcome the weakness in those elements.

According to what has been mentioned, it is necessary to regard the production process for each technology transfer project as an integrated system which represents a complexity of elements and a group of relationships within the elements.

2. Definition of the criteria for the choice of technology.

There are a number of criteria that should be taken into account to choose the technology piece required for the TTP, such as :

a. Appropriateness and suitability : the choice of the type of technology should be linked to the following :

- objectives
- specifications required
- local capability
- obsolescence and depreciation
- adoption and adaptation possibilities

b. Technology cost : cost of technology required is another criterion to be used to choose the technology piece. The cost is divided into :

i. Direct cost, covers:

- payment for purchasing and using patent and licence
- payment for using know-how
- payment for trade marks
- payment for preliminary technical services
- payment for machines and equipment

ii. Indirect cost, covers :

- over pricing
- interest for using know-how
- profits which should be paid to the donor of the technology
- inflation

iii. Other cost, covers :

- irregular transfer of technology
- delay in arrival of technology
- unfair restricted conditions

c. Accessibility to technological information : this criteria is very important and should be taken into consideration while choosing the piece of technology. It will indicate the possibility of transferring certain technology. Therefore, access is required to information regarding :

- patent and licence
- technical service
- sources of technology
- raw material

- cost
- market
- development, improvement and changes of technology
- standardisation and specification
- trade names and marks

The information about the above fields is necessary to help to take the right decision about the choice of technology and the suppliers (donor of technology).

d. Time factor and execution process : the implementation process, which comes after the decision has been taken as to the type and supplier of the technology, should be very well considered in order to avoid failure and also to achieve quick execution of the project. The following therefore should be taken into account before the execution and during the course of choosing the contractor :

- the recipient must be sure that the capability of the contractor and his experience are equal to the task

- training schemes should be set up for local human resources

- local personnel should join in the operation of the execution stage side by side with the contractor

- the recipient must control and monitor that the execution works are being done according to the

- contractual agreement regarding machines and consultants' arrival and time schedule.

3. Organisation of the technology transfer.

The execution of any technology transfer project should be followed by carrying out some organisational tasks regarding the contractual agreements between the recipient and the donor of the technology. The TT system therefore should carry out these tasks such as :

- collecting and organising the technical information about each technology transfer project for re-using in the future

- registering and documenting the technology transfer contracts and agreements

- taking major part in contract negotiation to set up effective agreement of technology transfer

- controlling the execution of the TT project, and monitoring the obligations of the contractor according to the international law of TT.

- setting up training courses or programmes to supply the requirements of the execution stage under the supervision of the contractor

- creating links with the scientific and technological organisation inside and outside the country

- ensuring close links with the objectives of the national development plan.

6.3.3 Training Scheme for Technology Transfer Staff

The national system of technology transfer requires to set up a training scheme in order to recruit its staff to do the job properly. This scheme should be a continuous process to include different levels of the people who are working in the system. The aim of the training programme is to create the capability technically and technologically to carry out the tasks of the system. The training scheme in this context will include :

i. The nature and content of modern technology in order to create a staff able to split up its components with links with the national development nature and objectives

ii. The merit of technology transfer process, in order to produce the knowledge about sources of technology, negotiation and channels of technology transfer, and contractual agreement conditions and costs

iii. The absorption of technology i.e. how to deal with foreign-made technology in order to make it

possibly adopted by local resources. This can be done by creating full awareness about designing, transferring and applying of these technologies into the domestic environment. Consequently, the maintenance of these technologies will be possible and effective.

iv. The modification of technology, placing emphasis on the production of the necessary infrastructures that enable local resources to modify foreign-made technology in order to make it applicable in the country. This might refer either to re-design some elements of imported technology, develop some aspects of local resources, or carry out both simultaneously.

v. Finally, the programme scheme should pay special attention to developing human personalities of the people who work in the technology transfer system, particularly those who work in programme f. Those people are subjected to various sorts of temptation and corruption due to their direct contact with the multi-national companies and the donors of technology abroad. This case should be clarified to everybody working in this system as national interest should be above all of any personality matters. For this reason, there must be a very tough decision towards those who use their position for achieving their benefits at the price of national benefit.

The above training programmes should be renewed and developed from time to time according to the evolution of science and technology in the world, and also according to the dimension and objectives of the national development in the country.

6.3.4 Conclusion and Advantages of the proposed system of TT.

In most developing countries, the process of transferring foreign-made technology is dealt with by various organisations at different levels in the country. There is no link between these organisations and also amongst the activities they deal with. In other words, there is no integrated process or system responsible at national level to carry out the activities of technology transfer that is required by the national development.

This work is an attempt to propose a system where foreign-made technology can be transferred and applied into the environment of less-developed countries. The system requires a Central Organisation for Technology Transfer and Development to be set up at national level. This organisation will be responsible for carrying out the activities of technology transfer starting from planning, implementation, and controlling, that imported technologies require. The economic and industrial projects that are approved by the Planning Board come to this organisation (as technology transfer project) for considering the execution process in terms

of technological inputs of each project that need to be transferred from abroad. In addition, the system considers the local capability, in terms of adoption and adaptation capacity, to take part with the execution of the TTP. Therefore, the development of the domestic capability is one of the major tasks of the system. Each TTP received by the system will be analysed through the planning and executive committees affiliated to the system. The aim of these committees is to discover the areas within the TTP that need technology; consequently the transferring and inserting of technology into these areas is possible and effective.

The advantages of establishing a national system of technology transfer include :

i. It changes the control process of technology transfer from the hands of the multi-national companies (donors) to the hands of national resources (recipients). That is to say, it encourages domestic resources to carry out the job and creates confidence in their capability. As time goes on, local capacity will be created and the job will be done normally. Therefore, and in the author's opinion, it is very necessary to break the huge wall that was built by the monopolistic attitude of the multi-national companies which always highlighted the incapability of domestic resources of developing countries which destroys the confidence in their potential capacity to carry out the job in this field. This attitude towards developing countries has been

deliberately established and over exaggerated for the interest of the donors of technology through the past two decades. The most important task of less-developed countries in this decade is to break this false psychological barrier and to show that they are able to develop themselves economically, socially and technologically.

ii. The proposed system of technology transfer does not impose strict conditions or deadlines about the type of technology that should be transferred. In other words, the system does not limit the economic and industrial organisations to a certain level of technology. This option will be opened and depends on the technical and technological analysis carried out by the committees of this system. Accordingly, it might be attractive to employ advanced technology for some projects, and not so for others. It might be also that some areas of TTP require sophisticated technology, while other areas require less advanced technology, and others require traditional ones. Therefore, the system is different from other systems of technology transfer mentioned in this work.

iii. The proposed system does not deny the mutual co-operation with the donors of the technology on the basis of mutual interests. However, it should show the leading part of the recipient in independent decision-making. This again depends on skills, knowledge and experience of the recipient at the negotiation table.

CHAPTER 7

Social Infrastructures of S & T Planning

7.1 Background Growth of Human Resources in LDC's

Developing countries face different kinds of problems that hinder the development of their human resources, and consequently impede the advancement of science, technology and the economic development as a whole. Most of these problems have arisen from the historical background of these societies. In other words, people in less-developed countries have inherited various social and cultural values which were created centuries ago under different primitive social and economic systems. These values, in fact, have played a major role in shaping the present structure of these societies. The values include (31) :

a. family relations and traditions
b. tribal system
c. religion
d. attitude to women
e. feudalistic system
f. colonial system
g. authoritarian institutions in political life
h. illiteracy and education

i. brain drain

It is necessary to mention that the above values, to a large extent, are still adhered to by people of the most developing countries at the present time.

Appendix 1 shows in detail the social background of the developing countries regarding the above values.

7.2 Dimensions of the Development

There are two basic dimensions for the development :

First : the economic dimension : indicates the development of economic infrastructures, such as building up plants, roads, railways, bridges, power stations, water supply, etc.

Second : the social dimension : indicates the development of social infrastructures, such as schools, colleges, universities, social welfare and security, training, etc.

It is common sense that the two dimensions should operate jointly to achieve comprehensive development of the society.

Developed countries, in fact, have realised the importance of the social development; therefore, more concern has been given to it, especially after the 1960's. Fig. 21 shows the balance between economic and social developments in developed countries (32), while developing countries have given little concern for the social development, which resulted in disruption and confusion leading to impeding the development as a whole. Fig. 22 shows the gap between social and economic development in these countries. In other words, social infrastructures development has been and is still neglected by the policy makers in less-developed countries due to the under-estimation of the importance of human resources participation for the development.

Fig. 23 shows comparison of both developments with industrialised countries.

In Iraq the gap between social development and economic development can be seen clearly through the National Investment Plans which have been set up by the government (Fig. 24).

Considering the allowances assigned for these plans this figure shows that the social infrastructures

development was much less than economic ones (33). In actual fact, these plans did not show proper attention being paid to the social development by the government, and therefore the gap with economic development is increasing. Fig. 24 shows the ingredients and allocations for the social and economic developments, while Fig. 25 shows the gap between these two dimensions.

According to what has been mentioned, it can be said that there are two major factors for impeding the development of human resources in LDC's :

1. The historical background regarding inherited values and traditions (natural reason)

2. The poor attitude of the National Investment Plans (policy makers) towards development of human resources (deliberate reason).

Therefore, the time has come for developing countries to pay more concern for the development of their human resources in order to match the evolution of science and technology on the one hand, and on the other, to meet the requirements of their economic development.

7.3 Human Resources Development : Proposed Procedures

The key introduction to the human resources development in developing countries should be started by knowing the

impacts of the technological changes on human resources. In other words, the main areas of human resources that are affected by the technology should be defined and developed accordingly. These areas are :

1. The impacts of technological changes on the work-force framework

The workforce framework will be very much affected by the technological changes. The labour division therefore turns out to be as follows : (Fig. 26)

a. unskilled labour who do not need a knowledge about the practical and scientific aspects of the work. For example, such jobs as cleaning, driving, portering, etc. Some years in the primary schools will be the source of these people. The demand for those people in fact will increase under advanced technology in order to support the production workers in their jobs.

b. skilled labour, who need good knowledge about the practical sides of the work and general scientific elements of it as well. The educational sources of these people will be the technical and industrial institutions and the polytechnic colleges. They are employed in the workshop as productive labour and they are in great demand.

c. professional labour, the people who need very good practical and scientific knowledge about the work, such as engineers, designers, programmers, planners, accountants, managers, etc. The colleges and universities are the sources of these professionals and they too are in great demand.

d. researchers and specialists, the people who need very good knowledge and technical know-how which enables them to create and develop ideas or methods about the work. The qualifications of these people are deep specialisation, high education and experience. In fact, under automation and advanced technology, the need of these people increased to keep up with the evolution of science and technology.

2. The impacts of technological changes on the organisation structure.

Technological changes have major impacts on the work structure of the organisation in terms of nature, methods, functions, and specialisation. The impacts, therefore, will occur as :

a. replacement of workers with machines and equipment which leads to a reduction in the number of workers.

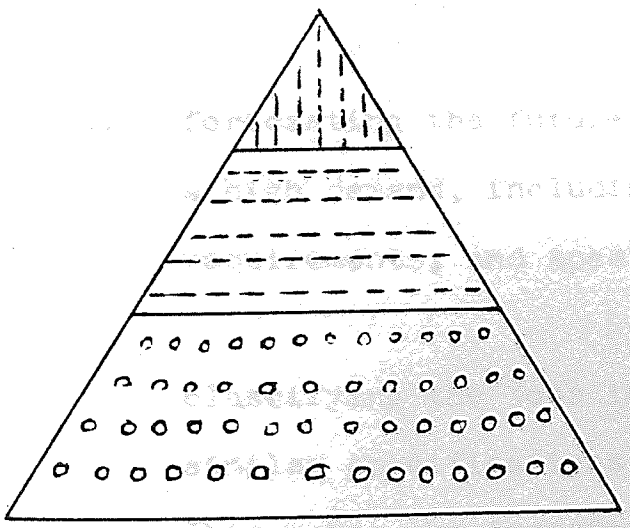
b. more specialisation is required due to the new

quality and precision needed by the work.

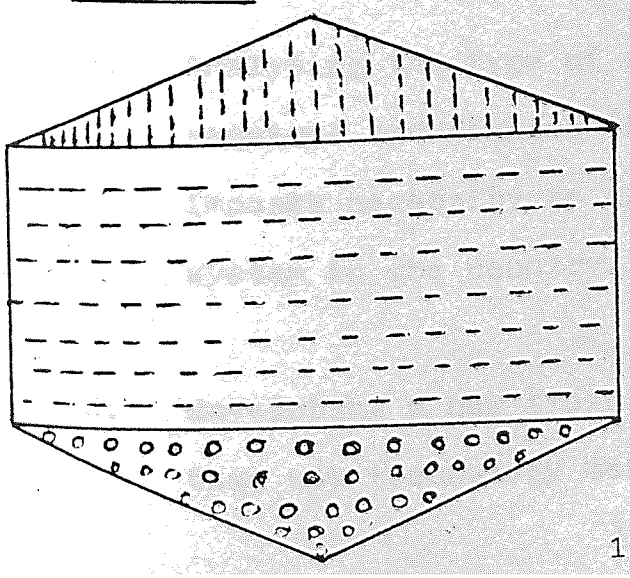
c. New functions need to be created within the structure of the organisation in order to absorb the increasing demand for researchers, programme setters, system analists, computing programmers, planners, and other specialists.

Therefore the organisation structure needs to be changed from pattern A (traditional structure) to pattern B (new structure) as below :

Pattern A



Pattern B



In pattern B the need for skilled labour increases and a new demand for specialists will emerge, while the need for unskilled labour will decrease because some of the skilled labour will clean and tidy their own work after finishing.

3. The impacts of technological changes on manpower planning.

The objectives and techniques of the manpower planning will also be affected by technological changes. New procedures therefore need to be employed for the planning of manpower, such as :

a. forecasting the future jobs for which there will be a high demand, including names, qualifications, requirements, and specifications

b. classifying the jobs into families, which have similar specifications and require similar skills. This makes the transference from one job to another possible and effective

c. Analysing the type of skills and knowledge required and finding the supply sources. This imposes necessity to create links with education system in the country.

d. developing a new training programme due to the fact that new technology means new jobs, new skills, and

new performance. Therefore, training schemes should be developed to produce various skills and knowledge required.

4. The impact of technological changes on the job evaluation and wages.

Finally, the job evaluation will be affected by the technological changes due to the insertion of new elements and components into the job content.

The Arab Labour Organisation has set up reasonable elements for job evaluation according to the technological changes. These elements are :

a. Labour functions evaluation include :

- skills			
	education	14%	
	experience or training	18%	
	intellectual skills	12%	
			44%
- effort			
	physical effort	8%	
	mental effort	6%	14%
- responsibility			
	towards material	8%	
	machines and equipment	8%	

supervision 10%

safety 5%

31%

- work condition

environment 6%

risks 5%

11%

Total 100%

b. Managerial functions evaluation include :

- knowledge

education 10%

experience 15%

training 7%

effort 8% 40%

- problem tackling

decision making 10%

communication 6%

modification and initiative 7%

relations 7% 30%

- responsibility

supervision given 6%

supervision taken 6%

records and documentation 6%

secret information 6%

financial efforts 6%

30%

Total 100%

This policy of job evaluation is applicable for the environment of developing countries as 44% of the job value is assigned to the skill. In other words, the policy is meant to encourage people to improve their level of skills and education in order to fit into the jobs. At the same time, the policy has not ignored the other elements of the job regarding effort 14%, responsibility 31%, and work condition 11%. It seems also that the policy is effective for the managerial job, where the need to experience, training, and capability for decision-making are all important elements and they have a high percentage. The policy assigned 10% for education due to the assumption that these people have already attained a certain level of education which enables them to do the job.

7.4 Training System : Proposed procedures

Training is one of the major areas that is affected by technological changes, and needs to be developed in order to produce the requirements of the development. Training in fact is a process of developing technical and technological capability of the human resources to enable them to assimilate the changes in science and technology for the sake of the national economic growth.

This section will illustrate a training model for developing countries. The model will cover the following :

i. the objectives of the training policy
ii. the requirements of the training
iii. workforce supply
iv. workforce demand
v. the need for training
vi. training techniques and programmes
vii. co-operation with other organisations
viii. evaluation

These items will be considered respectively.

1. The objectives of the training :

The goals of the training policy should be objective and clear to both the trainees and the trainers. Then by measuring progress towards the achievement of these goals, it will be possible to evaluate the whole policy. The aims of the training system therefore, include : (34)

a. To provide the requirements of the National Economic Development in the country. This can be done by breaking down the investment plan in order to diagnose the areas that need training regarding specific skills and know-how.

b. To achieve full employment, which can be done by

training unskilled people in order to occupy the available skilled jobs

c. To increase the capability of human resources in quantity and quality to enable them to do more than one job

d. To meet the science and technology requirements particularly in production, innovation and development

e. To improve vocational and intellectual levels of the workforce

f. To train large numbers of people in different training schemes in order to achieve full utilisation of the workforce.

2. Training requirements :

A training scheme at national or sectorial level needs the following requirements :

a. Information about population, such as

- male population
- female population
- distribution of population
- age
- rate of growth

b. Training facilities, such as :

- buildings
- laboratories
- machines and equipment
- personnel

c. Information about :

- economic activities, industry, agriculture, education, services, etc.
- science and technology evolution inside and outside the country in terms of skills, knowledge, know-how and jobs

3. Workforce supply :

A survey study of the workforce is needed to be carried out to define the supply. The survey includes the following :

a. Defining the present number of employees in terms of vocations, skills, and wages

b. Defining the number of people who are unavailable for work for a number of reasons, such as :

- people less than 15 years of age
- people more than 60 years of age
- people in gaol
- disabled
- housewives

c. Defining the areas of unemployment (exclude point b above)according to sectors, skills, vocations and wages .

d. Estimating the technological changes, impacts, on the workforce supply in the future.

4. Workforce demand

The demands for the workforce emerge from the following sources :

a. National Development Plan : as the plan contains a list of projects, and these projects need a workforce in various stages - planning, construction, and operational phases

b. Economic and industrial organisations which are already established. These organisations demand workforce from time to time according to :

- productivity changes
- technical and technological changes
- changes in working hours
- work expansion
- compensation for lost workforce through death, retirement, sacking, etc.

c. Services organisations also require work-force due to utilisation of new techniques and improving the quality of work, such as : telecommunication organisation, social organisation, health organisation, and so on.

5. The need for training.

The need for training may emerge from the following areas of analysis :

a. Organisation analysis, which indicates the analysis of the structure of the organisation regarding its departments and sections in order to define the part needs training. These departments are workshop, maintenance, planning, designing and so on.

b. Operation analysis : which covers the functions, of the job that need training, for example:

- job changes
- job mechanism
- new process within the job
- job content

c. Man analysis, which includes specific qualities of the worker in relation to his job; for example, ability, knowledge, attitude, aspiration, perception, and skills. The analysis of these aspects will help to discover the weakness and therefore a training scheme might be set up to train people to overcome these shortages.

6. Training programmes and techniques.

Training programmes should cover the following :

- economic and social aspects
- industrial relations
- leadership
- creativity
- maintenance procedures
- work planning, organisation, and controlling
- production methods
- safety and stabilisation
- time and motion

These programmes can be carried out by the following techniques :

- survey studies
- classes
- courses
- conferences and meetings
- pilot projects
- research groups
- training within production processes inside the workshop
- training inside the firm but outside the workshop (training centre within the firm or within similar industries).

7. Co-operation and relations :

In order to set up a successful training scheme, it is necessary to have links and connections with the following bodies :

- National Development Board
- education system
- science and technology organisations
- workforce planning body
- employment organisation
- similar training schemes abroad
- links with people at the grass roots or shop floor level about their needs and desires

Co-operation with the above bodies will help to exchange information that leads to setting up effective training systems at national level.

8. Evaluation :

Finally, it is important to evaluate the training scheme in terms of its efficiency and its contribution to the human resources development. The evaluation can be done by using the following factors :

- meeting the objectives
- achieving effective performance
- providing skills and knowledge required
- increased productivity

- creating new jobs and vocations
- employing workforce in the economic activities
- reducing the cost

The procedures which have been stated in this section are, in fact, a general outline required to propose a national system of training in developing countries. Therefore, it is suggested that a National Training Centre is needed to be established to carry out the procedures of training at national level, and especially to set up a training policy. Training programmes at sectorial or project level are necessary to be set up as well, but with close links with the National Centre.

7.5 Education System : Proposed procedures

Education is another major area that is affected by the technological changes and needs to be developed to produce effective human resources for the economic development of the developing countries. At the present time, less-developed countries faced with the task of introducing and implanting elements of modern science and technology into what is basically a feudal "soil" with tribalism, religion, and other social traditions. The outcome of this introduction was, and still is, inefficient regarding the contribution to the national economic growth of these countries. This is due to the lack in nature and content of the education process, being inefficient and ineffective in terms of the following features :

a. it does not create interest in the students for learning

b. it does not build the student personality

c. it does not make the student face the reality of society

d. it does not help students to solve the problems outside the school

e. there is over-emphasis on academic and theoretical topics

f. there is no attention given to industrial art topics

g. large numbers of unqualified teachers are employed

It can be said therefore that the education process has very little influence on the society. On the contrary, the society has a huge impact on the teaching and learning processes in the schools.

The time has come for developing countries to look seriously into the quality of the education process and make it more effective and productive. This is the only way to change the society for the better, receiving and interacting with the fast changes in today's science and technology.

7.6 Areas within the Education System that need to be developed in LDC's.

A. Industrial arts :

Industrial arts is one of the key areas that requires

to be created and developed whereby it can be introduced into relevant levels of the education system in LDC's. In other words, it is necessary for developing countries to pay special attention to developing programmes for industrial arts that can be inserted particularly into primary and secondary schools. These programmes should be given in a very simple manner, and include : (35)

- industrial drawings
- mechanical aspects
- chemical aspect
- electrical aspects
- radio and television
- carpentry
- architecture
- domestic arts and manual work
- building materials and components

The introduction of these programmes will achieve the following objectives :

- provide simple and principle skills and knowledge about life
- enable students to show and use their capabilities and their will to do the work
- encourage students to love and appreciate the value of work
- enable students from an early age to choose and follow the field of study in the future

- open students' minds to face and cope with the environment
- enable students to do useful things in their leisure time
- encourage students to practice invention and innovation
- create interest and sense of responsibility towards work
- create an atmosphere of co-operation between students
- enable students to save money by doing many jobs for themselves
- create carefulness, maintenance and safety
- create loyalty and patience
- eliminate the differences between students
- enable students to have good health and strength

To introduce these programmes into primary and secondary schools, the following are required :

a. laboratories for practical work should be established in the schools where each student has his own place
b. two or three hours a week should be assigned for practical work
c. a special qualified teacher should be provided for empirical work
d. joint management by the school and specialists from industry should be set up to exchange industrial arts from industry to the schools and vice-versa.

B. Learning process

Learning process is another area that needs to be modified and developed in developing countries. In other words, learning process requires to be modernised and enriched in its content and techniques to achieve quicker response to the society's needs and aspirations. The development of learning process should include various education levels, such as :

a. Primary and secondary level : at this level the following are required :

1. introduction of industrial arts programmes for the student aged 6 to 15 years
2. application of compulsory education where students should spend 10 years in school
3. achievement of the integrity of school programmes
4. creation of close links and co-operation between school and families at home
5. building special schools for the disabled
6. creation of links with local production units
7. the number of students in each class should be between 20 and 25
8. small laboratories for empirical work is necessary for each school
9. the relationship between teachers and students should be changed from being aggressive to friendly by recruiting qualified teachers

b. Technical education level : it is required to :

1. increase the number of technical institutes and introduce various technical aspects according to the needs of the development in the country
2. develop topics according to the evolution of science and technology
3. industrial specialists should take part in the planning of technical education
4. set up joint management between these institutes and people from the industry, agriculture, and services
5. set up incentive schemes to encourage students to join the technical institutes, such as, providing houses, high wages, efficient training, good working conditions and also offer the chance to join the university afterwards.

c. Colleges and universities level : it is necessary to :

1. create major changes in quantity and quality of the university programmes whereby they are capable of working side by side with the national development organisations, science and technology movement, and production systems in the country. At the present time, colleges and universities in most developing countries are not able to provide men who go and practice the work directly. Students, after finishing their studies in these organisations,

in fact, still need training before joining their jobs, which creates extra costs before they are ready for employment

2. create research and development units in these universities in which students can study and tackle problems of industrial development in the country, for instance, services problems, transport, building, management, engineering and so on.

3. develop suitable work conditions and efficient facilities where the students can be encouraged to develop their capacity for invention and innovation

4. link the universities and colleges with the economic sectors in the country and create joint management. Therefore the problems facing the sectors can be reflected directly in these universities and lead to proper solutions

5. create a good connection with production units whereby students can exercise practical research using the facilities of these units

6. organise a training course for the employees of various production units in the colleges and universities

7. link each university with a specific industry. The universities then become a source of supply for the needs of certain industries

8. achieve the democracy of education process which refers to :

   - allow all different classes of students to enter schools and universities

- provide financial allowances for the poor class of student
- create competition systems between students on the basis of average marks and capacity whether for the entrance or passing to various stages
- modify examination systems in order to truly reflect the capability and creativity of the students

To sum up, the education system in developing countries needs to be planned jointly between :

- educational specialists
- industrial specialists
- agricultural specialists
- management specialists
- others

These specialists should discuss the possibility of establishing an education project, school, technical institute or university. The following are important areas which need to be discussed :

- the need for, and the importance of, the education project
- the objectives
- the requirements
- the nature of the project activities

Fig. 27 shows the components of education project planning.

CHAPTER 8

Discussion

In today's world most units, whether they be individuals, families, or nations, are striving to achieve a better standard of life. The so called developed countries are often seeking to obtain more leisure time and therefore looking for ways to automate their manufacturing processes. The less-developed countries, often new countries attempting to establish themselves in the world, are concerned with establishing some form of a manufacturing industry in order to generate wealth to finance their growth.

This thesis has been concerned with the problems facing the developing countries in their attempt to grow. As a child looks to his elders for help and guidance so a developing country looks to the developed world for assistance.

The response of industrialists has not always had the less-developed country's welfare in the forefront of its thoughts and often their needs have been seen as a way of stifling possible future competition by providing them with obsolete technology and/or enforcing limiting marketing rights and patents.

In mitigation it must be said that the less-developed countries were themselves guilty of seeking only a short

term solution to their problems and did not worry too much about the long term.

The thesis has discussed the consequences of this course of action and has highlighted the resultant inability of less-developed countries to originate their own applied research and home designed manufacturing systems.

To overcome this fault the author proposes a national body for the planning of domestic capability of science and technology whose task is to oversee all aspects of national industrial development. Four major areas must be considered by this body if success is to be achieved.

1. Economic area : long term planning is required that will enable full use to be made of a country's natural resources. By developing natural resources all monies generated contribute to the wealth of the nation. If resources have to be imported and then converted into wealth producing products, then part of the monies created must be used to pay for the imports. The resulting national wealth is therefore reduced.

As manufacturing facilities are created so must transportation and marketing systems.

It is extremely doubtful whether a country can rely forever on its own natural resources and therefore industry must be developed to cover all possible sources. The

result becomes a complex system which to be effective must be planned and controlled and the body proposed by the author will fulfil this function.

Last, but not least, leisure outlets for the wealth created must be developed.

2. Social area : to be successful in creating an industrialised base the whole structure of less-developed countries may often require changing.

In earlier days the social structure may have centred about small villages and tribal conditions which are not applicable to industrialised life. The education system was not fully developed and very few received formal technical or business training. The few people who did receive a form of training saw little future for themselves within their own country and so often left to seek work in other developing or developed countries.

This must be changed if a country is to achieve progress and the proposed national body should ensure the proper development of structured teaching and training programmes with a feed back into the system by the students from these activities.

The author does acknowledge that there is a time lag involved here, and therefore charges the main controlling body with importing the required skills and technical know-how until home candidates are available.

3. Scientific and technological areas : to be successful in its industrialisation, the less-developed country must eventually be capable of standing on its own feet. It must be :

a. capable of carrying out its own applied research and development
b. able to design and engineer its own manufacturing units
c. able to establish its own markets
d. able to advise its own internal organisations
e. capable of specifying technological requirements

The national body proposed must therefore propose, institute, and monitor plans to enable these objectives to be met.

4. Technology transfer area : a number of alternatives will be available to satisfy the above three areas and these will require evaluating.

One possible source could be the transfer of existing technology in the form of hardware or ideas from the industrialised countries.

The work described in the thesis considers various existing models of technology transfer but considers them lacking because of their inbuilt assumption that the developing countries will always lag behind the developed countries.

An improved model in the form of the system to be incorporated into the above national structure is proposed.

In proposing the establishment of this national body the author readily admits that there is a danger of a bureaucratic organisation being developed. The system itself will therefore require to pass through a learning phase - what must be guarded against is the system generating inertia; authoritarianism can be tolerated.

The proposals contained in this thesis are vastly different from current practice and therefore it is proposed that initially a pilot scheme should be introduced in the area of technology transfer proposals and development. From the results of such a study inferences can be drawn as to the possible success of the total scheme if implemented.

The key factor for developing the proposed system is that it requires full government involvement at both planning and implementation stages. Accordingly, problems associated with implementation can be solved.

Finally, the author would like to suggest that a Technological Ministry ought to be established to deal with all the activities of science and technology at national level. This Ministry will include the following systems or organisations which have been proposed in the thesis :

- engineering and design
- consultancy
- information
- research and development
- technology transfer

The aim of this Ministry is to build up the domestic capability of science and technology to support the national development requirements, (Fig. 39).

CHAPTER 9

Conclusion

1. In relation to the existing situation.

1.1 Most developing countries have no proper system for evaluating and transferring foreign technology.

1.2 Within the developing countries, industries and projects have been considered as separate entities and not considered as part of a total national system.

1.3 There is no central procedure for recording the capabilities of the country's industry.

1.4 The type of transferred technology is often out-dated or else has some attribute not supportive to the industrial development.

1.5 Manufacture under licence agreements is associated with very restrictive clauses including limitation of markets, production, and development which act as a penalty against developing countries.

1.6 No attempt is being made to create the conditions within the less-developed countries which would enable them eventually to be self supporting.

1.7 The social structure of less-developed countries often acts against the process of industrialisation due to the influence of village and tribal life.

1.8 Existing models of technology transfer assume that less-developed countries always lag behind developed countries.

1.9 The society as a whole and governments in LDC's distrust the capability of local human resources and give them little chance of contribution in the development which has led to a reliance on foreign resources as more preferable

2. In relation to the proposed system.

2.1 A national body for planning of local capability of science and technology should be established to organise and control the industrialisation process.

2.2 The central body should be accountable to the highest possible authority in the country.

2.3 The body should formulate plans and monitor progress in relation to the following areas :

- economic
- social
- science and technology
- technology transfer

2.4 To enable the body to function efficiently, a survey should be made of existing capabilities and a procedure installed to monitor and record all future expansion.

2.5 A plan must be developed to improve the degree of technology included in the school curriculum.

2.6 Due to the time lag involved in improving capabilities existing personnel should be encouraged to study abroad but then return to their own country to develop its own training programmes.

2.7 The proposed system, if implemented, will enable less-developed countries to follow and monitor the evolution of science and technology abroad.

2.8 The proposed system will enable developing countries to overcome the conflict of decision-making regarding technology transfer between various local organisations.

2.9 A procedure for evaluating technology transfer within the national system should be adopted.

2.10 The technology transfer system proposed has the advantage over the existing theory in that it does allow for less-developed countries to achieve parity with the industrialised countries.

2.11 The proposed technology transfer system does not achieve economic independence only, but also political independence for developing countries.

3. In relation to problems that will be encountered (during implementation).

3.1 The national ruling body (government) will be required to pass legislation setting up the body and giving it statutary powers.

3.2 Prior to this step, a pilot scheme should be operated to demonstrate the proposed system's feasibility.

3.3 Education will be required to formulate new schooling and training programmes to include technology.

3.4 The social structure will be changed and family relationships and duties changed.

3.5 To reduce transportation costs or make use of natural resources, areas of population may be changed.

3.6 Financial resources need to be assigned for the national body by the government.

3.7 Administrative action needs to be taken regarding the functions, responsibilities and job description of the national body.

CHAPTER 10

Future Work

The thesis has proposed a system for industrial development in less-developed countries, and included in the work is a suggestion for a pilot scheme to assess the feasibility of the whole proposal.

On the assumption that a positive result is obtained then the following extensions to the thesis are suggested :

1. A procedure should be developed to assist in the quantitative assessment of projects submitted to the National Council.

2. The proposed technical training scheme should be further evaluated and procedures developed to enable teachers to receive training in industrialised countries.

3. A scheme should be evaluated to attract back to developing countries its own native people who have left and settled abroad, especially in industrialised countries. This may take the form of financial inducements to assist in resettlement or it could be the setting up of research facilities and industrial centres within universities.

4. Steps should be taken to implement the proposed education scheme to produce an effective learning process and enable students at various levels to receive efficient education.

5. Finally, government involvement is very much needed, therefore a procedure should be developed to embody the faith and the will of the policy-makers to adopt the whole idea of effective industrial development.

Figure 1: Science and Technology System

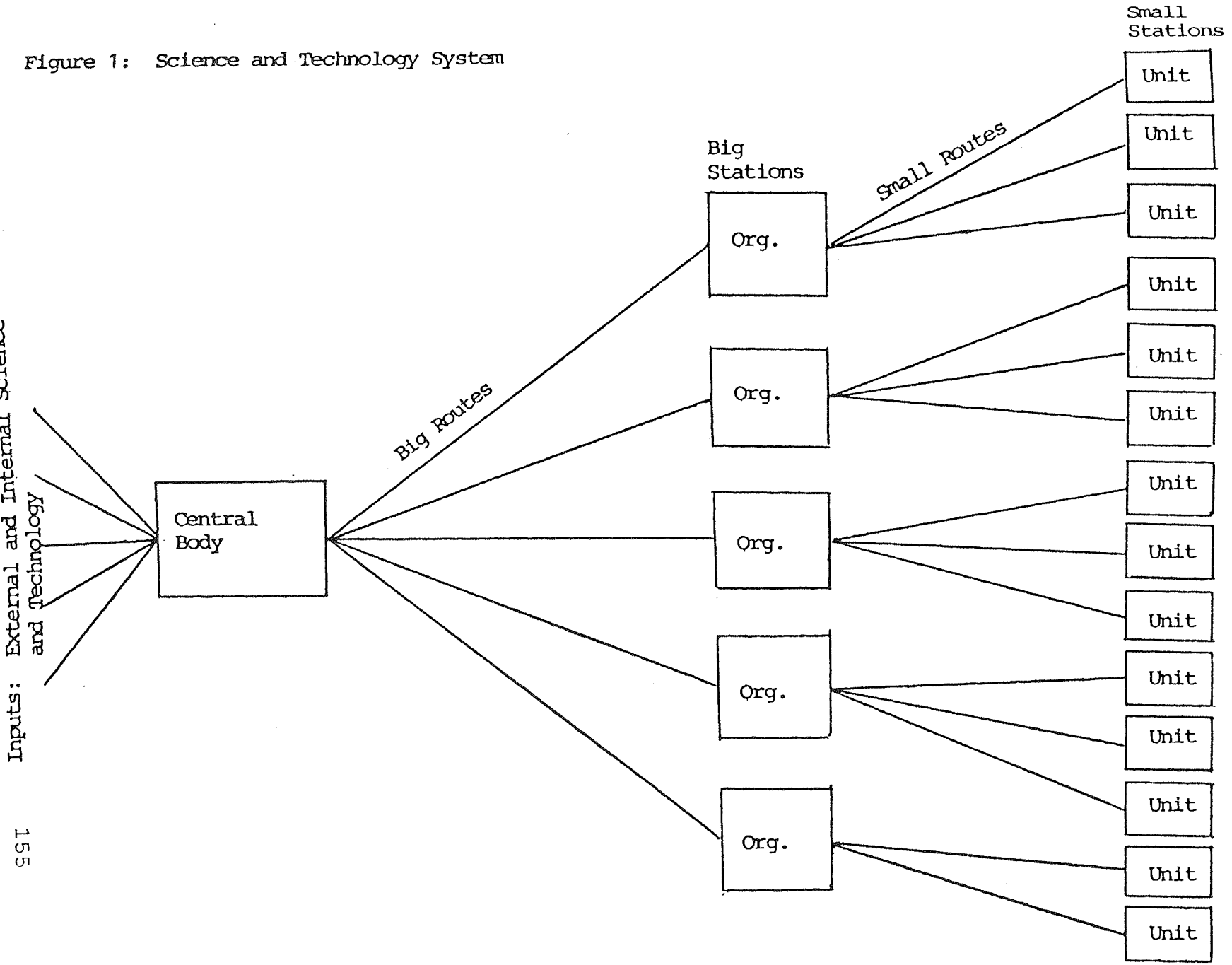
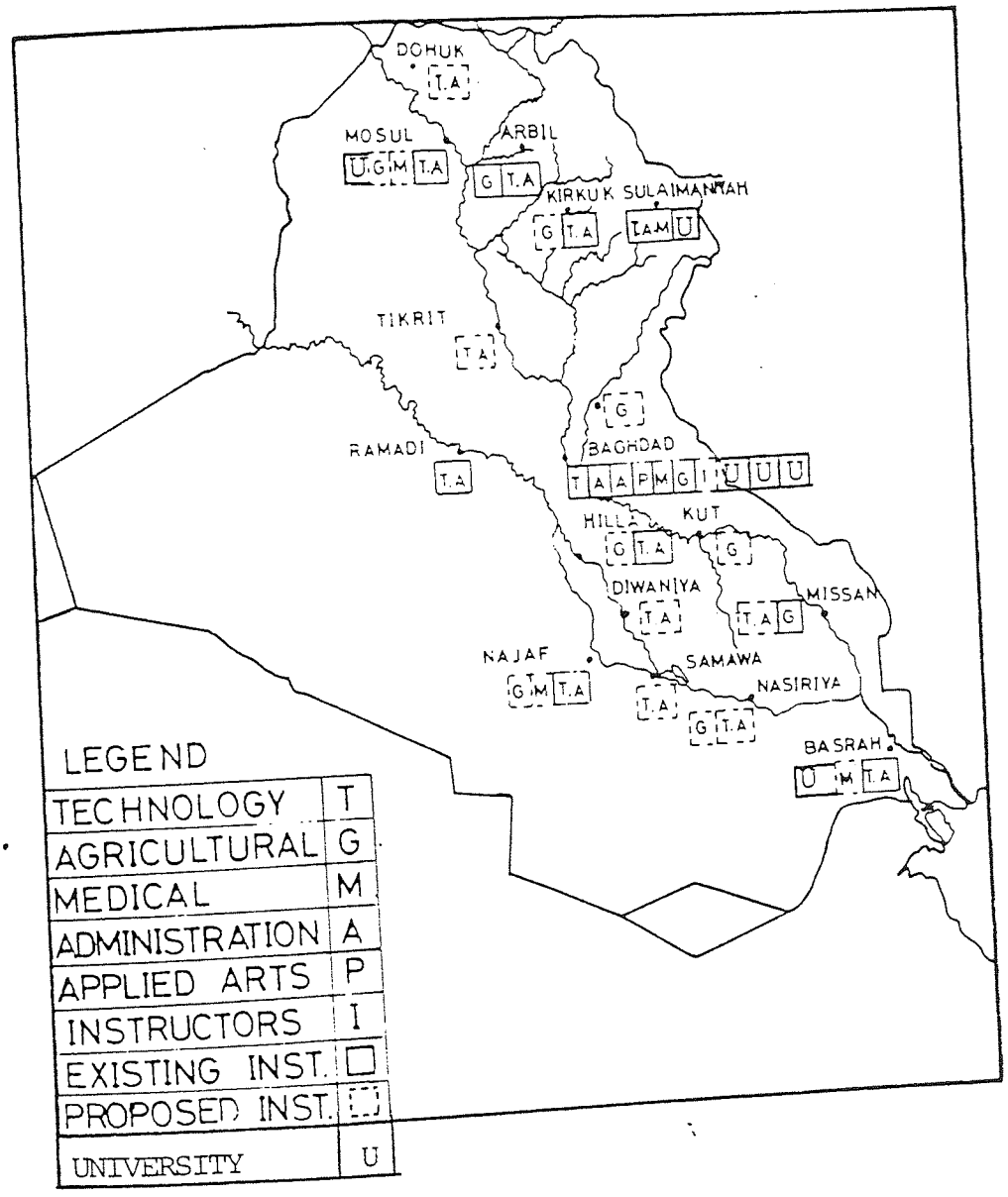


Fig. 2. Distribution of allocations between the economic sectors.

Sectors	1951 - 1969		1970 - 1980	
	Investment million Iraqi dinar	%	Investment million Iraqi dinar	%
Agriculture	445	23.5	1732	17
Industry	401	21	3318	32.5
Transport and communication	445	23.5	1412	14
Construction, education	492	26	1552	15
Others	113	6	2193	21.5
TOTAL	1896	100	10207	100

Source : Ministry of Planning, Iraq, 1980.

Figure 3 : Geographical distribution of the Technical Institutes and Universities in Iraq



Source : Foundation of Technical Institution, Ministry of Higher Education, Iraq, 1980.

Figure (4) The gap among different groups of the world

Items	Low income countries	Lower middle income countries	Upper middle income countries	High income countries
Mid-1976 population	1341.3	1145.4	470.6	10
Average percentage GNP 1974	$152	$338	$1091	$4361
Average birth rate (per 1000)	40	30	36	17
Average death rate (per 1000)	17	11	10	9
Average life expectancy (years)	48	61	61	71
Average infact mortality rate (per 1000 live births)	134	70	82	21
Average literacy rate	33%	34%	65%	97%
Average per capita education expenditure	$3	$10	$28	$217
Average per capita military expenditure	$6	$17	$31	$232

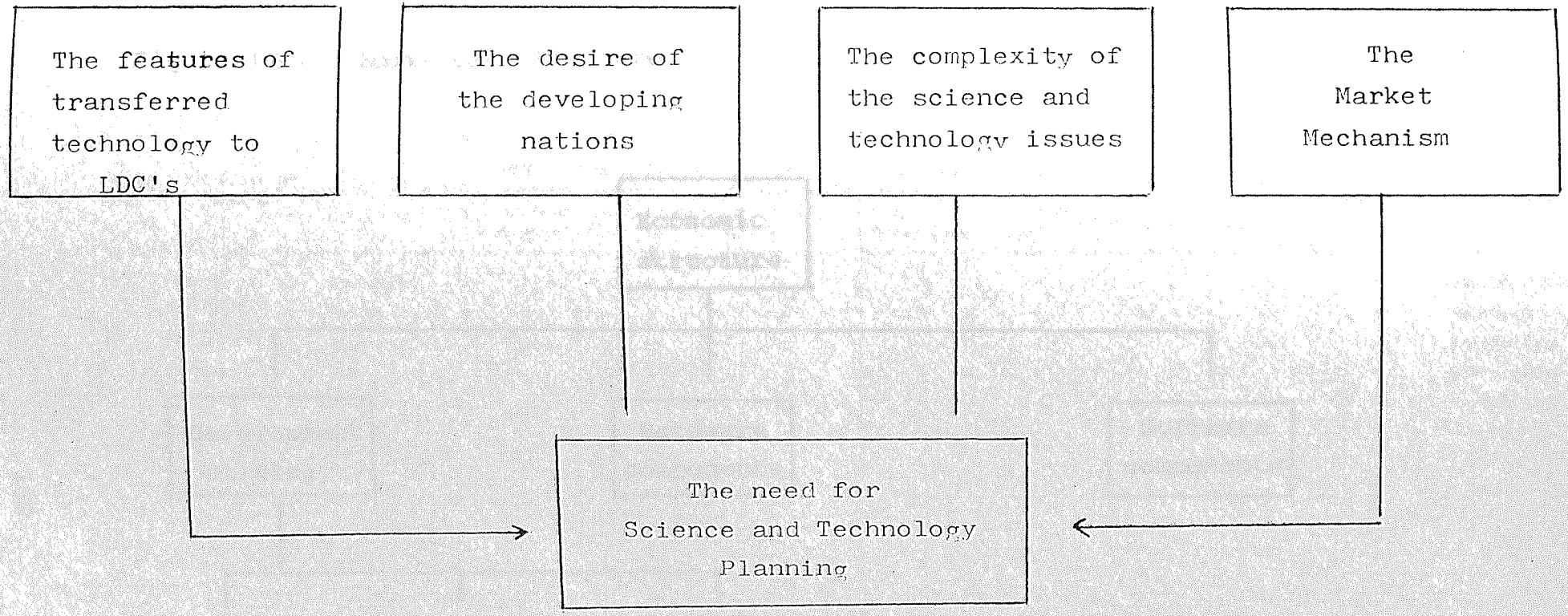


Fig.(5) The need for planning of science and technology in LDC's

Figure (6) Economical Structure

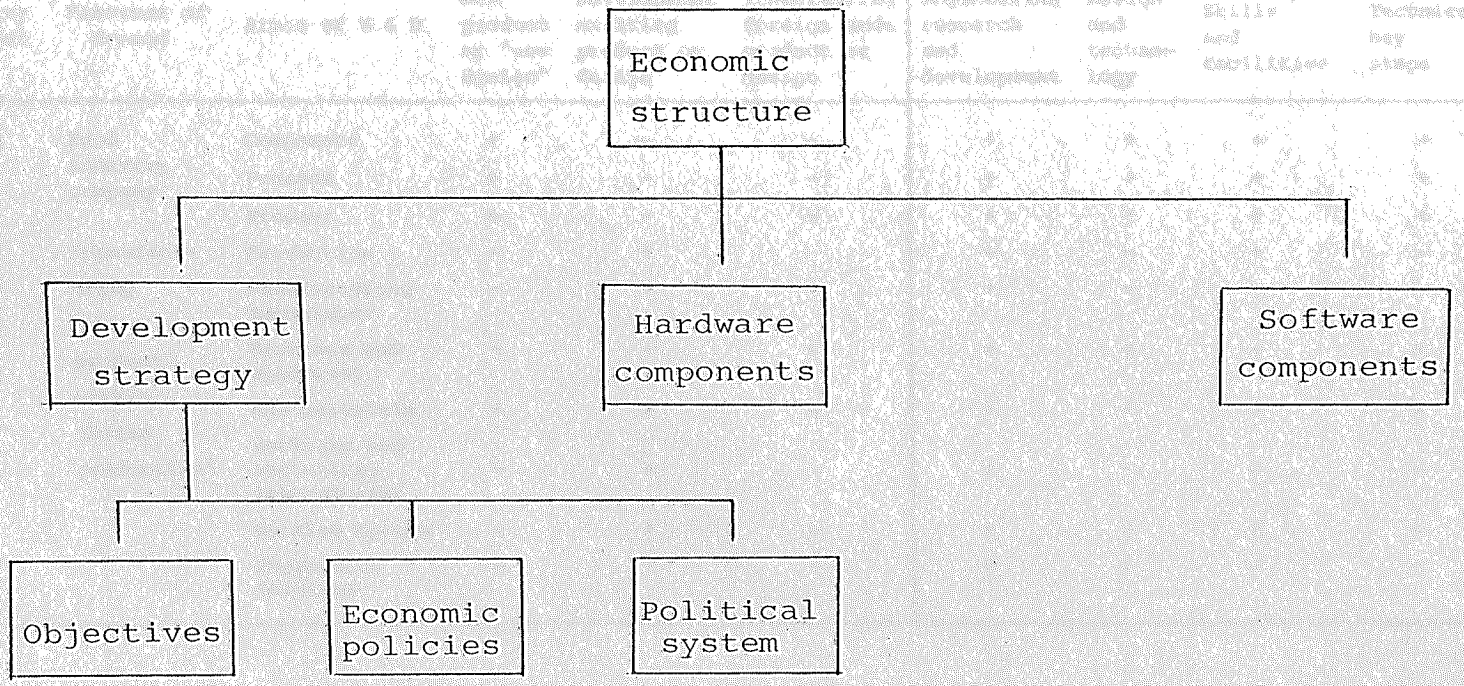


Figure (7) HOW THE SYSTEM OF E & D OPERATES

Entry Order	Resource of demand	Areas of E & D	FIRST STAGE OF ANALYSIS: New product or "new design"	Development existing product or design	Transferring foreign made product or design	SECOND STAGE OF ANALYSIS (Requirements): Engineering research and development	Design and technology	Skills and facilities	Technical key steps	Patent and Licence	Risks and Problems
1	Food industry company 'Manufacturing new product within family production'	Component	+	-	-	+	+	+	+	+	Impact on other manufacturing facilities particulary - plant layout - workshop - laboratories - skills
		Process	+	-	-	+	+	+	+	+	
		Product	+	-	-	+	+	+	+	+	
		Production	-	+		+	-	+	-	-	
		Manufacturing Techniques	-	-	+	+	-	-	-	-	
		Machines and equipment	-	-	+	+	+	-	+	+	
		Raw materials	-	+	-	+	-	-	-	-	
		Workshop and mechanical laboratories	-	+	-	+	-	-	-	-	
		Working System	-	+	-	+	-	-	-	-	
		Supporting Services	-	+	-	+	-	-	-	-	

Figure (8) Consultancy System Structure

Project Number	Source	Field	Areas
1	Food industries organis-ation	Economic consultance	Development trends country's economic wealth market structure state of industry financial system environment capital, volume & structure physical aspects, housing, transportation, buildings government services and facilities natural resources
2	Plastic industries organis-ation	Industrial consultance	production capacity technical know-how machines & equipment engineering & design type of industries training management maintenance raw materials work system
3	Oil	Social & culture	structure of society, classes, ethnics and traditions social security social organisation education & literacy skills and training labour market employment

cont'd/

Figure (8) cont'd

4	Electrical	Political	structure of political life planning policy local government, function and development taxation law and regulation, commercial law, labour law impact of politics on economy budget and banking policy lending and interest
5	Institute of Technology	Science and technology	structure of science and technology application of scientific research into industry motivations for professional in science dissemination of S & T information technology transfer requirements research and development technical studies and education production of knowledge and know-how

Fig.(9) Functions of Consultancy system

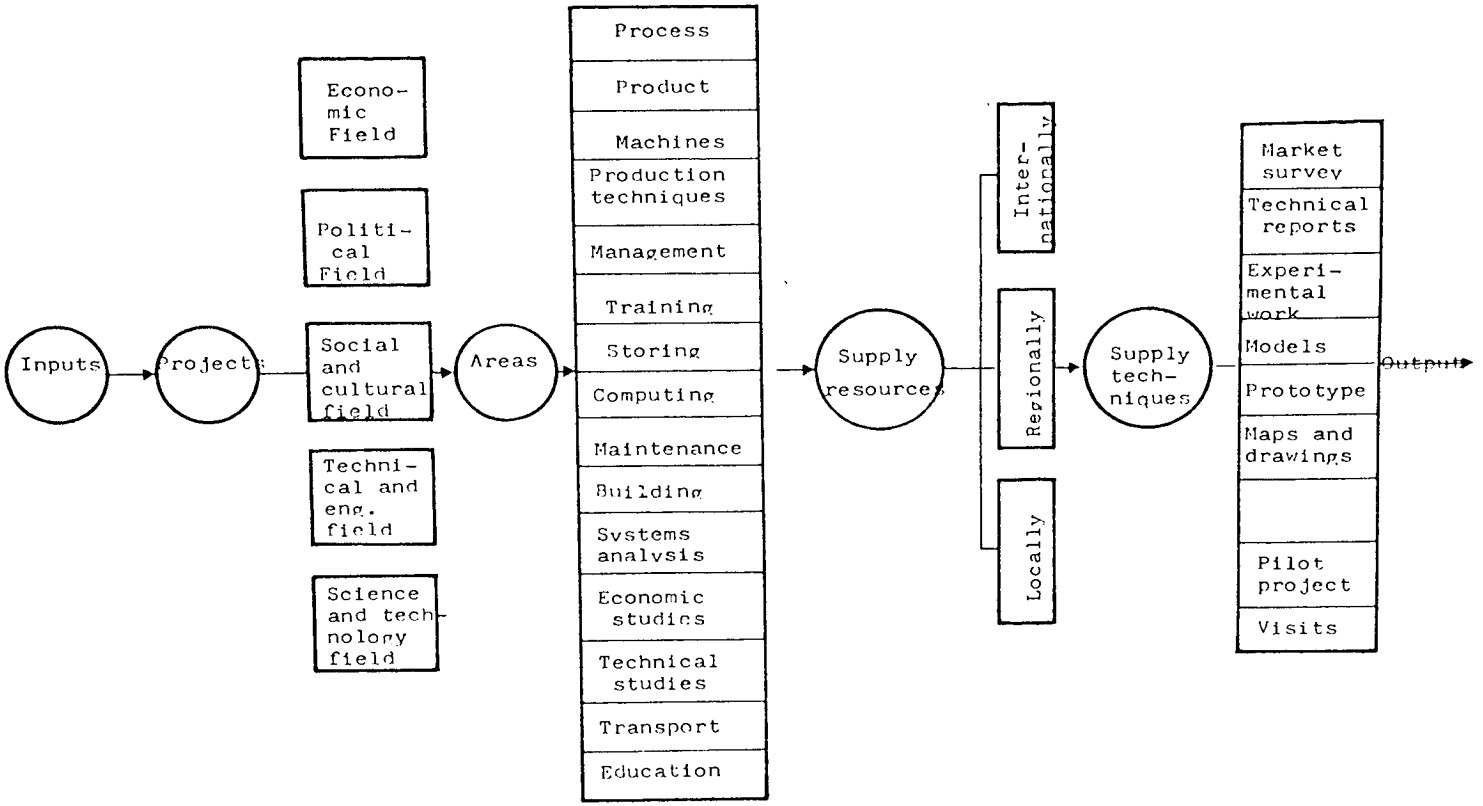


Figure (10) The Structure of the Information System

Entry ref	Sources	Division	Sub-division - area
1/F	Fertilizer industries organisation	Industry	Process/product technology Machines and equipment Production Techniques Operation research Management Training and skills Maintenance Marketing Raw materials Design and engineering Technological forecasting Financial control
2/I	Institute of Technology	Agriculture	Irrigation Fertilizer Machines and equipment Cultivation technology Seeds Water and rivers Working conditions
3/S	Social security organisation	Social	Manpower planning & utilisation Industrial relations Social Security Wages Education Training Health Social Organisations Working conditions People classes Beliefs, ethic and ages Needs and tests
4/O	Energy department	others	Space Energy Buildings Military Oil Gas Food

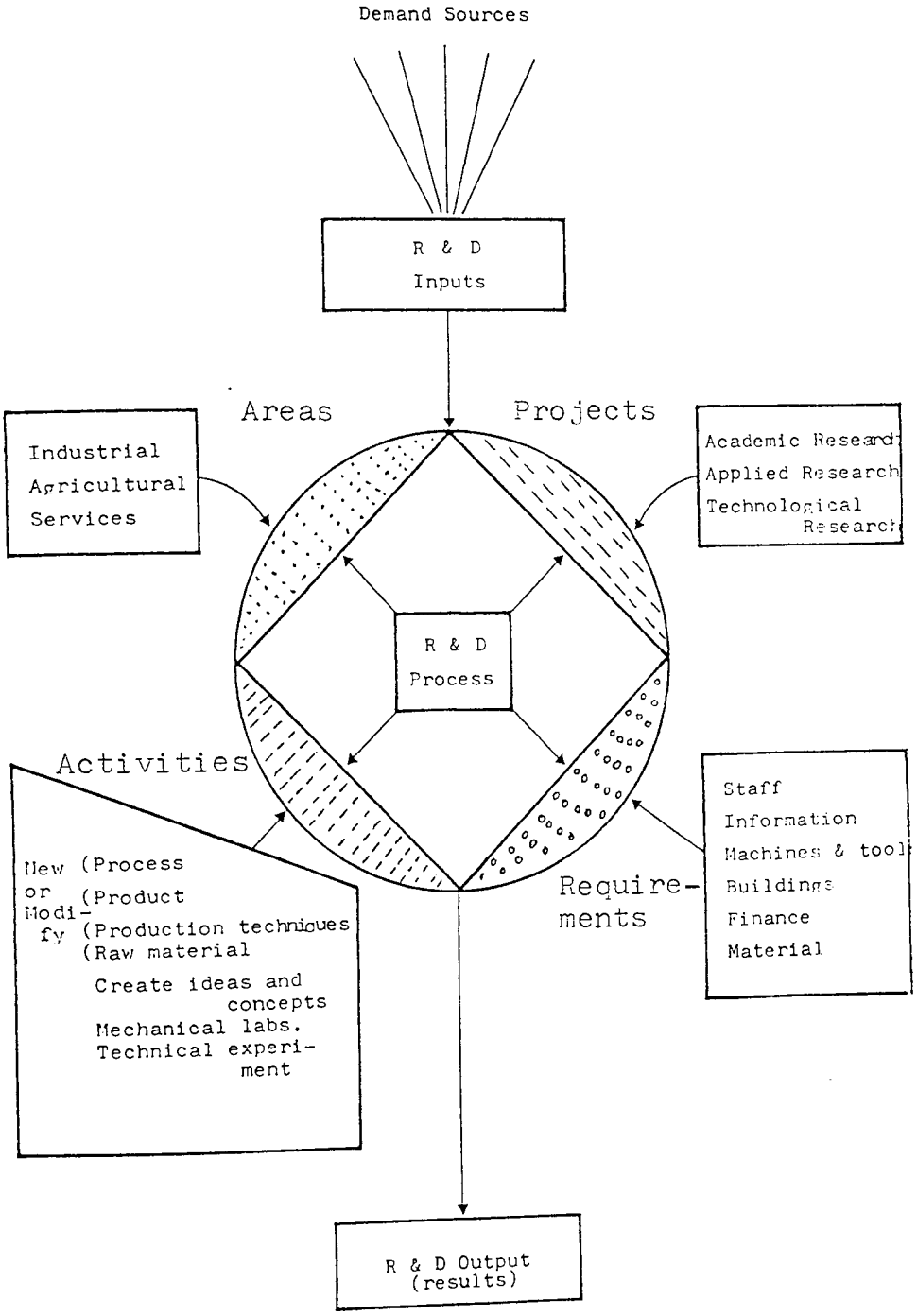


Fig.(11) How the system of R & D operates

Fig. (12) The structure of R & D

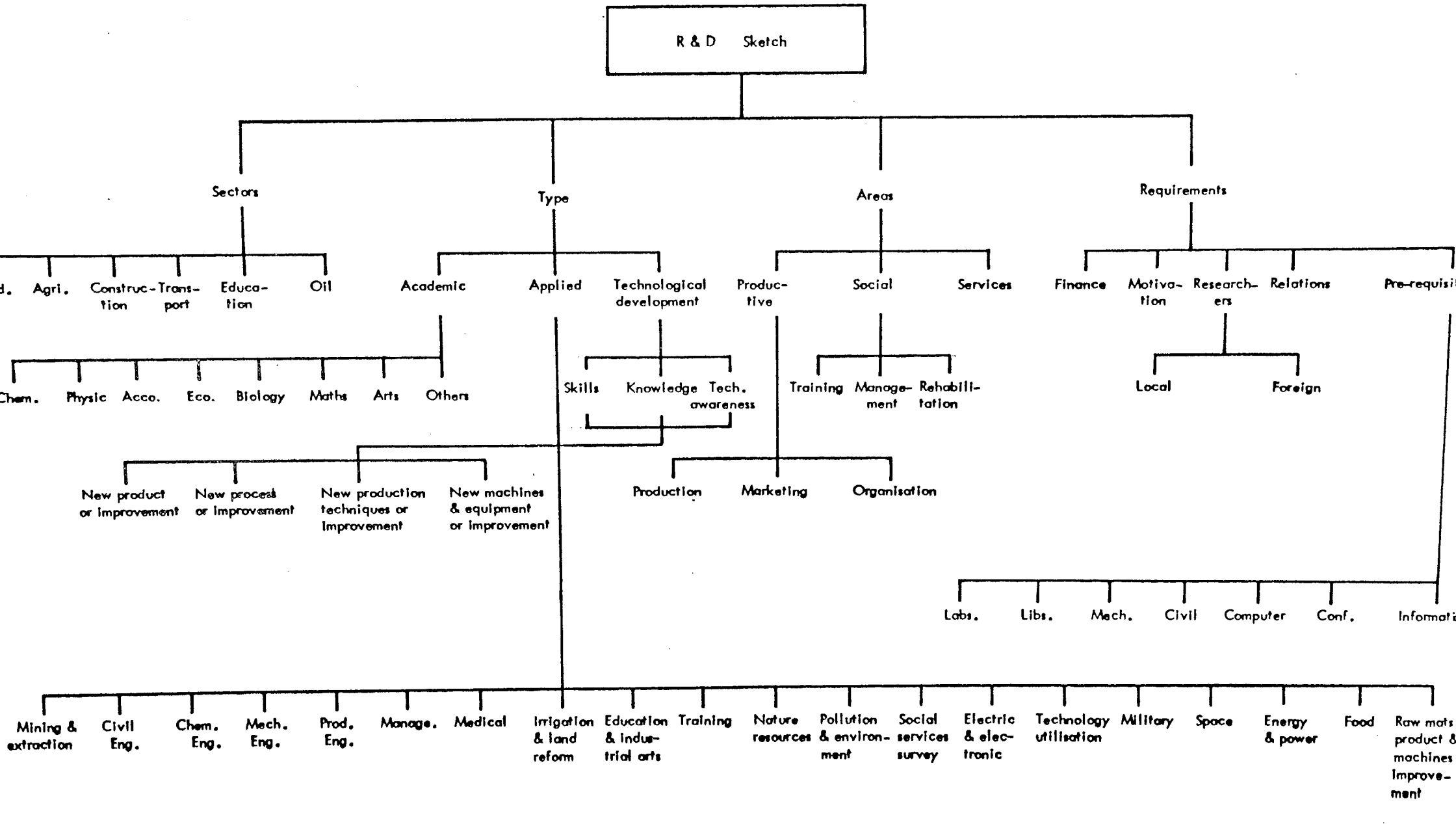


Fig.(13) Approximate starting date for beginning of industrialisation in various countries after David (23).

Country	Year
U.K.	1780
Belgium	1830
France	1840
U.S.A.	1840
Germany	1870
Sweden	1870
Japan	1870
Russia	1890
Holland	1890
Denmark	1890
Italy	1890
New Zealand	1890
Canada	1890
Australia	1900

Fig.(14) Dates of some major developments in Europe and U.S.A.

Developments	Date	Notes
Civil Engineering	1818	
Mechanical Engineering	1847	
Electrical Engineering	1871	
Mining Engineering	1778	
Television	1935	
Electronic Microscope	1930	
Radar	1930	
Ecole-polytechnique	1794	in UK
Harvard University	1847	in USA
Yale University	1852	in USA
Telephone	1876	by Alexander Graham Bell
Artificial Plastic	1869	by John Wesley
Radio (wireless) and telegraphy	1900	the broadcasting was in 1920

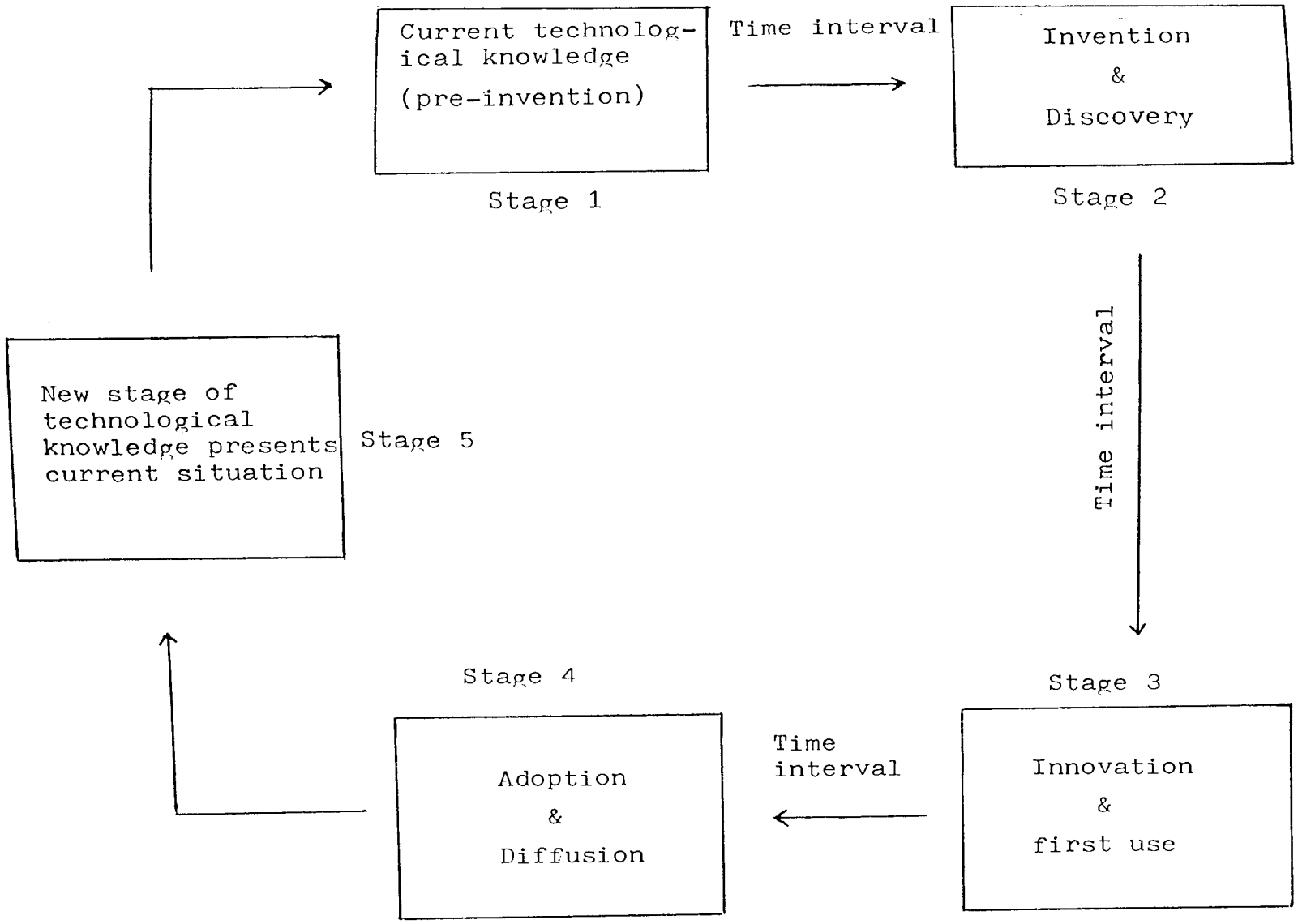
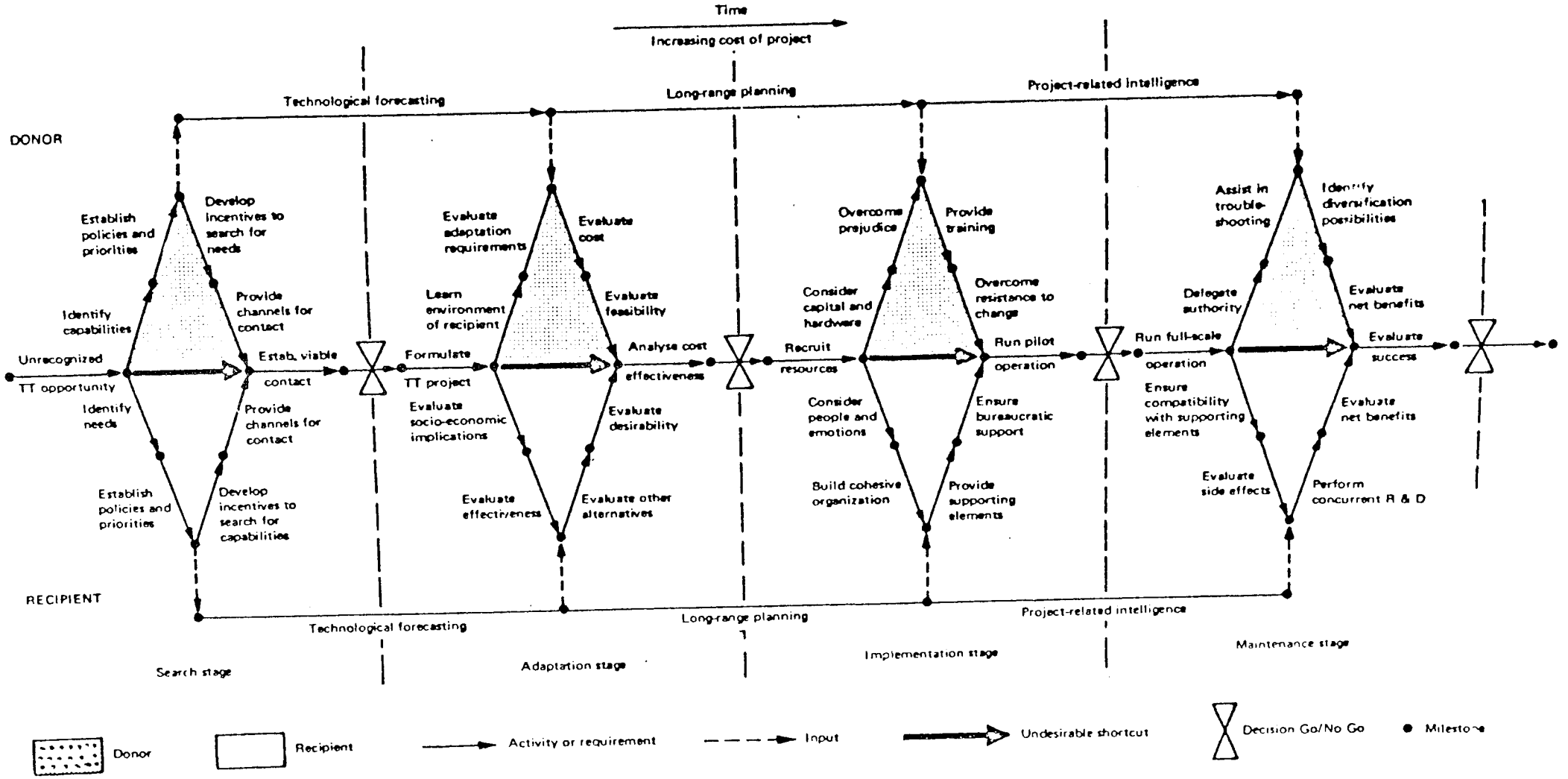


Fig.(15) Sequence of technological development in Europe.

Fig.(16) The time interval between discovery and application of some inventions in Europe.

Discovery	From-To	Years
Photography	1727-1829	102
Telephone	1820-1876	56
Radio	1867-1902	35
Radar	1925-1940	15
Television	1922-1934	12
Atomic bomb	1939-1945	6
Transition	1935-1948	13
Interated circuits	1958-1961	3
Steam engine	1776-1830	54

Fig.(19) Technology Transfer Model by Samuel N. Bar-Zakay (29)



TECHNOLOGY TRANSFER MODEL

Fig. (20) The structure of technology transfer system.

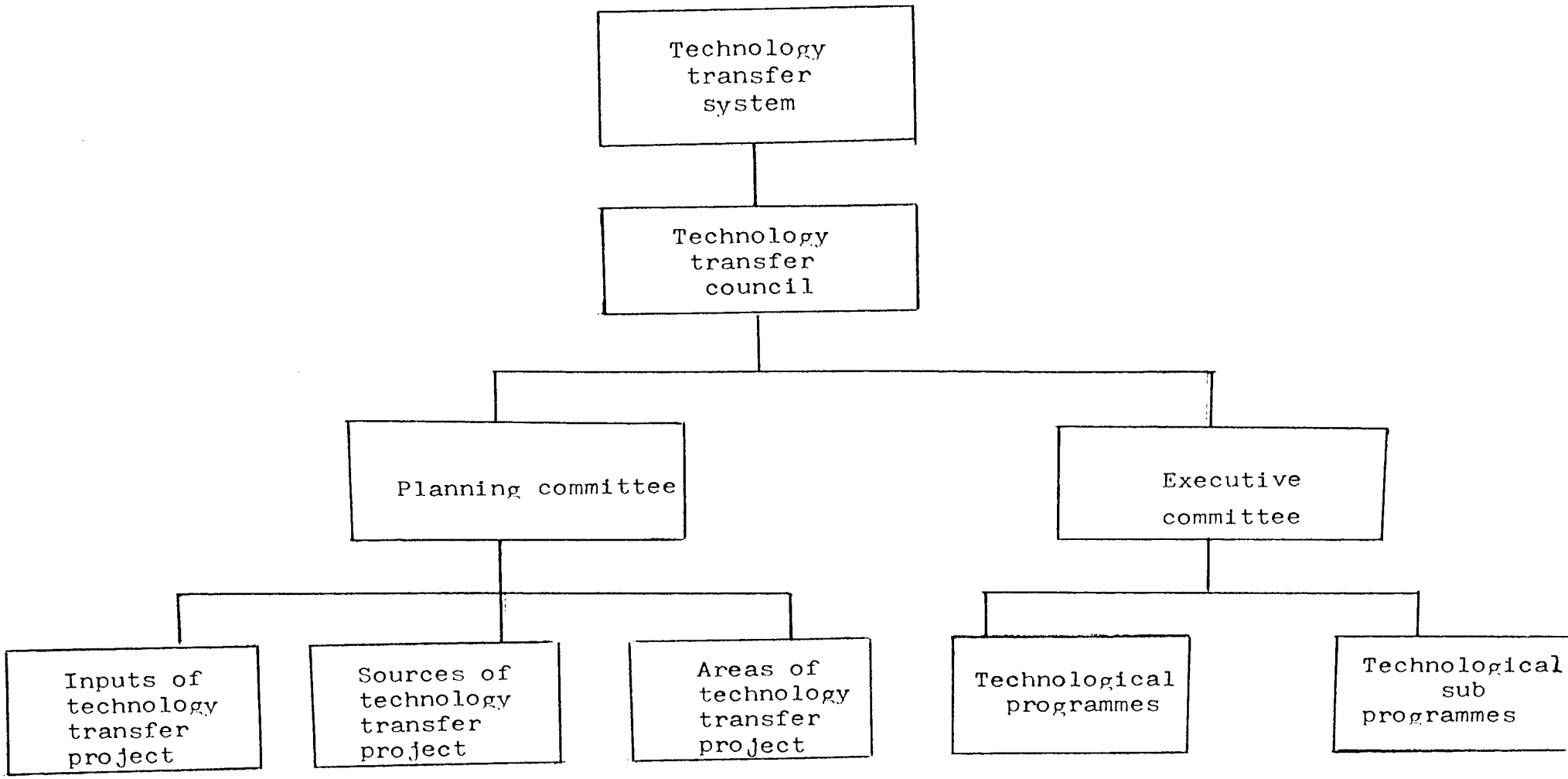


Figure (21) Balance of Economic and Social Development in Developed Countries after Al Nuragy (1)

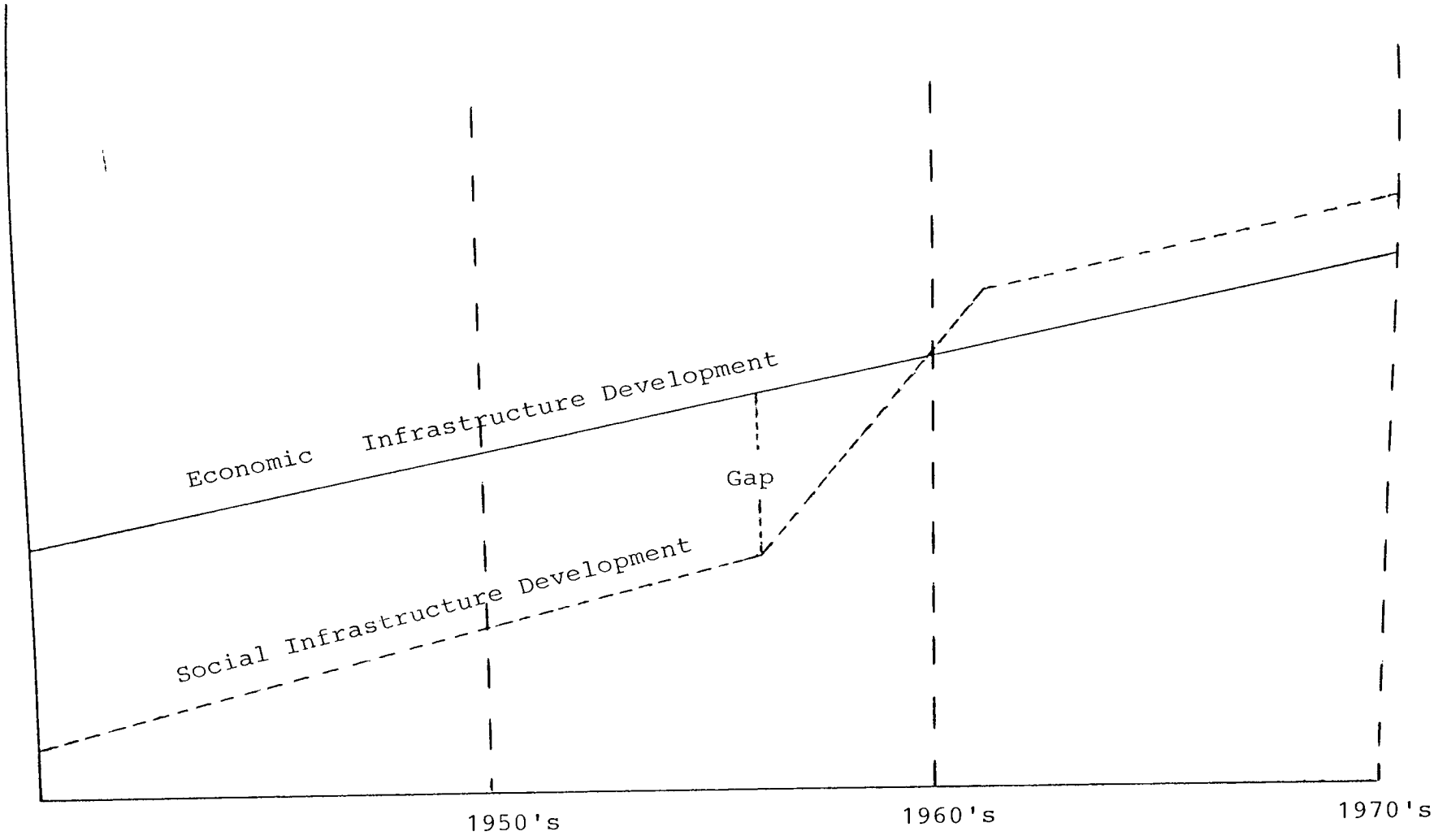


Figure (22) Economic and Social Development in Developing Countries after Al Nuragy (1)

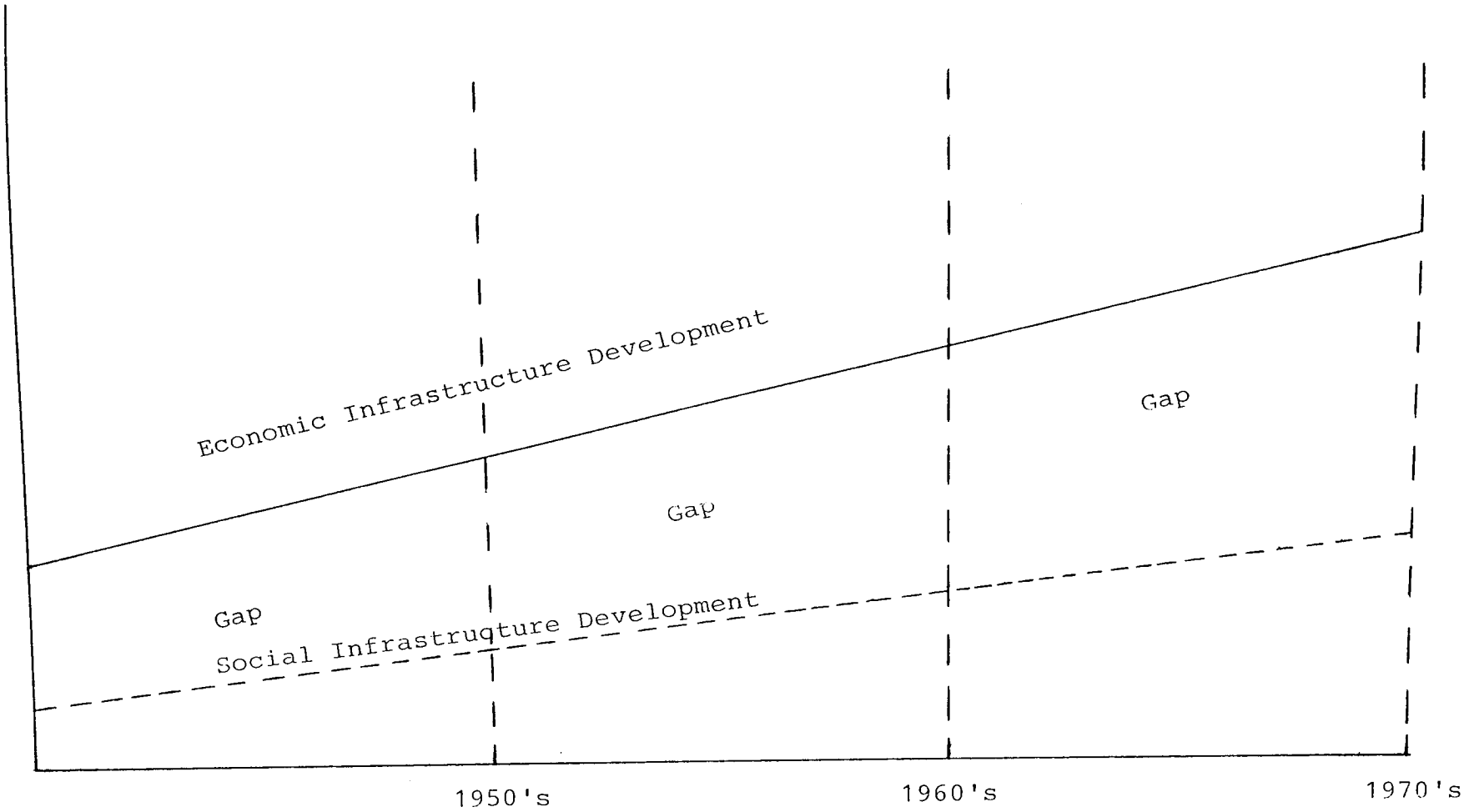


Figure (23) Comparison between developing and developed countries in terms of economic infrastructures development and social infrastructures development

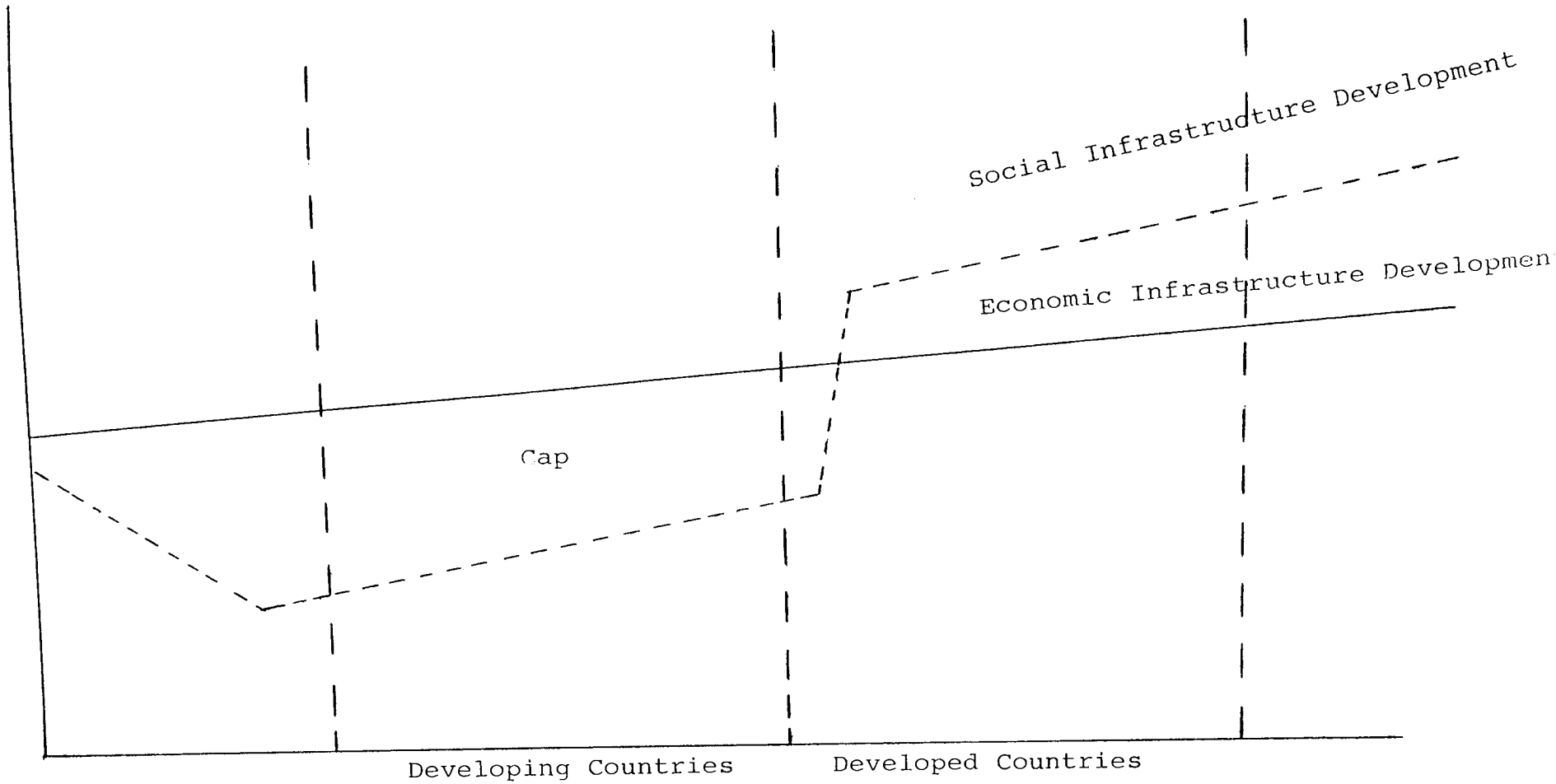


Figure (24) The ingredients and allocation of social and economic developments in Iraq through 4 Economic Plans

Items	1961-1965 plan %	1965-1969 plan %	1969-1974 plan %	1976-1980 plan %
Economic infrastructures				
Irrigation & drainage	24.3	24.6	31.5	
Storage	2.7	3.7	11.5	
Electricity	13.9	14.8	9.9	
Roads & bridges	13.3	14	10.3	
Railways	14.6	4.4	3.9	
Ship ports	6.8	2.7	1.5	
Civil flying	4.2	3.2	0.9	
Post & communication	1.4	2.4	6.1	
Water supply	1.6	4.1	6.2	
Gutters	2.9	3	2.3	
TOTAL	88.7	76.9	84.1	74.2
Social infrastructures				
Health	4.1	8.4	6.3	
Education	5.1	12	7.9	
Radio & television	2.1	2.7	1.7	
Total	11.3	23.1	15.9	25.8
TOTAL ALLOCATION AS %	100%	100%	100%	100%

Figure (25) The gap between the development of economic infrastructures and social infrastructures in Iraq

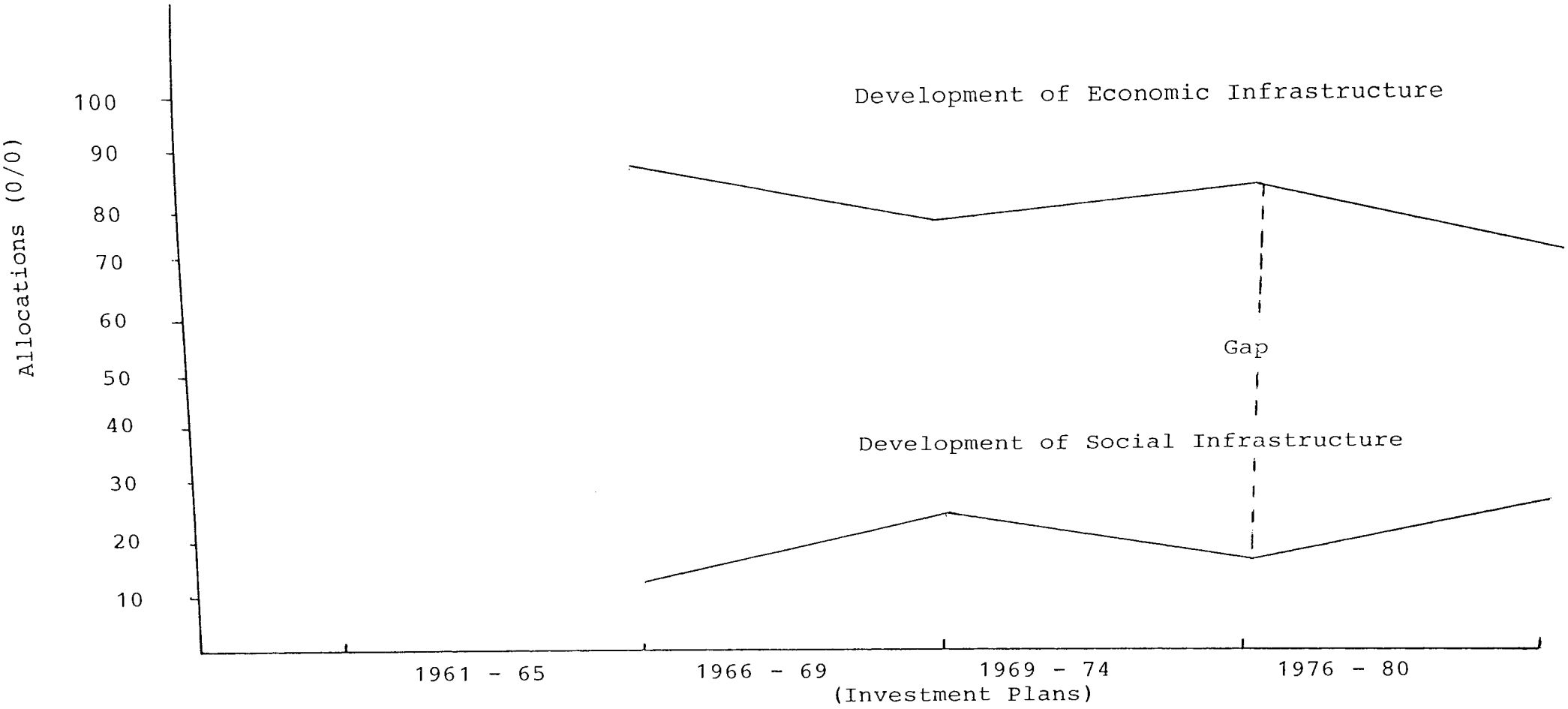


Figure (26) The impact of technological changes on workforce structure

Grade	Knowledge: Practical aspects	Knowledge: Scientific aspects	Resource	Fields	Demand	Notes
Unskilled	None	None	Primary schools	Cleaning & similar services	High relatively	-
Skilled	Good	General	Industrial institutes & poly-technic schools	Workshop	High	-
Professional	Very good	Very good	Colleges & Universities	Engineering, accounting, programming, planning, designined, controlling & systems analysis	Very high	-
Researchers	Very good	Very good	Specialist with high education & experience	Science technology & production	Very high	New demand

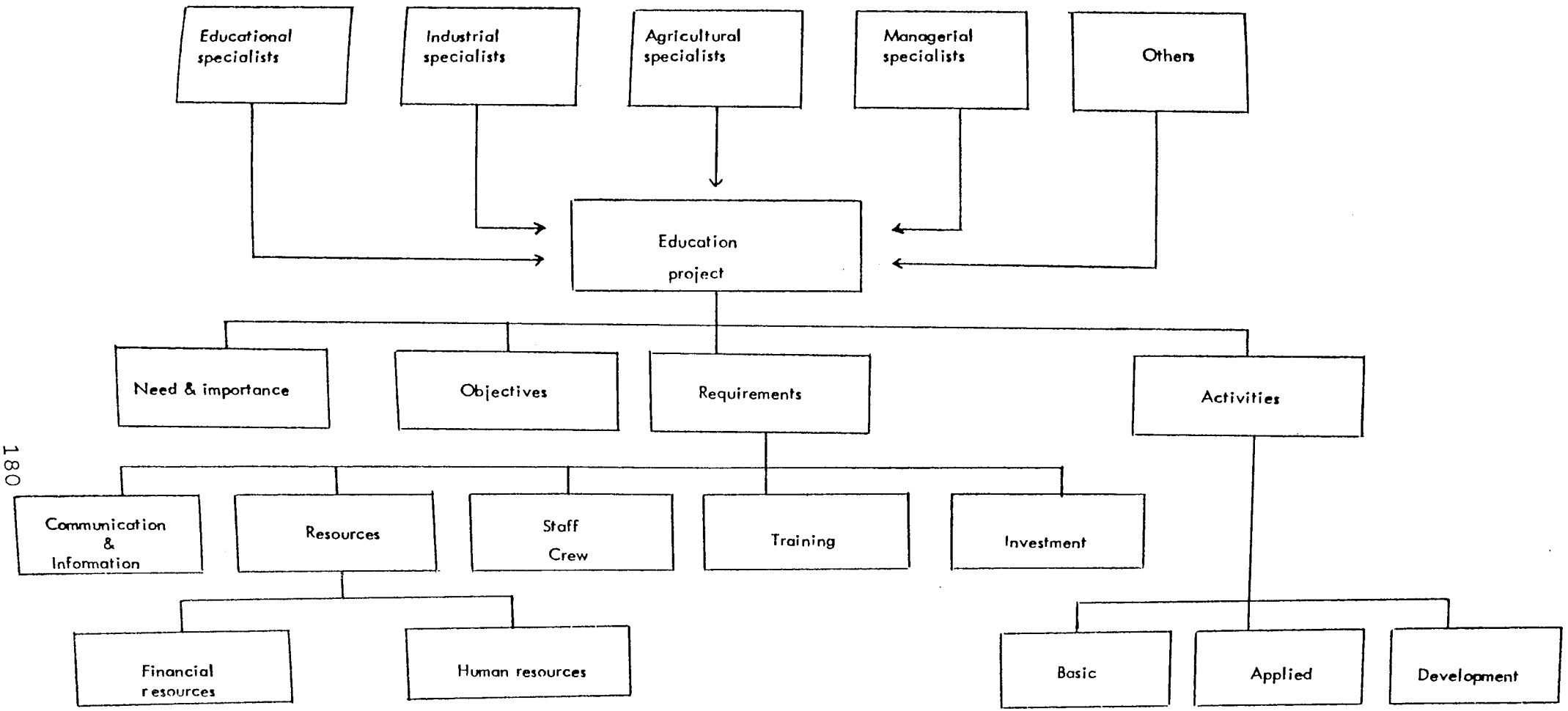


Fig. (27) Educational Planning

Figure (28) Women in employment

Countries	Percentage of women employed from total female population	Year
USSR	47.1	1970
Romania	48.1	1970
Japan	39.1	1970
W Germany	30.2	1971
UK	32	1971
Iraq	12.5	1972
Tunisia	3	1972
Kuwait	2	1970
Bahrain	3.3	1971
Lebonon	17.5	1970
Australia	32.4	1970
Algeria	1.3	1972

Figure (31) Percentage of children in primary schools of total population of age 6-11 years in 1970

Countries	Percentage of children in schools from total population of age 6 - 11
Lebanon, Kuwait, Jordan, Tunisia and Syria	90
Iraq, Eygpt and Algeria	70
Saudi Arabia	34
Morocco	55
Sudan	20
Yeman	8

Figure (32) The percentage of students in secondary schools and universities to relevant population group in different parts of the world

Areas	Universities % of relevant population group		Secondary schools % of relevant population group	
	1960	1970	1960	1970
N America	30.2	48	94	97
Europe & USSR	8.6	19	74	85
Latin America	3.1	6.3	45	65
Asia	2.6	4.2	36	55
Africa	0.8	1.5	24	38
Arab States	2.1	4	28	45
Oceania	10	14	80	89
World	6	11.4	50	63

Figure (33) Number of scientists, engineers and technicians in different Arab countries

Arab countries	Number of engineers and scientists per 100,000 population	Number of technicians per 100,000 population
Bahrain	365	-
Egypt	1657	-
Iraq	432	244
Jordan	170	43
Kuwait	1139	315
Libya	392	500
Lebanon	1163	250
Qater	1572	671
Saudi Arabia	365	-
Sudan	84	16
Tunisia	61	140
Yeman	22	11

Figure (34) Percentage of non-national scientists and engineers in Arab countries

Countries	Year	Number of non-national scientists & engineers as percentage of total stock
Bahrain	1971	78
Iraq	1972	10.7
Jordan	1972	2.3
Kuwait	1973	80
Lebanon	1973	2.2
Libya	1973	78.5
Qater	1974	90.5
Yeman	1975	12.5

Figure (36) The emigrants to some developed countries

Period	USA		Canada		UK		Total	
	Number	%	Number	%	Number	%	Number	%
from 1961-66	22,149	43	12,077	22	31,223	27	65,449	29
from 1967-72	68,041	68	44,521	29	52,817	20	165,380	32
Total	90,190	59	56,598	26	84,040	24	230,829	31

Figure (37) The loss of capital investment in terms of brain drain in developing countries

Period	USA (million dollars)	Canada (million dollars)	UK (million dollars)
1961-1965	4038	883	1136
1966-1970	14393	6945	2925
1971-1972	15448	3637	1462
Total	33879	11465	5523

Figure (38) World Workforce Population

Areas	Number of workforce (million)				No of increase (million)			Percentage of increase			Annual compound growth (percent)		
	1950	1960	1970	1980	1950	1960	1970	1950	1960	1970	1950	1960	1970
World (1)	698	802	953	1153	103	151	200	14.8	18.8	21	1.4	1.7	1.9
Africa (2)	88	103	126	157	15	21	31	17.5	21.8	25	1.6	2	2.2
Asia (3)	308	356	435	547	48	79	112	15.5	22.3	25.7	1.5	2	2.3
Latin America (4)	56	70	88	114	14	18	25	24.2	25.9	28.8	2.2	2.3	2.6
TOTAL (5)	452	529	649	817	77	120	199	17	22.7	26	1.6	2.1	2.3
Europe	135	141	149	157	6	8	8	4.7	5.5	5.1	0.5	0.5	0.5
Japan	36	44	52	57	8	8	5	21.5	19.1	9.9	2	1.8	0.9
N America	66	77	90	105	11	13	15	16.2	16.3	17.3	1.5	1.5	1.6
others (6)	6	11	13	16	2	2	2	21.8	22.4	22.5	2	2	2
TOTAL	2116	273	304	375	27	31	21	11.9	11.4	10.3	1	1.1	1

(1) exclude China, North Korea & North Vietnam

(2) exclude South Africa

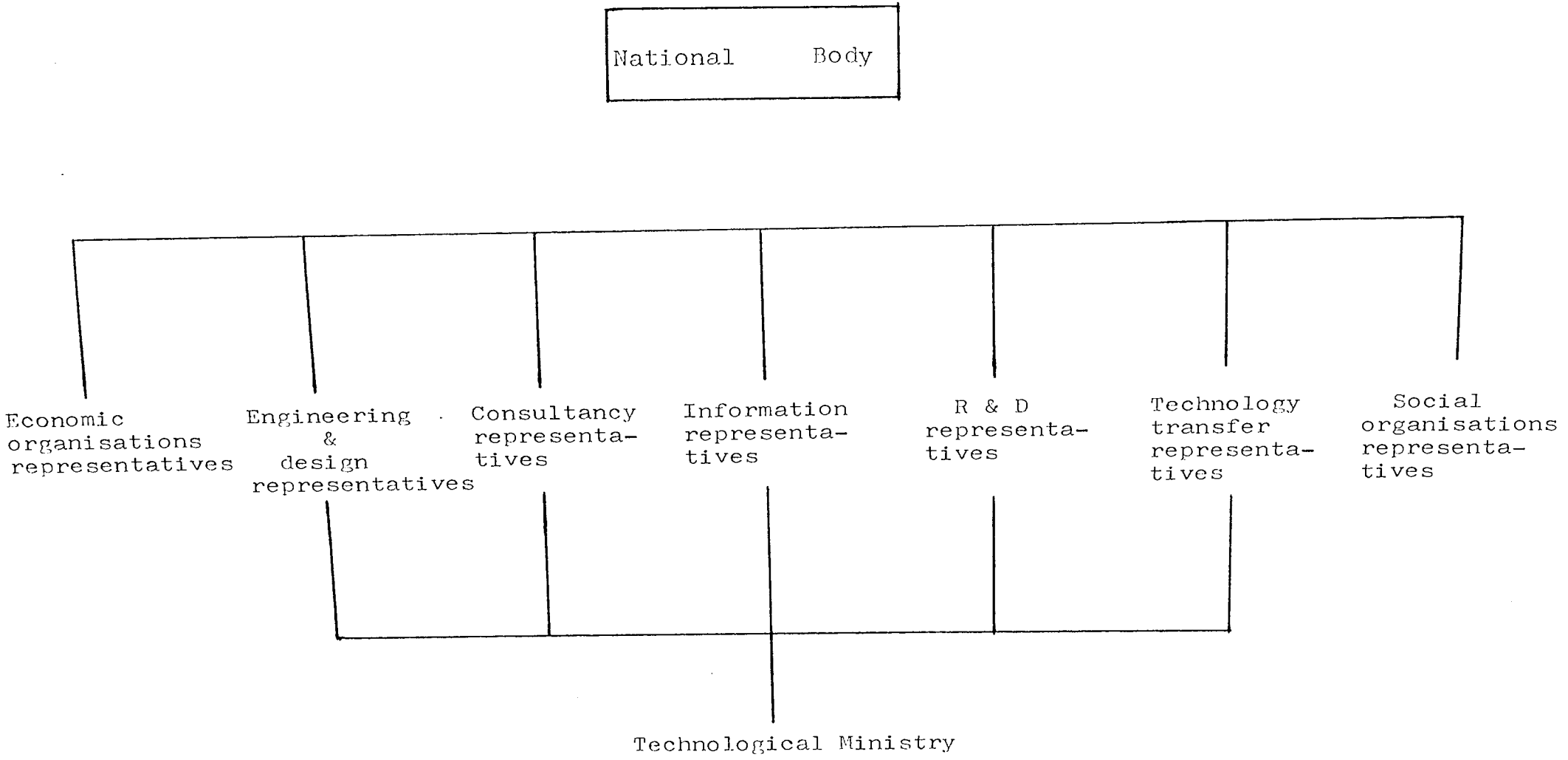
(3) exclude Japan

(4) include Caribbean

(5) Africa exclude South Africa, Latin America, Asia (exclude Japan), Oceania exclude Australia & New Zealand

(6) Australia, New Zealand and South Africa

Fig.(39) Planning domestic capability of science and technology in LDC's



APPENDIX 1

The Social Background Of The Developing Countries

(1) Historical Social and Cultural Traditions

People in less-developed countries have inherited various social and cultural values which were created centuries ago under different primative social and economic systems. These values have played a major role in shaping the present structure of the societies particularly in terms of human relations. Therefore, there is no reason to deny that these values to a large extent, are still adhered to by people of these countries at the present time. These include the following (31):-

(a) Family relations

The relationship among the family members can be described as follows:-

(i) the father is the dominate figure in the family

(ii) the mother should obey the father, cook and look after the children

(iii) the high authoritarian position of parents, especially the father, create a dependence type of personality for the children

(iv) the parents are responsible for their sons' and daughters' marriage and their future

(v) the married males stay with the parents, which increases the number of the family under the name of family unity

(vi) the sons and daughters choose from amongst the family relatives only

(vii) the oldest male replaces the father's position after death

(viii) the children are forced to practice parent's traditions, especially the religion

(ix) the absence of democratic relationships between the members of the family

It is obvious therefore that this sort of family tradition will present obstacles to the development of a modern society.

(b) Tribal System

It is well known that the tribal system was initiated a long time ago in the history of mankind. The basic idea of joining the tribe was for self-protection, as human life was not very safe due to the absence of the govenment, and tribes were supposed to protect their members from any danger. At the same time, the members of the tribe should declare their loyalty and submit themselves to the chief and his family. As time went on, the tribal chief became responsible for every aspect of his members' affairs, even individual matters such as

marriage, jobs and beliefs. Eventually, the chief sought power and respect from other tribes, which led him to motivate his people to enhance his aspirations and sometimes to declare war on other tribes. Under this system, people are forced to obey the chief and do whatever he likes, otherwise they may be killed in the name of disloyalty. In some cases, the members of the tribe are very proud of their tribe and work together to attain a strong position amongst other tribes, however, this is at the expense of poor and weak people.

The tribal system has different features from one society to another. For example, in the past Iraq had the strongest tribal system of all Arab societies. The system in Iraq had a very strong influence on the government departments, whereby officials in the government were forced to have friendly relationships and co-operate with chiefs and work together to run the country's affairs. On top of this, during the 1950's the government in Iraq appointed chiefs from some powerful tribes in the government departments as Ministers and Members of Parliament. This co-operation between government and tribes has made people obey and respect the tribal system more than the government, which has created chaos amongst government institutions and the

society. The worst values of the tribal system are as follows:-

(i) in many tribes, there is an obligation on the members of the tribe to avenge the death of another member

(ii) some of the tribes forbid the marriage of both males and females with members of the other tribes, particularly the women

(iii) in the case of killing or doing harm to others, whether within the tribe or to members from another tribe, the penalty will be what is called 'Al-Fassil' which means that the killer should donate one or more women to the family of the murdered person, and sometimes the donation takes place by assigning very young females to be given when she become adult. This poor female will find herself being given to somebody she has never seen before, and she has no right to refuse. If she does, she will be treated as rebellious and might be killed

(iv) the extreme loyalty and submission should be given to the chief of the tribe and his family and any offender will be prosecuted

One again can imagine the sort of society under this kind of tribal system which has, and still does dominate some developing countries.

(c) Religion

The following is not intended to be against any religion in principle and objectives as a reform movement for the society, but rather is against some religious leaders who have misused the ideas of religion and distorted its objectives by making a tiny religious class which claims the ownership of the religion and separates it from the society. At the same time, this religious class has failed to utilise religious concepts and values to develop the basic ingredients which form the basic for modernisation, namely the analytical, rational and critical techniques in most developing countries particularly Islamic countries. In other words, most Islamic leaders have not practiced the values of Islam as the base for secularisation. Therefore, they have failed to make a link between religion and social development. In fact, they exercised as a mediation process effecting individual personalities. The result of this was the apperance of the Mullahs who are mostly illiterates and use religion for their own purposes in various ways, such as:-

(i) most of them are working as General Practioners by giving religious prescriptions and advice to the sick and unfortunate people in return for money

(ii) most of them strengthen a fatalist attitude and an attachment to the past which makes people refuse to accept the modern values of life

(iii) they create a reliance on the meta-physical and supernatural forces which distorts the will and creative power of the human being

(iv) they widen the discrimination between men and women by regarding the woman's brain as incomplete, especially in education, jobs and social life. In fact, the true Islamic religion strongly encourages both sexes to have equal rights in life and is against any sort of discrimination whatsoever

As a result, peoples behaviour because of their naivety, simplicity and illiteracy, has remained captive to the ideas of these Mullabs. In addition, religion has become a matter which must not be interpreted in a unified and homogenous fashion across the nation.

To sum up, some religious leaders throughout history have distorted the basic ideas of the religion by creating new social and economic traditions. These traditions have been forcibly introduced into the society under the name of religion, and impede the social development.

(d) Attitude to Women

Although women form half the population, they are oppressed in many parts of the world particularly in developing countries. This oppression has come from a discriminatory attitude to women which is created by the family system and the other traditions of these societies. Women, therefore, have been forced to devote themselves to house-keeping and looking after the children. As time went by, the resources of women have been unused in terms of their participation in development. There is, in fact, a variety of reasons which form obstacles preventing women's development in developing countries, such as:-

(i) within family relations, males are more desirable than females due to the economic factor as males will be helpful for the parents while females once they get married, leave their parents

(ii) females marriage is strictly organised by the parents, so that females have to accept the decision

(iii) females have been banned from attending schools due to the parents religion, beliefs and traditions

(iv) families have placed restrictions on women's individual matters such as clothes, speech, visits and other social behaviour

(v) females suffer also from general social discrimination especially in employment, education and other cultural activities

The foregoing factors have seriously affected the women's resources for advancement in development countries. The talents and abilities of women have not been developed. This represents a waste of potential which has created

losses for the whole economy in terms of human investment capital and Gross National Product. Figure (28) shows the employment of women in some developing countries compared to some developed ones (36).

It is obvious from Figure (28) that some Arab countries have neglected women's role in development. This can be seen by the very small activities from the total female population, such as 1.3% in Algeria, 2% in Kuwait, 3% in Tunisia and 3.3% in Bahrain. Compare this to some advanced countries like the USSR 47.1%, Romania 48.1%, UK 32%, Japan 39.3% and W Germany 30.2%. This confirms that most developing countries have not yet fully utilised women in development, and unless this can be achieve, one cannot expect proper and successful development, simply because half of the society alone cannot develop the society as a whole.

(e) Feudalistic System

Most developing countries have suffered for a long time, and still are, from the Feudalistic system which dominates the agricultural activities. The system allows a few people (landlords) to own very large lands and use cheap employees to do the farming jobs. Iraq, for example, has faced in the past the most severe feudalistic system. The characteristics of this system have badly affected the structure of the Iraqi society as 70% of the population worked in agriculture during the 1950's. The features of a feudal system can be summarised as follows:-

(i) the landlord owns the land as well as the employees, therefore, he is allowed to sell and buy the farmers just like commodities in the market (slave trade)

(ii) the fact that the roles of being landlord and tribe chief were combined in one person means that there were very tight controls upon individuals as farmers and tribal members, from a single source of power simultaneously

(iii) the landlord usually had a close relationships with the government officials to enhance his position over the farmers

(iv) some farmers were assigned to work as servants for the landlord and his family

(v) the landlord usually appointed his relatives to run and control the farming work

(vi) submission and loyality should be declared by the farmers to the landlord. Physical punishment such as flogging, might be exercised for offenders

(vii) farmers were paid in terms of food, clothes and very little money yearly according to the production of the farm

(viii) the landlord and his family had the privelege to marry any women, regardless of age and with or without the consent of the woman

Finally, the feudal system has created authoritarian power in the hands of landlords in which people were made to respect and obey them more than government officials. As a result, farmers overall were oppressed economically, socially and politically, and this caused poor and backward relationships amongst the members of the society as a whole. It is pleasant to mention that this system has not operated in Iraq since 1968.

(2) Colonial System

Developing countries have faced different kinds of colonial systems imposed by the West since the 17th century. The long domination of developing nations by the Western imperial powers has shaped the development process in these countries. In addition, the distortion which associated the whole structure of these societies socially, educationally, culturally etc

Colonies were established for the following reasons:-

(a) cheap raw materials

(b) markets

(c) power and strategic position among others

(d) employment for the nationals of the colonizing power

The consequence of this system is the exploitation of resources of these countries without devoting sufficient concern to the social and industrial needs, and leaving these societies very poor and backward in terms of economic and social conditions and education. Therefore, the remedy for these problems has become difficult, taking into consideration the fast evolution of science and technology at the present time.

(3) Authoritarian Institutions in Political Life

Unfortunately, most developing nations have been and still are subject to the authoritarian regimes which came to power after political independence was gained. The politicians in these countries have failed to create a democratic system which would enable them to develop social and economic values in the modern manner and give equal rights to every member of the society to participate in jobs, education, training etc. The outstanding phenomenon is that most developing countries have had a chain of political and military coups after independence, where different political parties and systems took power to achieve large social and economic change but without success. In fact, these coups have resulted in unsettled economic, political and social situations which weaken the whole development in these countries. What is more, what is planned to be achieved under regime A will be cancelled under the following regime B, and so on, which has led to a lack of the society's confidence in governments.

(4) Illiteracy

Rising nations have faced and still face a large number of illiterates within their societies and especially amongst women which obviously hinders the whole process

of the development. Figures during the 1970's have indicated that out of a total world population of over 4000 million, there were 800 million adult illiterates and 250 million children without any schooling. The proportion of these illiterates living in developing countries was and still is very high. Figure (29) shows the percentage illiteracy rate in different parts of the world in 1970 (13). It has been forecast that the world percentage of illiteracy will drop from 34.2% in 1970 to 29% in 1980 and will be 15% by the end of this century.

In Iraq, for example, the illiteracy percentage is still high particularly amongst women where Figure (30) shows some improvement amongst people in the age group 15-45 as follows (33):-

Figure (29) Illiteracy percentage in different parts of the world

Areas	Illiteracy %
N America	1.5
Europe & USSR	3.6
Oceania	10.3
Africa	73.7
Asia	16.8
Latin America	23.6
India	70.6
Sri-Lanka	10

Figure (30) The Illiteracy percentage in Iraq

Year	Percentage of illiterates	
	males	females
1965	54	83
1972	40	76
1973	39.6	75.3

This large proportion of illiterates obviously limits their contribution to the economic and social growth. In other words, if those people were literates their participation in the development would be more effective and productive, leading eventually to a high rate of economic growth. A study conducted in the USSR estimated the share of literates in the whole development according to their degree of literacy as follows: (37)

Number of years in schools	Share in productivity %
4 years in school	23
5 to 6 years	30
7 to 9 years	40
10 to 11 years	56
people who are in vocational school	55

One can easily imagine how progress is affected by the level of literacy in the society.

(5) Education System

The foregoing obstacles have badly affected the process of official education in developing countries whereby the system has become unable to create and supply the necessary resources for development. The discussion in this section will include primary schools, secondary and University education and what has become known as the 'brain drain'.

(a) Primary Education

Primary school is the basis of the education system in any society. This part of education, as other parts, faces a variety of shortages within the environment of less-developed countries, for example:-

(i) small numbers of primary schools
(ii) unqualified teachers
(iii) poor education curriculum
(iv) poor geographical distribution of schools up and down the country particularly rural areas
(v) poor educational facilities

These shortages have limited the chance of education for children especially in the 6 to 11 year age group. Figure (31) shows the percentage of children who were in primary schools in 1970 in different Arab countries (38).

(b) Secondary schools and Universities

This sector of education is obviously affected badly by primary schools in terms of the number of students joining the secondary schools and universities as well as the quality. Figure (32) shows the percentage of students in the secondary schools and universities in different parts

of the world (38). The figures in developing countries overall show the disaster in this part of education whereby more than half of the relevant population groups suffer from not being able to receive secondary school or university education.

The inability of secondary schools and universities to absorb a large number of students in the long run will reduce the number of engineers, scientists and technicians in these societies, and consequently affect the whole development process particularly in science and technology. Figure (33) shows the number of scientists, engineers and technicians per 100,000 population in different Arab countries (38). The number of engineers, scientists and technicians in some Arab countries unfortunately show that they are still living in the medieval ages, while others are more advanced. However, there are huge numbers of expatriates working in these countries, especially those which show more advance, such as Qater, Libya, Kuwait and Bahrain. Figure (34) shows the percentage of expatriate engineers and scientistis in Arab countries. What makes the situation worse is to compare the number of scientists and engineers in developing countries with the corresponding figures for industrialised countries. The comparison shows the gap between the two groups and indicates the poor scientific and technological base which has been created by the

inadequacies of the education system. Figure (35) shows the number of scientists and engineers per 100,000 population in different areas of the world in 1976 (38).

Figure (35) Number of scientists and engineers in different areas of the world

Areas	Number of scientists and engineers per 100,000 population in 1976
Africa	80
Latin America	1000
Asia (excluding Japan)	125
Arab countries	800
Industrialised countries	2875

(c) Brain Drain

This phenomena in fact affected and still does affect, very badly the structure of the education system in developing countries and consequently, the structure of social and economic development. Developing countries have faced the outflow of scientists, engineers and other specialists abroad especially to industrialised countries. The number of migrants to the United States of America, Canada and the United Kingdom alone reached approximately 300,000 between 1960 and 1972, see Figure (36). Most of the emigrants to these countries were medical doctors (70%), engineers (10%) and natural scientists (15%), (39),(40).

In economic terms, the emigration of scientists and engineers represent an investment for the hosts but represents a capital investment loss for their home countries. This can be calculated by estimating the social capital values (investment values) that are added to the economy of the host countries, which in this case are the developed countries. A study has shown that developing countries lost about 50 billion dollars during the period 1961-1972. Figure (37) shows the loss of developing countries in terms of capital investment by the brain drain between 1965 and 1972. In addition,

developing countries have another loss resulting from the sum of money that has been spent on the emigrants' education in their own country which is very high and cannot be estimated. One can imagine, therefore, the dangerous effect of the brain drain on the national development.

(6) Workforce Structure

All the previous factors, particularly literacy and education, have badly affected the structure of the workforce in developing countries. In other words, as a result, these countries face a large number of people in the labour market looking for jobs. It is obvious that the economic system is not sufficient to absorb these numbers of workers which leads to an increasing rate of unemployment. At the same time, the productivity of the employed workforce is low due to the lack of skills and due to the low level of education.

The population of workforce in less-developed countries during the 1970's was 169 million with a growth rate of 26% for the decade, while in industrialised countries, the growth rate of the workforce for the same period was 10.2% (39). This is to say, that during the decade of the 1970's, there was 2/3 rd of the world population lviing in poor countries and only 1/3 rd in rich countries. This indicates that the need for jobs in developing countries was twice that in industrialised countries. On the other hand, the annual growth rate of the work-force in emergent countries increased from 1.6% in 1950 to 2.2% in 1970 while the percentage decreased in developed countries from 1.1% to 1% for the same period. Figure (38) shows the population of the workforce in different parts of the world for the period from 1950 to 1980 (39).

To sum up, the foregoing factors separately and jointly have formed the present structure of the society in less-developed countries. Any attempt, therefore, to reform the society should be started by destroying the phenomena which impede the growth of the society as well as to develop the good values. This remedy can be put into practice only be reconsidering the literacy and education programmes to make a good supply source for human resources which participate in the social and economic activities.

The author believes that the elimination of these backward social traditions can only be brought about by the creation of an efficient education system.

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