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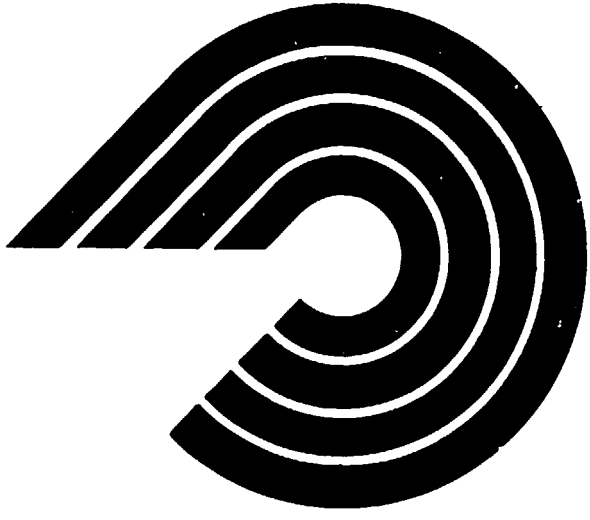

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

GUIDELINES FOR INDUSTRIAL PLANNING IN DEVELOPING COUNTRIES:

BASIC PRINCIPLES AND PRACTICES

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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna, 1988

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While the Guidelines rely heavily on all these sources, responsibility for the final version rests with UNIDO and, in particular, with the Department of Industrial Operations, Industrial Planning Branch.

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Preface

Many developing countries have an increasingly urgent need to know how they can formulate and implement industrial plans that will succeed in the face of less-than-favourable socio-economic conditions. Fortunately, the experience of some developing countries in industrial planning is already rich in success, and when this experience is combined with that of the already developed countries, it allows preparing guidelines for other developing countries. Drawing on this experience and on the results of UNIDO technical co-operation projects, it becomes possible to set out appropriate planning principles, recommend workable procedures and suggest industrial policies and strategies that would be suitable for such countries.

The Guidelines presented here focus on the special issues that are likely to arise in connection with planning for developing countries and on the methodologies that can be applied to ensure that the plans are realistic. They also discuss the organizational structures that are necessary for plan elaboration and implementation.

Those who are doing the planning and those who are implementing the plans face a huge challenge, for it is they who are responsible for promoting the country's objectives. They must trigger the motive force of industry in the face of immense and seemingly intractable problems — global economic crises, rapid advances in technology and changing patterns of industrialization. As they strive to allocate the country's resources and bring about a self-sustaining growth process, the planners and implementers must remember, above all, the need for clarity in their concepts and procedures and the need to strengthen the country's institutions and sharpen its skills.

UNIDO experience has shown that the key to successful planning and implementation is a multidisciplinary approach. Not only must the planning body have a good grasp of complicated socio-economic problems and of organizational procedures, it must also have an in-depth knowledge of technology and economics. Its task will become even more complex as the country's industrialization advances, bringing with it a diversified output, specialization, and integration of production capacities.

Aware of this growing complexity, UNIDO judged that industrial planners specializing in one discipline would welcome a basic knowledge of other, related planning disciplines. These Guidelines attempt to provide that knowledge, although they are not a substitute for the knowledge contained in textbooks on the subject, nor do they describe the latest methodologies or new, unproven technical procedures. They avoid prescribing set, inflexible procedures for the various steps in preparing and implementing industrial plans. Instead, they take as their point of departure the very special experience of developing countries, and they are addressed to the planners, economists, administrators and engineers who are preparing and implementing industrial plans in these countries, as well as to the technical assistance experts whose counsel is being sought.

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Introduction

The Guidelines that follow are arranged so they can serve both as a reference book for people who do the industrial planning in developing countries and as a textbook for UNIDO training programmes. While paying considerable attention to the problems of plan formulation, they also pay attention to the often intractable problems of implementation. The role of private industry in the planning process of developing countries is also dealt with.

Although theory and practice are both discussed (and frequently found to be at variance), the Guidelines are essentially based on observations. In some cases they suggest that the planning practices of developing countries be changed, but in other cases they advocate that planning theory be adjusted to suit local conditions.

Although the Guidelines are meant to be a practical tool for people engaged in planning, they are not intended to become a series of mechanical procedures. Industrial planning involves a complex set of socio-economic decisions, and the problems that are met with are too diverse to be solved in a simplistic, mechanical way.

The Guidelines fall into six chapters. Chapter I lays a foundation for the planning process and discusses the problems peculiar to industrial planning in developing countries. Chapter II deals with the establishment of an integrated process for plan preparation and implementation. Chapter III discusses planning strategies for developing countries, with the aim of ensuring the most rational utilization of available resources for industrial development. Chapter IV deals with the main problems encountered in elaboration and follow-up of industrial plans in developing countries and with the informational prerequisites. Chapter V introduces some basic planning tools, and chapter VI presents, in a simple way, the various steps required for the preparation of industrial plans in developing countries.

I. Introduction to industrial planning in developing countries

A. Development planning concepts

The term "development planning" is given different shades of meaning in the literature on economic planning. For the most part, it is viewed as a subjective process by which a government manages an economy in order to accelerate its growth, although occasionally it refers more broadly to any government regulation of economic life. Indeed, it is true that development planning presupposes government involvement in economic activities, but it is more than this. If a government wishes to regulate the economy, it will need a plan, but merely having a plan does not ensure its successful implementation, nor does it necessarily produce benefits.

In most developing countries, socio-economic development does not occur spontaneously, nor can it be made to occur simply by regulating a few, or even many, economic activities. Rather, such development will take place only if the countries introduce principles of planning that reckon with the objective behaviour of social forces and with economic laws, and if they set goals that are realistic and not just arbitrary. If there is no planning at all, or if the planning ignores economic facts of life, the national economy will experience bottlenecks and rigidities. For example, failure to relate investment expenditures to physical resources may cause imbalances that ultimately depress the economy and slow its rate of growth.

To understand the complex process of production so that scarce resources can be allocated efficiently, it is first necessary to identify the objective aspects of social and economic factors.

Definition of development planning and industrial planning

"Development planning" is a conscious effort on the part of society to guide a national economy towards steady and sustained long-term socio-economic progress in order to better satisfy the needs of the people. Organized by the government, this effort takes into account the behaviour of the main social and economic factors and tries to make a rational allocation of the country's manpower, natural resources, financial resources, fixed assets, materials and energy.

Industrial planning is that part of the development planning effort that focuses on the industrial sector while not, however,

losing sight of its links with the other sectors. It seeks to progressively transform all of a country's socio-economic structures by introducing and adapting modern industrial production techniques.

B. The scope of industrial planning[1]

Comprehensive planning can be carried out for the national economy as a whole or for particular sectors or sub-sectors of economic and social activity. Planning at the national level involves broad economic issues and goals—for instance, economic growth, population, employment and income distribution. It results in the drawing up of a national economic plan that defines the issues, sets the goals and prescribes the approaches.

Planning at the sectoral level must encompass not only the physical transformation of goods but also economic and social conditions. Besides concerning itself with industry as a whole and with specific industry groups and branches, it must also, for example, pay attention to commerce, communications, agriculture, housing, social facilities and other social and material services. In planning at this level, the sectors are sometimes subdivided to permit a more detailed analysis of problems.

A national plan provides the perspective for developing an economy and defines the objectives and roles of the different sectors, setting a framework for sectoral planning. It allocates financial resources, human resources and natural resources, and it co-ordinates the sectoral targets. To facilitate this co-ordination, a plan for the industrial sector should define the sector's forward and backward links with the other sectors of the economy, such as agriculture, construction and mining.

C. Types of development planning

Development planning in centrally planned economies differs substantially from development planning in mixed economies. The former is usually referred to as "directive planning" and the latter as "indicative planning".

1. Directive planning

Directive planning is applied in countries that do not practise market economies. It is a detailed and centralized system of resource allocation and production and is based on the quantitative reconciliation of needs and supplies, which in turn is based on an input-output analysis that reaches down to every industrial enterprise and collective farm.

Under directive planning, the State controls the levels of saving, of consumption and of investment, as well as the structure of prices. It achieves

[1]These *Guidelines* have mainly been written with manufacturing industry in mind. However, account is taken of the interlinkages with other sectors of the economy.

this control through regulations, directives and incentives. The central planning body prepares its plan on the basis of informational inputs and expertise from different hierarchical levels of the relevant ministries, enterprises and institutions. Once approved, the plan becomes law. Although political authority for the plan is vested in the decision-maker at the top, in practice the decisions are arrived at by an iterative technique that takes place between the decision-maker and the people who will execute the plan:

What and how much is to be produced?

How is it to be produced and where?

What inputs and what resources (investment and operating) are to be used?

What are the technologies and from where are they to be obtained?

How is the output, including interactivity transfers, to be distributed?

It should be pointed out that there is no such thing as a "pure" directive planning system: elements of indicative planning, such as wages, taxes, prices, subsidies and moral incentives, can also be used.

2. *Indicative planning*

"Indicative planning is the use of policy-determined targets to co-ordinate private and public sector investment and output plan. Decision-making remains decentralized but sectors of the economy are encouraged to meet agreed targets. A major rationale of indicative planning is improvement in the flow of information within a market economy, and reduction in the uncertainty surrounding decision-making."[2]

A plan formulated under this system sets out objectives, but for the most part they are not mandatory. Prices are determined primarily by market forces, and the State regulates mainly through policies, incentives and other promotional measures. As the plan unfolds, market forces can sometimes keep its targets from being met. These deviations from plan call for frequent readjustments to avoid serious imbalances.

In a "mixed" economy, which describes the status of practically all developing countries, indicative planning has some directive aspects. The plan may, for instance, be binding on the public sector, where the government has a good degree of control, but not on the private sector, where the main thing that can be influenced is the size and composition of investments. For example, planning in France has been characterized as "mandatory" in the public sector and "indicative" in the private sector. The Director-General of the Commissariat Générale du Plan expresses this as follows: "French planning can be said to be less than mandatory and more than indicative. It can reasonably be defined as active planning."[3]

When indicative planning in developing countries is compared with indicative planning in developed countries, similarities as well as differences emerge. Both kinds of countries practise market economies, and both use the public policy instruments of government to influence the pace and direction of

[2]David W. Pearce, ed., *Dictionary of Modern Economics* (London, Macmillan, 1983), p. 204.

[3]Pierre Massé, *Planning in France*, paper read at the Business Economists Conference at New College, Oxford, 5-8 April 1962 (London, Business Economists Group, 1962), p. 17.

the economy, through planning. The difference lies in the function of the planning. In developed market-economy countries, it serves chiefly to maintain a balance between supply and demand, averting economic crises. In developing countries, planning is a *sine qua non* for industrialization. Its mission is to restructure the country's productive forces, to expand its industrial sector and to introduce modern technologies into agriculture, construction and other sectors of the national economy.

As the functions of planning differ, so do its approaches and instruments. In developed countries with dynamic private sectors, plans consist mainly of forecasts of global economic trends and recommendations for government policies that would stabilize the economy. In developing countries, plans are instruments for industrialization.[4] They must be able to bring about structural change. For example, if a developing country decides it wants to set up basic industries, the planner must decide on the rate of investment and choose the appropriate technology. To enable an infant industry to survive, he may even fix the prices of its products at a level substantially different from those that would prevail under unrestricted market conditions.[5]

3. *Choice of planning system for developing countries*

The choice and thrust of a planning system are determined by the degree of control a government is able to exercise over economic agents. Where control exists, a planning authority can allocate resources and assign responsibility for implementation. Where no control exists, the government will have to resort to persuasion to influence economic agents to meet its objectives. This persuasion will be in the form of suitably designed economic policies, such as legislation, regulations, subsidies, incentives, taxes, customs duties and monetary policy.

Experience shows that in market-economy countries where the State owns some enterprises, even these State-owned enterprises cannot be brought totally under government control. A politically powerful manager may, for example, be able to maintain a degree of autonomy *vis-à-vis* the government. Or, a plant may be located in a remote area or have its own engineering capabilities. Even in countries that do not practise market economies, it is impossible to control all production (it is, for example, very difficult to control small-scale farming and handicrafts). It is extremely important, therefore, that the planning authority in a developing country realistically assess its influence over economic agents and then invite their full participation in the planning process.

After assessing the extent of its control in the different economic spheres, a government can divide its plan into different approaches:[6]

(a) The part of the plan that concerns economic activities owned by the government and able to be completely planned by it will be "directive".

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[4]There is a significant distinction between industrial growth and industrialization. This problem will be dealt with as the discussion proceeds.

[5]"... the unrestricted play of market forces is not the most suitable means of promoting industrialization on a world scale nor of achieving effective international co-operation in the field of industry ..." *Report of the Second General Conference of the United Nations Industrial Development Organization* (ID/CONF.3/31), chap. IV: "Lima Declaration and Plan of Action on Industrial Development and Co-operation", para. 42.

[6]The idea of dividing a plan in this way was introduced by G. de Bernis, of the University of Grenoble. This has significant implications for improving plan preparation and implementation in developing countries, as will be seen in the following chapters.

"Directive" should not, however, be taken to mean "dictatorial". Managers and workers should be allowed to help elaborate the plan so as to ensure their commitment to its implementation. This part of the plan is highly significant since in most developing countries it comprises the key production capacities and is the only part of the plan where implementation can be controlled. It should also be pointed out that the implementation of other parts of the plan depends on the successful implementation of this part;

(b) The part of the plan that concerns economic activities owned by the government but difficult to control will be "semi-directive" rather than fully directive. Here, the government can use various means to achieve its purpose. It can, for example, give out or withhold funds, especially foreign exchange, and it can persuade the workers or offer them incentives, thereby exerting pressure on managers to fulfil plan targets;

(c) The part of the plan concerned with the activities of the private sector will be "indicative". After consulting with the private sector, especially on the medium- and long-term plans, the planning body can set specific goals. The government must then use every available means, including the following, to induce the private sector to meet these goals:

Selective licensing of new enterprises;

Selective investment in the infrastructure to influence the location of different economic activities;

Price and taxation policies to encourage some undertakings and discourage others;

Credit and customs policies.

With the planning process as complex as it is, it is clear that no country in the world can hope to control all its productive activities. Conversely, no country does not have some activities that are State-owned and hence controllable. It follows that any plan for industrialization will have to be a pragmatic mixture of directive, semi-directive and indicative elements, the proportion depending on the pattern of ownership and on the extent of government influence.

The qualitative and quantitative aspects of these directive and indicative elements do not differ. Both kinds of elements require expedients such as targets and deadlines, without which the plan will not be coherent. However, private enterprises, as well as State-owned enterprises that are difficult to control, may call for some special techniques:

(a) The planning authority must negotiate with them. In this context, it must set up procedures for consulting with peasants, handicraftsmen and small enterpreneurs;

(b) Incentives must be offered to private sector enterprises and also, perhaps, to difficult-to-control State enterprises.

D. The role of industrial planning in industrialization

1. Industry and economic growth

Rapid economic growth is a relatively modern phenomenon. Before the Industrial Revolution, economies grew only slowly and over long periods of

time. There was little development and many setbacks, due to war, disease or natural calamities. In a much-quoted essay, "The Economics of our Children", Lord Keynes once said:

> "From the earliest times of which we have recorded . . . down to the beginning of the eighteenth century there was no very great change in the standard of life of the average man . . . ups and downs certainly. Visitations of plague, famine and war. Golden intervals. But no progressive violent change . . . This slow rate of progress was due to the remarkable absence of important technical improvements and to the failure of capital to accumulate."

The Industrial Revolution—with its mechanical power, factory production, continuous technical change and accumulation of capital—changed all that. Since then, the per capita income in industrialized countries has increased by leaps and bounds.

2. *Industrial development vs. industrial growth*

Industrial development is an integral part of overall socio-economic development and is subservient to it. Indeed, development is successful only insofar as it serves the country's basic socio-economic objectives. Industrial growth, by contrast, is simply an increase in, say, the number of plants or wage earners and is not an end in itself, nor is it necessarily a sign of successful industrialization. In economies where the modern sector is relatively isolated from the traditional sector, it is possible to achieve industrial growth without achieving development. In such cases, the trickle-down effects are negligible because of internal structural rigidities, or because decisions on finance, markets and technology are made elsewhere, or because the factor proportion endowments of the developing countries are being applied, inappropriately. Industrial growth within such an economic enclave may even have an adverse effect on the traditional sector, or on food production or the environment. Planners must therefore see to it that growth takes place hand-in-hand with development and that the industrial sector plays its proper role, which is to bring about and sustain a socio-economic transformation.

3. *Goals of industrial development*

The aim of industrial development is to raise peoples' standards of living by increasing the domestic production of consumer, intermediate and capital goods, thereby expanding the circle of incomes, markets, technology and employment.[7] This calls first for an assessment of resources, potentials and constraints in order to formulate strategies and second for the drawing up of

[7] "In the formulation of industrialization plans and strategies, . . . social justice should be a guiding factor in achieving the objectives of raising the living standards and eliminating extreme social disadvantages and unemployment particularly among young people. To this end, proper industrial development should permit such growth as is required for economic development . . . The equitable distribution of the benefits of industrialization among all sectors of the population;" (*Report of the Second General Conference . . .*, paras. 58(b) and 58(d)).

industrial master plans to guide investments in productive facilities and support services, including training. If the assessment is thorough and the plans carefully laid, then it should be possible, in time, to produce locally most of what is consumed locally. It should be possible, too, to improve the country's ability to import, so that what cannot be produced locally can be obtained, in equitable trade, from outside.

There is widespread agreement that industrial development is the only way of extricating developing countries from poverty and backwardness. This is because industry creates by far the best conditions for the efficient functioning of an economy, for maximizing national income and for speeding up economic growth through enhanced capacity for domestic savings. With the help of industrialization, which utilizes modern production techniques, the rest of an economy can be diversified. For example, the agricultural sector can be modernized if industry is able to supply agricultural and irrigation equipment, fertilizers and pesticides; and infrastructures can be modernized and expanded if industry is able to supply transport and communication equipment and construction materials. Thus, industrialization not only builds up the manufacturing sector of an economy, it also, by introducing industrial means of production into other sectors of the national economy, increases labour productivity in those sectors as well.

A country is said to have become industrialized when it has achieved a degree of industrial self-reliance; when its production and trade are able to satisfy the basic needs of its population;[8] and when a significant portion of its economic and social structure has been transformed by industrial production with strong internal linkages.

4. The role of industrial planning in developing countries

The principles of industrial planning provide a basis for identifying and quantifying a country's development objectives. Drawing on these principles, planners can devise concrete ways of achieving the objectives and of mobilizing the country's resources. Industrial planning is, in short, a means for bringing about industrial development. By taking into account a country's own human and natural resources as well as its access to external resources, industrial planners can work out an optimal rate of industrialization and can formulate the policy instruments and mechanisms that will achieve the desired socio-economic development.

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[8] "Basic needs as understood in the Programme of Action [proposed by ILO], include two elements. First, they include certain minimum requirements of a family for private consumption: adequate food, shelter and clothing, as well as certain household equipment and furniture. Second, they include essential services provided by and for the community at large, such as safe drinking water, sanitation, public transport and health, education and cultural facilities . . . A basic-needs-oriented policy implies the participation of the people in making the decisions which affect them through organisations of their own choice." (*Meeting Basic Needs: Strategies for Eradicating Mass Poverty and Unemployment*, Conclusions of the World Employment Conference, 1976 (Geneva, International Labour Office, 1976)), p. 24.

Industrial planning in developing countries must first and foremost expand the industrial sector, including agro-based industries. This expansion should, in time, achieve a number of goals (see figure I):

(a) It should satisfy the basic needs of the population for manufactured goods, preferably through domestic production, but where this is not feasible, through equitable trade;

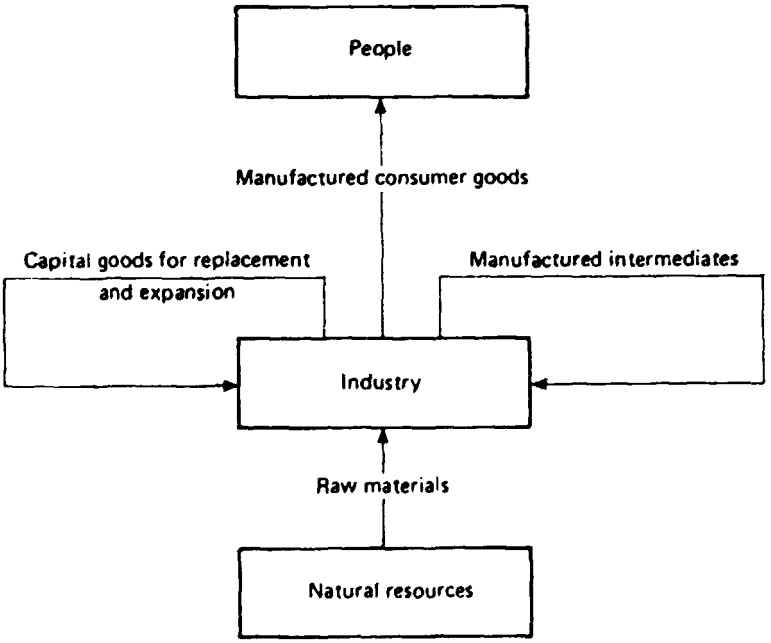
(b) It should satisfy, to a large extent, the requirements of the country's industries for manufactured intermediates;

(c) Where economically justifiable, it should produce equipment for replacement or for expansion of industrial production capacity.

Planning cannot, however, serve the needs of development unless it at the same time manages to modernize and restructure the agricultural sector by supplying up-to-date agricultural and irrigation equipment, construction materials, fertilizers, pesticides etc. Plans must also be made to upgrade transport facilities and education as well as to modernize mining, which will in turn allow the rational exploitation of natural resources, especially minerals.

Despite the need to plan for other sectors, it is clear that industrial planning has priority, for a structural projection of industry makes it possible to analyse and verify all the other sectors of an economy. However, since the over-rapid and uncoordinated development of industry could hurt these other sectors, particularly the agricultural sector, planners must strike the correct balance between industry and agriculture. The latter's need for industrial inputs

Figure I. Industrialization transforms a country's natural resources to meet the basic needs of the people



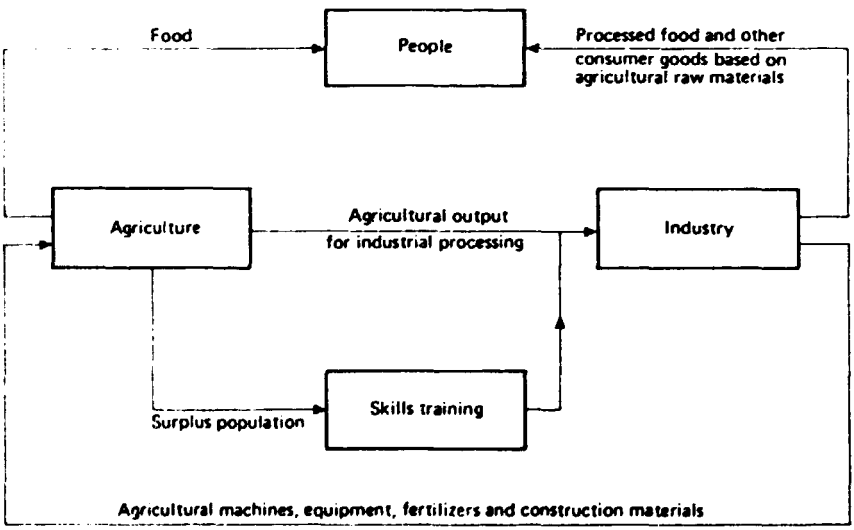
to trigger structural transformation should be matched with its potential to generate the investment surpluses needed for sustaining industrialization.

When agriculture is restructured, the overall economy is benefited in many ways:

(a) Higher agricultural productivity increases agricultural surpluses. These in turn raise the incomes, and hence the living standards of farmers, stimulating demand for manufactured consumer goods and eventually creating more jobs in industry. Food surpluses, as well as wool, cotton, timber, straw and bagasse, can be processed by the industrial sector, thus expanding output based on local raw materials and allowing for the export of processed agricultural products rather than commodities;

(b) The introduction of new technology into the agricultural sector increases labour productivity, creating a surplus of labour in rural areas that can be absorbed to advantage by the expanding industrial sector. Industrial planners must work out a mechanism for the transfer of surplus rural labour to industry and must draw up a programme for the required education, training and upgrading of skills. It is worth mentioning here that the relationship between industry and agriculture constitutes the most critical area in industrial planning (see figure II).

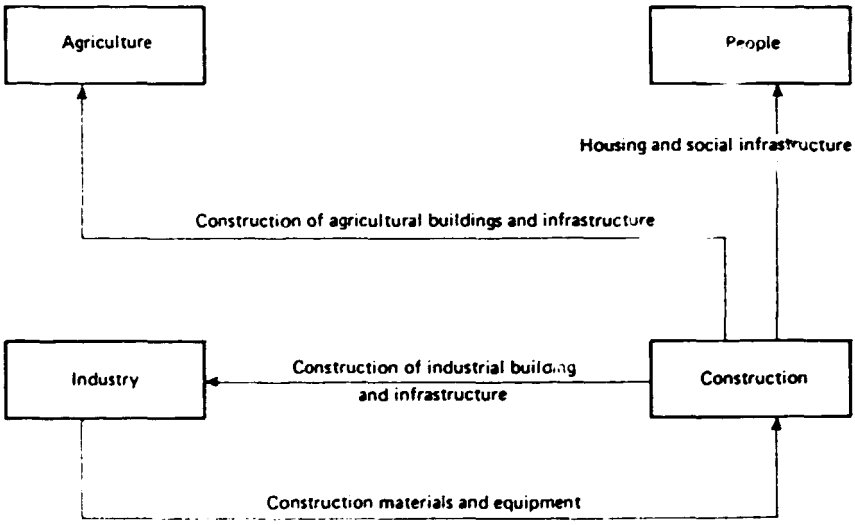
Figure II. Industry and agriculture interact to satisfy the needs of the people



The restructuring and modernization of other sectors of the economy, such as mining and services, also plays a key role in industrialization. The relationship between industry and mining can be very important. For some developing countries, particularly those that are rich in crude oil, copper, bauxite or other minerals, it is almost as important as the relationship between industry and agriculture.

Modernization of the construction sector is crucial as well. Just as industry will need large-scale works, like factories and estates, warehouses, roads, railways, bridges, ports and housing, so also agriculture will need silos, dams and irrigation networks, communication networks and rural access roads. Since in most developing countries construction is still carried out in traditional ways, with very low performance and productivity, it is usually this activity that becomes the bottleneck in implementing industrial or agricultural plans. Even so, construction accounts for a major share of capital formation in many developing countries, and the industrial sector must provide it with enough building materials and equipment to make it efficient. Industrial planning must quantify the investment linkages between the two sectors and strike the necessary balance between industry and construction (see figure III).

Figure III. Pivotal role of construction in industrial development



Even more urgent is the housing situation in developing countries, where a high percentage of the urban population lives in unacceptable conditions that are deteriorating even further. This deterioration is due, on the one hand, to overall population growth, rural/urban migration and the rising ratio of urban to total population and, on the other hand, to a shortage of construction materials. The amount and timing of investment in physical and social overheads, as well as the conditions under which financial viability can be assured, are basic issues to which industrial planning must address itself.

E. Obstacles to development planning in developing countries

There is a growing recognition among developing countries that they cannot achieve economic independence, overcome their backwardness or realize a socio-economic transformation without the intervention of the State. This intervention is needed for many reasons:

(a) Domestic capital formation is at a low level in most developing countries;

(b) The private industrial sector is weak both in absolute terms and relative to the commercial sector and to real estate, which exert stronger attractions;

(c) The economies of most developing countries are dualistic in nature;

(d) Economic and financial resources are concentrated in the public sector because they come mainly from taxes levied on various activities, particularly foreign trade, or from the export of minerals and other commodities. Therefore (and this is particularly true in the initial stages of industrialization) it is only the State that can mobilize the financial resources to develop social and physical infrastructures and carry out large industrial projects, where the pay-off periods are likely to be long and where much of the capital may have to be in foreign currency;

(e) The need for foreign capital means that the government must become involved in negotiating terms and conditions and in regulating the pattern and volume of the capital inflow.

Thus government is not merely an organizer of the development process, it is also a direct participant in it and shoulders major responsibility for planning and pursuing industrial activities. Notwithstanding this central role, experience in many developing countries shows that governments have *not* been able to impose their will on all of the economic agents. The gaps between a plan's expectations and its actual achievements show how complex a task it is to assess and forecast the behaviour of internal and external factors and incorporate them into a plan.

1. Social and administrative problems

For development planning to be effective, two social preconditions must be met. All the groups that exercise political or economic power have to agree upon the planning framework, the objectives and the methods; political instability, for example, would destroy this consensus. Even more important, there must be a serious commitment to the plan on the part of the country's policy-makers and on the part of the people who have to implement it.

In general, the less developed a country is, the less developed its administrative machinery for planning and plan implementation, and the less able it is to deal with the complexities of the process and the sustained and co-ordinated efforts needed to achieve plan objectives. These weaknesses in a government's administrative machinery are caused partly by a lack of trained manpower and resources. They may also be partly historical, however, in that the machinery was originally set up to function under completely different conditions and has not yet been modified to suit the new circumstances.

2. Insufficient control of the private sector

In most developing countries the government already regulates the private sector to a greater or lesser extent through economic policies such as taxation, price policy, protection etc. However, these policies may not be sufficient to

call forth the kinds of investment envisaged by the plan. The planner is then faced with the problem of how to induce the participation of the private sector. Several kinds of private investment may need encouragement:

(a) Investment in industrial activities instead of in speculative activities, such as real estate;

(b) Greater participation of small-scale entrepreneurs, who must be persuaded that industry would provide a better outlet for their personal savings than some traditional but less productive activities;

(c) Investment in industries for processing commodities that would otherwise be exported in raw form;

(d) Investments that would satisfy the objectives of regional balance and income distribution;

(e) Investment in specialized, small-scale, high-technology industries.

Policies, procedures and instruments for the effective participation of the private sector must be clearly defined at the outset. They should grow, if possible, out of negotiations with representatives of this sector and should reflect its potential as well as its constraints. Once this has been done, the planner must co-ordinate the private investments with investments in the public and traditional sectors.

3. Transnational corporations

Transnational corporations formulate their strategies to suit the large scale of their operations, and they have many alternatives from which to choose with respect to operating sites, kinds of production and types of technology. They have no particular reason to tailor their strategies to accord with the wishes of their host country (indeed, from their point of view, this would make the strategies less perfect), and in only some cases do the interests of both parties coincide. The planner therefore has to deal with an entity that may be unresponsive to plan objectives or to control.

In some cases, however, depending on a country's stage of industrialization, its scientific and technological capabilities, its size and natural resources, co-operation with transnationals may prove indispensable. It will then be important that the partnership is equitable. The planner should investigate ways to avoid total dependence on transnationals. For example, to reduce technological tie-ups with specific foreign corporations, the planner should, with the help of technicians, resist purchasing a total package. Instead, he should break projects down into standardized components that can be bought elsewhere on the world market, including from other developing countries. It should be kept in mind, however, that this option will add to the developing country's burden of responsibility.

It may also be possible to involve competing firms in the delivery of different parts of a project so as to avoid dependence on a single firm. Another way to reduce dependence would be to choose products that can be made from raw materials available in the country or in other developing countries instead of products that need semi-processed intermediates and semi-finished components that are available only from the transnationals. Once it has been decided to co-operate with a transnational, the planner should closely examine

all the possible economic disadvantages and risks of this co-operation. He should then devise ways of controlling this co-operation to maximize the spread-effect benefits of the investments and ensure that they are retained by the host country.[9]

4. Global trends

The planner faces hard decisions in setting export and import targets when terms of trade are constantly changing, commodity prices are fluctuating and the international monetary system is unstable. Adverse global trends have often meant costly delays in development projects, or even their abandonment altogether. These problems are more acute for countries with mono-cultures: if they could diversify, they would be in a better position to withstand externally induced shocks.

Some of the external factors inhibiting industrialization in the developing countries are as follows:

(a) Adverse terms of trade, which tend to distort production patterns in these countries;

(b) Fluctuations in commodity prices, which restrict the capacity to import and lead to the postponement of development projects;

(c) Tariffs and other protective measures, which inhibit a developing country's capacity to manufacture goods for export;

(d) Restrictive monetary and fiscal policies, which impair the profitability of development projects;

(e) Debt and debt-servicing burdens, which curtail the ability to borrow and limit the rate of new investments and capital formation in these countries;

(f) The high cost of acquiring technology, as well as restrictive practices in its transfer, which heightens dependence on the developed countries.

A country's independence of external pressures can be sized up by looking at who makes the production decisions:

What is to be produced?

For whom is it to be produced?

How is it to be produced?

Where is it to be produced?

It is, of course, difficult to plan the industrialization process when it is mainly the world market that decides what is to be produced, for whom it is to be produced and how it is to be produced. While a permanent solution to this dependency problem would require dramatic changes in the economic structures of developing countries, planners can begin to deal with it by:

(a) Taking into account trends in the relative prices of commodities and manufactured goods;

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[9] "... the activities of transnational corporations should be subject to regulation and supervision in order to ensure that these activities are compatible with the development plans and policies of the host countries, taking into account relevant international codes of conduct and other instruments;" (*Report of the Second General Conference ...*, para. 42).

(b) Looking ahead at the long-term prospects for restructuring the world's production facilities and pinpointing that part of a market that may be exploitable;

(c) Designing measures to offset the negative effects of debt servicing and international monetary, exchange rate and fiscal policies;

(d) Anticipating long-term technological needs and formulating the appropriate policies and programmes;

(e) Actively taking advantage of regional, inter-regional and global programmes to mitigate the severity of adverse trends.

Conclusions

The concentration of economic and financial resources within the public sector provides the governments of developing countries with means of promoting their industrialization processes, especially insofar as these resources enable them to invest in social and physical overheads. However, a number of obstacles, both internal and external, have kept industrialization from living up to expectations.

The internal obstacles have to do mainly with government machinery—there may, for instance, be too little discipline among policy-makers, the planning approach may be inappropriate or the planning may be ignoring the private sector. If planning is to promote industrialization, there needs to be an appropriate climate within the government administration. Policy-makers must be committed to the plan, and they must, if necessary, be willing to restructure the administrative system to create conditions favourable to the industrialization of both the public and private sectors.

Three types of external obstacles are encountered in industrial planning in developing countries. The first is transnational corporations, which are firmly controlled by forces outside the country and usually pursue objectives that are at odds with those of the country. The second obstacle is adverse terms of trade and the relative price system implicit therein, which tend to push the economies of developing countries in directions that run counter to the national industrialization strategies. This obstacle calls for offsetting policy measures that would promote the export of manufactured goods, while at the same time developing domestic productive capacity to meet domestic needs. It also suggests a need for greater co-operation among developing countries. The third obstacle is fluctuations in the world market. These fluctuations raise complex problems for planners, who must act to minimize their interference with plan implementation.

This is the array of problems being faced by developing countries as they attempt to industrialize. The problems are immense and constitute a serious constraint to industrialization. While industrialization cannot be achieved spontaneously in a situation dominated by unrestricted market forces, it can be achieved, given the right socio-economic environment, by the application of scientific principles. It is these principles, as well as practical procedures for planning the industrialization process, that are the subject of these Guidelines.

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II. Preconditions for and organization of industrial planning

A. Review of industrial planning practices

1. History of planning in developing countries

Developing countries began to plan for their industrialization just after the Second World War. India was a pioneer in this endeavour: soon after national independence, it set up an advisory planning board to propose measures for co-ordinating planning activities. By 1950, the Indian Planning Commission had set in motion an effective and comprehensive planning process. Soon, most other Asian countries that had gained, or were about to gain, independence accepted the necessity of planning. Development planning in Asia later received a boost from the newly formed Colombo Plan for Co-operative Economic and Social Development in Asia and the Pacific.

The Economic Commission for Africa (ECA) and the Economic Commission for Latin America (ECLA) started by advocating national planning for their respective regions in the 1950s, and a number of African countries were among the first developing countries to prepare national plans. In Latin America, ECLA projections were the core of planning efforts: as early as 1953, ECLA was preparing projections based on assumed rates of growth for a number of countries. These efforts culminated in the Declaración of Punta del Este (Uruguay), issued in August 1961. In this document, the participating countries agreed to set up programmes to develop their economies.

On the whole, developing countries have made enormous efforts since the 1950s to create planning mechanisms, and there is general agreement that this planning has helped to bring about a degree of industrialization. Huge irrigation projects, cement, iron and steel industries, and mechanical engineering complexes, as well as ports and power and communication facilities, are evidence that the planning function has been able to change the rate of investment in favour of savings and that it has succeeded in channelling these savings into activities, industrial and otherwise, that lead to structural change. Nevertheless, the benefits of industrial planning could in many cases have been far greater. Policy-makers, economists and planning experts from developing countries have been engaged in discussions on several topics: impediments to planning; ways of making sure that plans are realistic; and actions to counteract the external forces and events that threaten implementation. The need for an appropriate planning environment has also been discussed at length. Most of the analysis has been devoted to the techniques and models of industrial planning. On one matter there has been full accord: establishing a planning process is a complex task that requires formidable organizational and management skills.

2. *Approaches to planning*

Most developing countries concentrate their efforts on a pre-planning stage, during which they allocate financial and/or budgetary resources. They usually pay little attention to the implementation stage. Because a planning document is often regarded as the final objective of the planning process, work often stops once the document has been officially approved. Some governments regard a development plan simply as a document they must have in hand to allocate State revenue among development projects. Others, thinking they will have a better chance of attracting foreign financial assistance if they have a development plan, rush to put together a document that turns out to be unrealistic. Still others turn out a development plan to gain political prestige and enhance their image.

An industrial plan is sometimes drafted in a single, isolated operation by a few technicians, perhaps assisted by foreign experts, without much exchange of ideas with outside parties. This is not a good way to carry out industrial planning. The experience of developed countries proves that planning must be a continuous and iterative process and that national economic plans cannot be drafted in a single operation.

It is, moreover, unsound to formulate a plan entirely within the confines of central planning office or to simply compile it from proposals submitted by, say, the Ministry of Industry or other parties. Unfortunately, in the great majority of developing countries, planning is regarded in just this way, that is, as a government task to be carried out by a single, specialized agency—the central planning body—without the co-operation of other State organs or the private sector. A successful planning process must have the real and active participation of all elements of the society that will eventually contribute to achieving the plan, such as the Ministry (or Ministries) of Industry, industrial enterprises and other organizations in the public sector, as well as representatives of the private industrial sector and of the labour force. For this purpose, it is recommended that a plan be drafted in stages, as an iterative process, and that the drafting involve economic bodies at all levels of management.

There are three different approaches to achieving industrialization in developing countries. Developing countries that do not practise industrial planning *per se* tend to take a project-by-project approach. In this approach, documentation on individual public investment projects, which usually have little relation to one another and probably no unifying concept, may be gathered together and published in one large document, which is then termed the "plan". Sometimes the projects never even appear together at all, except as listings in a budget.

The project-by-project approach has serious shortcomings, some of which are set out below:

(a) It fails to relate projects to each other or to the existing manufacturing sector. The main requirement for internal consistency of the plan is simply that the whole should equal the sum of its parts. This lack of inter-sectoral co-ordination can lead to serious imbalances and constraints;

(b) A plan prepared using this approach is little more than a financial document and does not take into account the physical capacity of the country to carry out the projects;

(c) The capital budgets encompass only the governmental sector and not the private sector;

(d) Since such an approach takes no account of existing industry or of other sectors of the economy, individual projects do not reflect the various linkages.

The preparation of a capital budget is a necessary step in planning, but it is not enough, especially in a country that is in a more advanced stage of development. By then, the rates of return of the alternative investment opportunities are no longer as apparent as they were at a simpler stage of development, and the objective economic factors are so complex that highly sophisticated methods are needed to control them.

An integrated public investment approach is more advanced than a project-by-project approach. A well-elaborated plan of this type begins by estimating the local and foreign public investment resources that can be mobilized. It then divides these resources among a selected group of sectors subject to public investment and ranks them in order of priority.

Under integrated public sector planning, a government intervenes in the private sector only to the extent of adopting clearly desirable measures to improve the climate for private investment, including the provision of credit facilities through development banking institutions. Still, few countries have properly integrated public investment plans. Indeed, their plans usually fall somewhere between the project-by-project approach and the integrated investment approach, with most plans closer to the former than to the latter.

A comprehensive planning approach considers the economy as a whole, including the productive and social sectors of the economy. For this approach to succeed, a number of conditions must be met:

(a) There must be a network of planning bodies and units specialized in different economic activities to elaborate a consistent plan using iterative techniques;

(b) Appropriate statistical information must be available, particularly on the private sector, and there must be policies to ensure that the private sector's activities are in harmony with plan objectives;

(c) There must be co-ordination between plan preparation and the operating management of the economy, as well as harmonization of financial resources with physical capacities. These will be discussed in detail later in the Guidelines, where we will attempt to demonstrate the problems that impede comprehensive planning in developing countries and the system by which a country can shift to comprehensive planning.

Summary

When a developing country puts together a plan mainly so it can allocate investments or attract foreign financial assistance, the document is not a plan in the true sense because there is little or no co-ordination of the component parts, and little or no account has been taken of development in the private sector. Since such a plan is primarily a financial document, there is little likelihood that it can be implemented within the allotted time or budget.

B. Difficulties during the implementation phase

Until recently it was thought that the most important task of industrial planners in developing countries was the formulation of a consistent plan. Now, however, it is realized that this is not enough. While it is still important for a plan to be consistent, well-prepared and based on clearly defined development objectives, these qualities alone do not make it more likely to be implemented than an inconsistent, ill-prepared plan. Disappointing results in most developing countries prove that much more attention needs to be paid to the implementation stage of the plan.

While some failures to implement programmes within the allotted times can be traced to inadequate plan preparation, despite advances in planning methodology, more often it is the implementation procedures that are inadequate, and may even be worsening. Indeed, it is widely believed that the main problem in the industrial planning process for developing countries is not plan formulation but plan implementation. This is particularly the case in those developing countries where planners fix targets solely on the basis of financial potentials and fail to take account of requirements for physical capital, technical skills and construction capacities, or of the managerial, administrative and political roadblocks. Such targets generally turn out to be beyond reach. Timing is also a crucial function of planning: proper timing of the different projects ensures a dynamic process without bottlenecks. Another important function is to maintain both the target rate of implementation within the sectors and the factor proportions in the economy.

Failure to carry out industrial plans in developing countries may manifest itself in two ways: the first is delays in the execution of projects and the second is higher-than-planned costs. Long delays are common, particularly in the public sector. If delayed, projects with very high investments, such as steel plants, heavy engineering, petrochemical and electrical plants, can incur heavy losses. Extending the scheduled construction period also raises costs, particularly in countries where inflation rates are high. If interest charges during construction are included, every extension of the period of execution adds to the costs. There are many other reasons why costs get out of hand. If parts of a project are finished too soon, there will be maintenance expenses, and if equipment has not been properly maintained, repair expenses, too. Changes in the technology used or in the function of the project will lead to additional expense. There will also be losses in foreign exchange and production if the project is export-oriented or is meant for import substitution, as well as losses associated with under-utilization of the upstream and downstream capacities if the project has substantial backward or forward linkages.

Apart from deficiencies in the original plan, there are three main reasons for difficulties during plan implementation: separation of plan preparation from plan implementation; weak links between planning and management; and lack of control over internal and external influences on industrial growth.

1. Separation of the preparation stage from the implementation stage

The unfortunate practice of preparing plans without thinking about how they are to be realized is often met with in developing countries. Planners make the mistake of considering the financial resources of the country but not the

physical resources required to carry out the projects. Often their plans are merely schemes for public expenditures or for aid to private enterprises.

The funds available to accomplish an industrial plan depend, first, on the savings that have been accumulated within the country and the money that can be borrowed from abroad and, second, on the portion of these savings and loans that has been allocated to industrialization. Part of the funds for industrialization is spent in local currency for manpower, construction materials, transport and construction work etc. The rest is spent in foreign currency to purchase equipment, licenses etc. The distribution of such funds between local and foreign currency is unrelated to the country's existing supply and distribution pattern.

During the implementation stage, planners and policy-makers are usually happy just to get the funds. They manage to ignore the lack of physical capacities for converting them into finished projects, even in the face of experience showing that demands for production factors, for example, construction materials and civil construction capacity, as well as other items of infrastructure, often exceed local supplies. This imbalance can lead to congestion and bottlenecks at ports, or along roads and other facilities of the infrastructure, especially when several projects are being carried out at one time in one place.

2. Weak links between planning and management

It sometimes happens that plans are made by a central planning body that fails to co-ordinate with the operating management of the economy, and the reverse can happen as well—that is, the policies and programmes of the operating establishments may bear no relation to the industrial plans formulated from above. Often the national central bank adopts one kind of investment policy while the Ministry of Industry proceeds with its own kind. In countries with systems for licensing private sector activities, the licenses may not always be awarded in strict conformity with the industrial plans. In other cases, the plans have very little chance of being carried out because the decision-makers at the top do not have the authority (or do not exercise it) to issue binding directives or because disruptive *ad hoc* decisions are being made at all levels of the hierarchy.

3. Impact of unfavourable conditions

For most developing countries, a healthy agricultural sector and a favourable foreign trade balance are crucial for economic development; unfortunately, however, it is precisely these two sectors over which the countries have practically no control. Thus, a plan for industrial development, even if it is neatly constructed and perfectly administered, can be defeated by unforeseen events such as floods or a drought, or a sudden drop in demand for goods being exported to the world market.

Conclusions

For many years, it was thought that the key element in industrial planning in developing countries was a well-prepared, consistent plan. However, as more and more good plans failed to be realized, it

became clear that implementation was an equally important element.

Difficulties with plan implementation can for the most part be attributed to three factors: (a) separation of plan preparation from plan implementation; (b) weak links between planning and management; and (c) pressure of unfavourable conditions on the internal or external markets.

C. Time-frames and institutional set-ups for industrial planning

1. Time-frames

In theory, an industrial plan can be of any duration. However, since it is an integral part of national economic planning, it should cover the same period as the plans for the whole economy. Most countries prepare three types of plans, annual, medium-term and long-term, with different time horizons to suit their different functions.

A medium-term plan is one that runs for four to six years, with five-year plans the most popular (experience shows that this period is short enough to permit reasonably accurate projections). Medium-term plans, which contain more details than either annual or long-term plans, constitute the principal form of industrial planning. They determine the major directions, objectives and tasks of industrial development as well as its dynamics.

Since a medium-term plan is the core of the entire planning process, there must be continuity between it and its annual and long-term counterparts. In fact, a medium-term plan is the necessary first step of a long-term plan. This means that the same methodology must be used for all these plans and that the content of their major sub-sectors must be unified. Medium-term plans should serve to specify and correct long-term plans; and annual plans, in turn, should serve to correct and adjust medium-term plans.

Some developing countries work instead with short-term plans covering two or three years. This shorter time-frame may be resorted to in two situations: *(a)* markedly unstable economic conditions due to a major political or economic development and *(b)* lack of statistical data in the early stages of planning. It is not, however, normally desirable. Short-term plans are too short to permit reasonably accurate projections or to embody long-range goals, and their role in influencing industrial development is limited since they do not last long enough to mobilize resources or bring about basic structural changes.

Because short-term plans are not very effective, a country that has no medium- or long-term plans must make serious efforts to shift to a longer- range outlook.

Experience shows that long-term plans are important for two reasons. First, they envisage qualitative changes in the industrial sector, giving perspective to the medium-term plan. Second, a number of projects cannot be fixed into medium-term plans because their gestation periods are too long.

Long-term plans have fewer targets and contain fewer details than medium-term plans. Their targets are only approximations, although they must be accurate enough to indicate priorities and to enable planning authorities to focus their medium-term plans on the sub-sectors with the best potential. Long-term

plans can also predict well in advance what kinds of studies will be needed before specific projects can be formulated and can warn of shortages that might become serious bottlenecks.

A few developing countries adopted very-long-term plans at the start of their planning experience, but because of the high level of uncertainty attached to projections so far ahead, almost all of these plans turned out to be inaccurate in their later years. The countries then started to look ahead 10-15 years, rather than 20-30 years. In fact, a period of 10-15 years is now widely accepted as the appropriate time-frame for long-term plans in developing countries. One caveat: it is not advisable to develop a long-term industrial plan if long-term plans for the country as a whole cannot be prepared, for it is these overall national plans that provide the crucial forecasts of population, national income, savings, public consumption and investment.

Because medium-term plans specify investments for the entire plan period and set targets to be achieved by the end of the plan period, they cannot be used as programmes of action for the intermediate years. This function should be performed by annual plans, which detail exactly what must be done to convert existing medium-term plans into programmes of action. However, because they lack experience and the necessary statistical base, few developing countries prepare annual plans. They rely instead on State budgets, which determine the main investment allocations, but these budget documents are not adequate substitutes for annual plans.

Long-term, medium-term and annual plans are not separate exercises. They are, essentially, different steps of the same planning process, and all must be carried out at each level, national, sectoral and sub-sectoral, of the planning hierarchy.

A medium-term plan becomes a rolling plan if it is revised at the end of each year as the first year of the plan is dropped. At this point, the planner makes new estimates, sets new targets and adds new projects to the last year of the plan. Thus, a five-year plan for the period t_0 through t_5 is revised at the end of the year t_0 and a new detailed medium-term plan is issued for the period t_1 through t_6. A similar procedure is followed at the end of each ensuing year: the plan is renewed, and the total number of years, five, remains the same.

Developing countries that have tried rolling plans have found them to be a difficult and unnecessary exercise. A much better way of updating a medium-term plan and making it operational is through annual plans. This does not mean, of course, that long-term and medium-term plans should be reissued yearly in the same way as rolling plans. Instead, the projections in the medium-term and long-term plans can be adjusted to take account of revisions in the annual plans, so that there are always targets for several years ahead.

Conclusions

To function well, the industrial planning process requires three types of plans: annual, medium-term and long-term. These plans must ensure continuity and must be unified in respect of content and methodology.

The differences in the time-frames of these plans are related to their functions. Medium-term plans are the core of industrial

planning. Long-term plans afford an overall perspective and allow the formulation of an industrialization strategy. Annual plans serve as programmes of action for medium-term plans.

2. *Planning machinery*

Since planning efforts are generally co-ordinated through an annual budget, the budget office, usually at the Ministry of Finance, becomes the point from which industrial development is monitored, at least during the initial stages of a country's development. However, practically all countries eventually establish a separate, relatively autonomous central planning authority.[10]

Central planning body. The experience of many developing countries shows that the establishment of a central planning body does not in itself substantially alter the existing pattern of fund allocation nor does it significantly improve the efficiency of plan implementation. The mere grafting of such a body onto an existing administrative apparatus without a concomitant reorganization of the overall apparatus cannot transform the planning process. The functions of a central planning body must be clearly spelled out. If they are not, the body will be weak. When there is more than one planning authority in a country, the situation can become complicated, because many overlaps and rivalries can arise.

Importance of strong central authority. The targets set in industrial plans must be attained as scheduled if economic growth is to be sustained. Good public management of the plan and compliance with its directives will ensure that they are. If the authority and leadership of the central planning body are weak, even properly prepared plans cannot be implemented. In such cases, competing interest groups may rearrange priorities or ignore prior decisions. This cannot happen where the central planning body has well-defined and generally accepted authority to oversee and guide the executing institutions or where, alternatively, there exist well-defined mechanisms for sharing the responsibilities of plan implementation. While compliance can be demanded of the public agencies that are under government control, it would be unrealistic to impose directives on those sectors of the economy that cannot be controlled. These sectors must be influenced instead by regulations, incentives and sanctions.

Industry planning bodies. The setting-up of a central planning body is a desirable first step, but it does not necessarily mean that the planning process is under way. Planning cannot be left to a single organization but must involve the whole array of operating organizations as well as the labour force. Every unit of the public industrial sector, as well as representatives of the private industrial sector, should be mobilized to help with planning and should be assigned tasks within their areas of competence. The planning functions should ideally be distributed among those parties according to the structure of the industrial sector. To do this, special planning bodies must be set up in the

[10]These Guidelines refer to a country's planning authority as the central planning body, although in practice such a body goes by many names, for instance, Ministry of Planning or planning commission.

government departments and public sector organs at all levels of management (see figure IV):

Planning department (or departments) at the Ministry of Industry level;

Departments for planning the sub-sectors, for example, the construction, chemicals, textiles and engineering industries;[11]

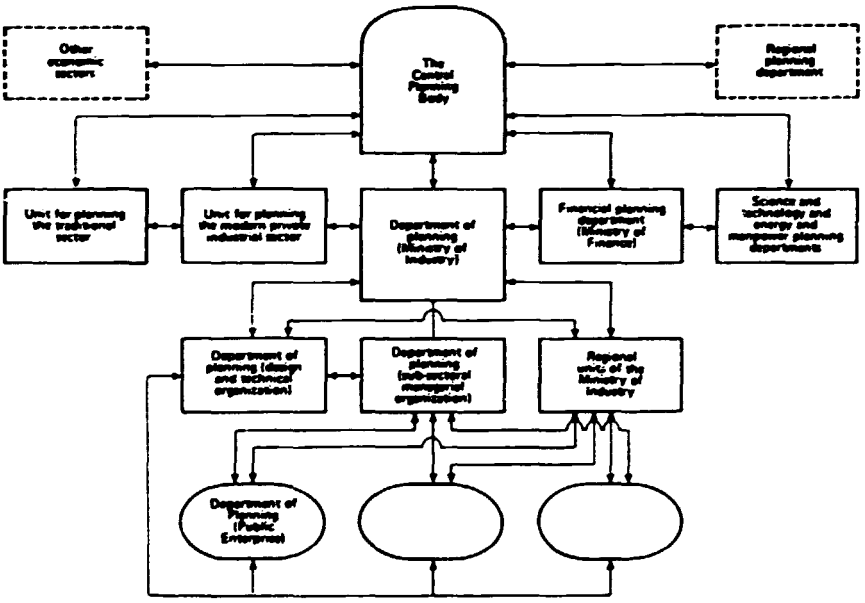
Planning departments for each public industrial enterprise;

Planning units to establish new projects;

Regional planning units;

Planning units for both the private modern sector and the private traditional sector at the country level;[12]

Figure IV. The appropriate organization of an institutional industrial planning system in developing countries



Industrial planning also requires inputs from bodies that specialize in manpower, finance, technology and energy. This exchange of information calls for close interaction between various government departments, financial institutions, R and D organizations and training institutions.

[11]For develoing countries where these sub-sectors have not yet been developed and there are few experienced planners, these and the following units can at first be included in the planning department of the Ministry of Industry. Then, as the industries develop, they can be set up as separate units.

[12]These units can be located in Chambers of Commerce and Industry, in associations for manufacturers, or in any other institution that is able to represent the interests of the private manufacturing sector.

3. *Functions of the various bodies*

For the planning machinery to function efficiently, an appropriate overall planning structure must be built up. This structure should be able to sustain a coherent, consistent and iterative planning process, from the highest to the lowest level and from the lowest to the highest.

Central planning bodies should be responsible for:

Formulating and revising long-term, medium-term and annual national plans;

Co-ordinating sectoral plans;

Preparing annual operational plans with which medium-term plans can be implemented;

Following up on plan implementation, including periodic evaluations of progress;

Recommending policies, instruments and other measures that can mobilize the financial, material and human resources needed to carry out the public sector portion of the plan;

Formulating ways of inducing the private sector to achieve targets in areas such as pricing, credit, and export/import policies;

Developing methodologies for planning that will promote the comprehensive organization of all planning activities and compliance therewith;

Increasing the awareness of policy-makers, engineers, administrative officials and the labour force, as well as informing the public about the plan's targets and any difficulties faced by the plan.

Industry planning bodies must be responsible for three functions in their respective fields of operation: formulating and revising the long-term, medium-term and annual plans; preparing an annual operational plan for implementing the medium-term plan; and implementing the plan and following it up.

The different industry planning bodies have different functions:

(a) Planning departments of public industrial enterprises are the basic industrial planning units in economies where the public sector is important. They plan most aspects of industrialization: production (output, costs and profit); investment and depreciation of fixed assets; the labour force and labour productivity; technology; economic utilization of inputs; social and infrastructural investments; and indicators for evaluating efficiency. They submit their plans to the sub-sectoral planning departments;

(b) Technical planning departments at the sectoral level tentatively select projects, choose the technology, integrate proposed new capacities with existing capacities and co-ordinate new projects with respect to markets, raw materials, location and similar factors. They also fit projects into long-term plans in respect of their outputs, inputs, manpower needs and investment requirements. When it is a matter of expanding existing production, the technical organizations work with the planning departments of the public enterprises and sub-sectoral economic managerial organizations;

(c) Planning departments of the sub-sectoral economic managerial organizations, in, for example, mechanical engineering, construction materials or

chemicals and petrochemicals, are responsible for preparing and implementing sub-sectoral plans. Not only must they co-ordinate the plans of all the production units in their sub-sector, they must also co-ordinate the longer range aspects of their work with the work of planners in the public sector and planners in the private sector. Sub-sectoral plans are submitted to a Ministry of Industry, which prepares the overall industrial plan on the basis of these inputs;

(d) Planning units for the private traditional sector are set up, often within ministries of industry or planning, but also as separate entities, to integrate handicrafts and cottage industries into the overall industrialization process. The planning units of these organizations are responsible for disclosing the problems of the traditional sector, such as prices and availability of inputs or prices of competing local and foreign products; investigating the best ways for promoting production in the sector; co-ordinating plan preparation with the planning departments of the sub-sectoral economic managerial organizations; and fostering effective co-operation. They also disseminate information on legislation and policies covering traditional activities; they try to work out a system of relative prices and rural economic and social infrastructures that would improve the functioning of the traditional sector; and they explore possibilities of creating seasonal manufacturing jobs in agricultural regions;

(e) Planning entities for the private modern industrial sector, some of which function within the government and others of which function outside it, may play an important role in defining the potential of the sector and in identifying the constraints that impede its development. They monitor expansion possibilities for the private sector and negotiate with the Ministry of Industry and the central planning body to win the kinds of government policies that are needed to gain the participation of the private sector. The outcomes of these consultations are sometimes stated in position papers, which are submitted to the planning unit of the Ministry of Industry or to the central planning body;

(f) Regional planning units play a significant role in setting the regional balance of the entire economy. They are responsible for analysing two kinds of information: *(1)* the geographical distribution of population, mineral deposits, soil types, water and agricultural resources etc. and *(2)* social conditions, such as the degree of industrial concentration, specialization and co-ordination of goods production and services. As industrial co-ordinators in their respective regions, these units have considerable influence when it comes to choosing locations for new industrial projects. They are also influential in redistributing and restructuring industrial capacities, industrial inputs and development of infrastructure in accordance with the geographical distribution of labour and natural resources. The regional units also report on difficulties encountered in plan implementation.

4. The unity of planning and management

The unity of planning and management is the cornerstone of the planning process. It is the linkages between the central planning body and the various industrial planning bodies, from the Ministry of Industry on down, that allow for mobilizing the nation's economic agents and involving them in the planning process, from preparation through elaboration and follow-up. At the outset of the planning process, the industrial planner needs to explore ways of

strengthening these links. He may, for example, suggest setting up an advisory panel made up of the ministers or managers concerned, experience having shown that such a panel can be of great value to a central planning body.

5. Structure and content of industrial plans

Industrial plans should reflect the country's situation with respect to three factors:

Type of ownership, and the extent to which the government is able to control the relevant activities;

Division of labour within the industrial sector, and type of managerial system;

Regional distribution of the labour force and the natural and material resources targeted for utilization;

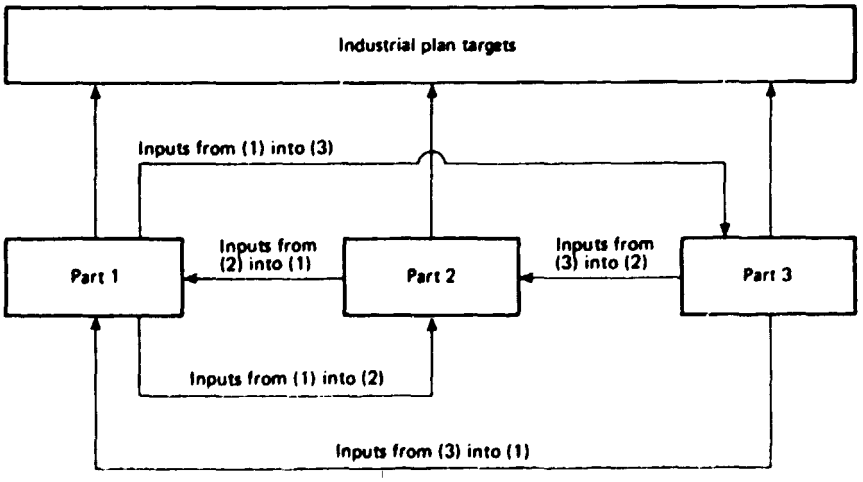
The first item, extent of control, is so important that it sometimes justifies dividing the overall plan into parts accordingly (figure V):

(a) The first part of the plan covers activities that are initiated and implemented mainly by the government. These usually include public sector enterprises and those industries that are considered to be crucial to self-sustained industrialization or to the national interest. Here, it is the government that must justify economic viability, negotiate investment conditions and install suitable managerial and operational systems;

(b) The second part of the plan covers industrial activities where ownership and responsibility for performance are shared between government and the private sector. The plan should spell out how these activities can contribute to its objectives;

(c) The third part of the plan covers the private industrial sector, both modern and traditional. The plan should offer incentives for these sectors to meet its targets.

Figure V. Interdependency of the public and private sectors in the setting of plan targets

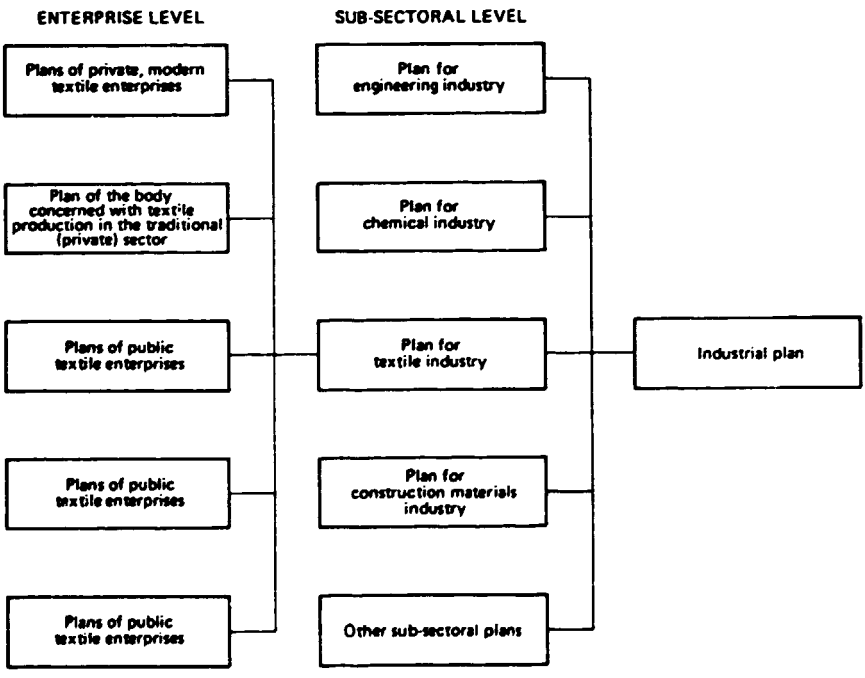


The relative weights of the three parts of the plan will vary from country to country. Where the public sector is dominant, the plan's first part will weigh more; conversely, where a government cannot control all the activities in its public sector or where that sector is small, the third part of the plan will weigh more.

To ensure that plan targets are fulfilled, there must be effective linkages between all three kinds of enterprises, public, semi-public and private. The part of the plan that spells out strategies, policies and instruments must clarify these linkages, and it must promote consistency and mutuality of action.

Alternatively, an industrial plan may be divided by sub-sector (figure VI)—for example, construction materials or textiles. These sub-sectors can then be categorized according to ownership type as public, semi-public or private. Yet another way of dividing an industrial plan, by region, will ensure the rational distribution of manpower and materials and will avert bottlenecks in infrastructure and support services. Disaggregating the planning in this way guarantees that at every individual enterprise, managers, administrators and labour will all be taking part.

Figure VI. Typical disposition of sub-sectors and enterprises in an industrial plan

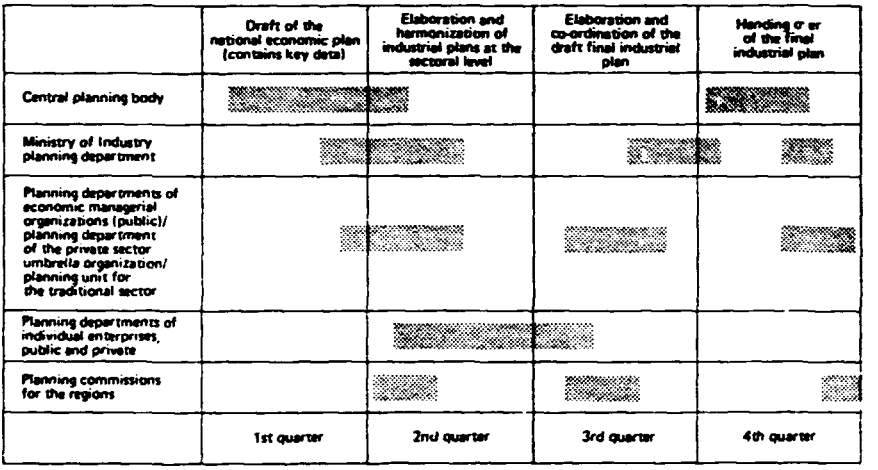


These joint efforts to find the best solutions, for industrialization in general and for each sub-sector or enterprise, can greatly improve the quality of the overall industrial plan. They must be carefully orchestrated, however, if the plan is to be coherent.

6. *The course of planning*

An industrial plan's course of action must be designed to ensure a logical sequence of events and an interlocking of the different steps (figure VII). One way of proceeding would be as described in the next five paragraphs:

Figure VII. Sample timetable for a country's annual economic plan



The central planning body prepares the first draft of a national economic plan on the basis of past experience and in accordance with various macro-economic aggregates, such as growth of gross domestic product (GDP) and population and distribution of income between consumption and investment. The draft takes into account many kinds of information: analytical surveys of the existing production structures and capacities of the economic sectors, including the traditional sector; an assessment of natural resources, manpower and level of technology; a capacity review of infrastructure facilities and support services; an evaluation of policy measures, instruments and mechanisms; and an assessment of savings and investment rates, and export and import capacities. Next, the central planning body divides up the draft plan into economic sectors. The resulting sectoral plans, including, of course, the industrial plan, are further subdivided according to type of ownership or by sub-sector or region.

Once the above preparatory steps have been taken, industrial planning proper starts with the drawing up of plans for public enterprises by the planning departments of the sub-sectoral managerial organs. These plans, together with plans for the private industrial sectors, both modern and traditional, are co-ordinated within the planning department of the Ministry of Industry, which is responsible for finalizing sub-sectoral and sectoral master plans, as well as for instituting the policy measures and instruments required for their implementation.

An industrial plan involves both vertical and horizontal relationships. The vertical relationships are those between an individual enterprise, at the bottom, the economic managerial organ of the sub-sector, in the middle, and the Ministry of Industry, at the top. The horizontal relationships, which are those

between the public, semi-public and private sectors, need harmonization at all levels of the vertical hierarchy, including the planning departments of the economic managerial organs and their counterparts in the other sectors, for instance, agriculture. The integration of sectoral and regional plans and programmes into a single, coherent national plan is the best way of ensuring that industrialization is achieved within the allotted time.

Proceeding with the plan in this way facilitates the economy-wide mobilization of resources and factor inputs. Sectoral targets need to be revised from time to time due to the interdependency of the different activities. Repeating the computation of sectoral economic data at each stage reduces discrepancies and leads to more accurate results, from which plan targets are derived. This process of repeated, step-wise approximation is referred to in planning practice as the iterative process.

Sometimes the target of one enterprise turns out to be at odds with the target of another enterprise in the same sector or in another sector. This is why it is unwise to try to finalize all the targets of the plan in a single step or within a single planning body. Countries that have done a lot of planning find that they often refine their plans as they go along, making them more precise during each succeeding stage.

D. Public management of industrial plans

1. Follow-up of plan implementation

One of the most serious obstacles to industrialization in developing countries is the non-achievement or the uneven achievement of plan targets. Since these failures can unbalance development or stop it altogether, there must be a continuous monitoring of plan implementation. It is not enough to simply prepare plans and then implement them from time to time. There must be constant attention on the part of the planners and a systematic follow-up and analysis of the failures and successes.

In a developing country, responsibility for carrying out an industrial plan is usually decentralized at the sub-sectoral or enterprise level, under the guidance and supervision of the Ministry, or ministries, of Industry. Responsibility for evaluating a plan's progress, on the other hand, is usually centralized in the central planning body, which depends on accurate and timely progress reports for its evaluations.

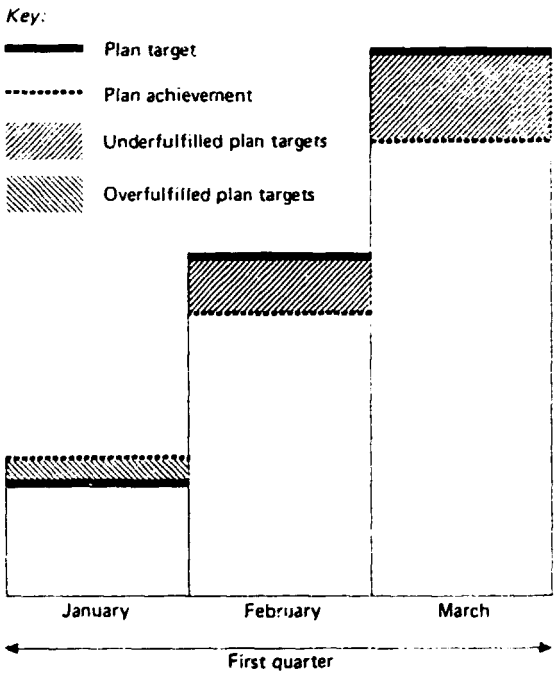
The establishment of new productive capacity calls for preparatory work at the sectoral level. The Ministry of Industry then monitors compliance with the schedule to detect delays and suggests timely corrective action. By way of contrast, increasing the production from existing enterprises is the responsibility of plant managers, who also monitor implementation and report on difficulties encountered. In the case of the private sector, the central planning body relies on a system of consultations as well as on regulations, penalties and incentives to make sure implementation stays on schedule.

Both kinds of enterprises, those in existence and those under construction, should be followed up. Since the latter are so crucial to the progress of developing countries, particularly in the initial stages of industrialization, special follow-up operations must be established in all the planning units. It is

important also that the capabilities of the construction industry be strengthened in order to shorten the gestation periods of projects and lower their costs.

So that planners and decision-makers can keep track of its implementation, a plan must clearly specify its targets and describe the responsibilities that are being assigned to the various levels of the planning hierarchy. The follow-up should be systematic and should compare planned and actual figures, taking care to examine the same indicators as were specified in the plan itself (figure VIII).

Figure VIII. Typical quarterly follow-up chart



A good reporting system will make it easier to follow up on implementation and avoid delays in execution. The reports must spot potential bottlenecks as early as possible and determine their causes; they must then evaluate the extent to which delays threaten the achievement of plan targets and recommend corrective measures. The system must allow the comparison of actual performance with planned performance, and to do this it must have the following features:

(a) Reports will be made at least quarterly; they will be standardized, simple and short, and targets will be expressed in physical and monetary units;

(b) Quarterly reports on the implementation of new projects will quantify the progress made, in physical and monetary terms, as well as describe the bottlenecks and constraints encountered;

(c) Quarterly reports on production targets in existing enterprises will include information on capacity utilization rates, the waste rates for materials and adherence to the cost plan;

(d) The central planning body will itself publish a quarterly report that synthesizes the inputs from the various industrial planning bodies, indicating potential bottlenecks and their causes and suggesting adjustments to the plan;

(e) The central planning body will also prepare a comprehensive report on the implementation of the medium-term plan, describing in detail the trends, problems and constraints that occurred during the period in question;

(f) Follow-up reports will be made public so as to mobilize public support for projects and participation in them.

2. Policy instruments for implementation

Because the socio-economic aspects of implementation are so complex, the planning authorities need to address them with policies some of which are general and other of which, specific. In the category of general policies there are several kinds of policies:

Policies intended to popularize the plan and to secure for it the active participation of the people involved;

Incentives and penalties set by the government to encourage implementation;

A price policy for the whole economy;

Policies on foreign trade, foreign exchange and foreign investment;

A credit policy;

Manpower policies that cover such matters as wages, training, conditions of labour, the status of women and related social concerns;

Technological development policies, which need to pay attention to protection of the environment.

Since all the specific policies listed below place demands on the State budget and have the potential to unbalance it, they must be ranked in order of priority:

(a) Policies for administrative institutions:

New institutions should be created or existing ones streamlined to speed up implementation of the plan;

The respective governmental bodies should be held responsible for fulfilling their own portions of the plan.

(b) Policies for the private sector, both modern and traditional, to ensure that activities of the private sector are in harmony with plan objectives. These might include licensing policies and incentive measures in connection with

credit policy; sectoral and sub-sectoral policies in the sense of orientation policies; policies on choice of technology, e.g. capital- vs. labour-intensive; contracts with the public sector; policies for domestic and foreign investment;

(c) Policy measures to upgrade socio-economic conditions in the traditional sector. These measures might include extension services; entrepreneurship development schemes; production and marketing co-operatives; training courses; guidance in product design and development;

(d) Policy measures to strengthen agriculture and increase its linkages with the industrial sector:

The establishment of storage, transport and marketing facilities for agricultural products;

The supply by industry of agricultural inputs such as fertilizers, pesticides and tools;

The encouragement of agricultural co-operatives;

The creation of opportunities for off-season employment in industry to complement and supplement agricultural activities and incomes;

The organization of extension services;

The creation of conditions conducive to overall socio-economic development.

Industrial policy can be executed through several instruments. The investment process can itself raise incomes and generate employment, but wage and fiscal policies may be needed to attain a balance-of-payments equilibrium, and taxation may be needed to attain income distribution goals. Tariffs, controls and multiple exchange rates may be used to expand and protect domestic industry. The level of tariff protection may vary from industry to industry, depending on the degree of self-sufficiency a country wishes to attain, the size of its domestic market and the availability of natural resources. Administrative controls, which comprise such instruments as investment licenses, import licenses and foreign exchange permits, are used where market prices cannot be relied upon to efficiently allocate resources.

The planner needs to analyse the effects of these policy instruments on income distribution, employment, the rate of savings, imports and exports and the balance of payments. Some experts argue that promotional measures, such as incentives, export subsidies and multiple exchange rates, are superior to protective measures, such as restrictions on the import of competing goods or tax holidays. Gross differences in foreign exchange savings, per unit of domestic investment, between import-substitution activities and export-producing activities may convey the impression that considerations of comparative advantage are being neglected, but this can be refuted by showing that there are substantial external economies, that domestic resource inputs have low social cost or that the activity in question is an infant industry that will grow to robust maturity.

The trade-offs between protective measures and promotional measures are well-documented in economic literature. The choice between them, and the extent to which each should be applied, has to be determined in the course of preparing the plan. Developing countries have, over the course of time, applied various policy instruments with varying degrees of success, and they have learned from their experiences. However, each country faces its own set of problems and its own potential for resolving them, depending on its size, its

stage of industrialization and its mix of inward- and outward-looking industrial policies. This aspect of the problem is discussed in chapter IV of these Guidelines. What needs to be underlined here is that the planner, as he is drawing up the plan, should choose the instruments to be used to attain the plan's goals, and he should do this by evaluating the instruments that were used in the past and assessing their potential for success in the future.

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III. Strategy options in industrial planning

Industrial development strategies, which express long-range, qualitative goals and directions, constitute the overall framework within which industrialization must take place. If they are not clearly defined and explicitly stated, it will be difficult or impossible to formulate and implement the shorter range working plans. However, there is no single set of strategies applicable for all developing countries, primarily because their stages of development, per capita incomes, economic structures, populations and natural resources are so diverse. Each country will have to adopt its own strategy based on its priorities and will have to decide for itself what it can achieve both short-term and long-term. Strategy options will vary greatly, depending on the level of industrialization a country has already attained, its natural resources and factor inputs, and its potential for mobilizing external technological and financial resources to supplement its own efforts.

Generally speaking, developing countries can be placed in one of the following categories:

(a) Countries that have sizeable internal markets and that have already industrialized to some extent on the strength of those markets, of which Brazil and India are examples;

(b) Countries that are, despite their limited internal markets, highly export-oriented in manufactured goods, of which Singapore and the Republic of Korea are examples;

(c) Countries that manufacture intermediate goods from their agricultural or mineral production, of which Ghana, Côte d'Ivoire and Paraguay are examples;

(d) Least developed countries (LDCs), whose main productive activity is agriculture.

Group *(a)* consists of countries that have already succeeded in replacing many imports and are now at the point where they are able to export manufactured goods and, at the same time, expand their import substitution programme by producing some capital goods. Group *(b)* consists of countries that, although they never emphasized import substitution, have begun to export, mainly to the developed countries; they rely on their cheap labour and are very dependent on foreign sources for the inputs and equipment they need for their manufacturing activities. Group *(c)* comprises countries that have started up large-scale industrial production based on their natural resources but that have yet to diversify their industrial bases. Group *(d)* consists of countries with meagre natural resources and lacking many of the entrepreneurial, technological and infrastructural prerequisites for industrialization.

The planners in each country must choose an appropriate set of strategies and must also readjust these strategies from one industrial plan to the next. In discussing the individual strategies, some of the characteristics that make them suitable in different kinds of developing countries will be pointed out.

A. Basic industries strategy

To ensure sustained industrial growth in developing countries, basic industries should be given priority because they give rise to backward and forward linkages in domestic production.

A basic industries strategy presupposes a highly integrated pattern of markets, raw materials and infrastructures. These requisites may already be in place, as they are in group *(a)* countries, or they may be created artificially by a group of countries acting on a regional basis or entering into a multinational co-operative arrangement. The strategy must identify the sub-sectors in which a country wishes to develop its own capacities, specify priorities and core projects and describe the skills and technologies that will be needed.

The basic industries strategy approach does not aim at complete self-sufficiency. It is not necessary, nor is it in most cases possible, to create, overnight, an industrial base that would allow for completely self-reliant development. Instead, policy-makers and planners choose this strategy because it will lead to the optimal utilization of natural resources and the interlinked production of capital, intermediate and consumer goods. The plan must identify that share of demand which the country intends to meet through imports and that share which it intends to meet through domestic production. Self-reliant and self-sustaining growth requires built-in mechanisms that restructure the economy so as to increase industrial production capacity and strengthen intersectoral relations.

The strategic objectives to which the planner has to address himself include the following:

(a) Total mastery of the technology of producer goods, such as machine tools and heavy power-generation equipment; of capital goods for the consumer and intermediate goods industries; and of common facilities, e.g. transport and utilities, equipment;

(b) The development of a capital goods industry, perhaps in co-operation with other developing countries, to enhance the country's long-term development prospects, with a view to fostering specialization, complementarity and trade;

(c) The harnessing of the entire national industrial potential to supply agriculture with pesticides, fertilizers and heavy and light farm machinery at reasonable prices. Wherever possible, the heavy agricultural equipment should be designed expressly to function under local conditions. The construction and transport sectors must also be provided with the inputs and equipment they require;

(d) The enhancement of the domestic capacity to provide the essentials of education, health and housing;

(e) The export of consumer products with a high value-added content and of industrial intermediates and equipment to both developed and developing countries.

A planner must gauge the size of the market before setting up a basic industries strategy; indeed, size matters far more in the case of capital and intermediate goods industries than it does in the case of consumer goods and agro-based industries. The size constraint means that developing countries with large populations and markets are more able to set up basic industries than developing countries with small populations and markets.[13]

By investigating the following, planners in small developing countries can judge whether a particular basic industry is feasible:

(a) The minimum economic size of production of the different basic industries and their component stages of production, given the country's particular circumstances. For example, small re-rolling mills for the main steel products have been found to be economically justifiable in many smaller developing countries;

(b) The possibility of acquiring small, efficient units for basic industries (steel mills are an example), as well as the possibility of manufacturing products that require less capital-intensive methods and that can be made in smaller quantities. One example of the latter possibility is brick, tile and lime kilns, which are generally small, dispersed, low in capital cost, fueled by oil, wood, peat or coal, whichever is available and economical, and serve a relatively limited market radius. Other examples are light engineering workshops for rural areas and small mechanical engineering units to carry out metal-work repairs and to produce certain spares and simple products. For developing countries that are islands, marine repairs are of importance;

(c) The possibilities for regional or sub-regional co-operation among developing countries, some of which do not have the resources to establish such industries on their own, and others of which do not have large enough markets. By pooling resources and establishing multinational industries that benefit from economies of scale, they would overcome these constraints on their industrial development and would achieve, collectively, self-reliance and self-sustained industrialization.

B. Import substitution strategy

Industrial growth, particularly in the initial stages of industrialization, is in most developing countries closely linked with import substitution, i.e., with producing articles domestically instead of importing them. In this sense, the import-substitution strategy overlaps the basic industries strategy, which is also to some extent a substitution of capital and intermediate goods that had once been imported.

Countries have been emphasizing this strategy for a number of reasons: First, many of them already have large internal markets. Secondly, new

[13] We may define small developing countries as those with populations of up to one million and of low per capita income; and smallish as those with populations between one and ten million, as well as those with populations of less than one million, but of relatively high per capita income.

industrial undertakings possess a substantial built-in edge as a result of the high costs of overseas freight, insurance and other expenses related to the import of finished products. Thirdly, if the intermediates can be produced locally, import substitution will reduce the continuous outflow of foreign exchange. Above all, the strategy is pursued for the invaluable opportunity it offers to learn by doing, and it is this benefit that is often used to justify tariffs to protect an infant industry.

The import-substitution strategy has its drawbacks, however. First, it can distort consumption and production patterns, leading to the inappropriate allocation of scarce resources; if this happens, the costs of import substitution might outweigh its benefits. Secondly, it could lead to technological dependence, particularly where the import substitutes are of the final processing type. If semi-processed intermediates or components of relatively high value still have to be imported, the value-added in the country is small and may even be negative at world prices. This problem is more pronounced in the LDCs, where the intermediates cannot be manufactured domestically because the markets are small or because the parent company insists on adherence to predetermined quality specifications. Importing the intermediate rather than the final product creates backward linkages with suppliers abroad and can take away the freedom to purchase the final product from more than one source, which tends to perpetuate dependency.[14] Thirdly, the import-substitution strategy can lead to an industrial structure that pre-empts domestic and foreign exchange resources even if the resulting economic costs outweigh the benefits.

The planner faces difficult decisions. He must satisfy himself that manufacturing a particular product domestically will indeed contribute to plan objectives in terms of: *(a)* net benefits for the national economy; *(b)* efficient allocation of scarce investment resources; *(c)* net saving of foreign exchange over the lifetime of the project; and *(d)* potential for the acquisition of technology and prospects for an expanding circle of markets, incomes and re-investment.

These concerns point to the need for closely scrutinizing each import substitution project before including it in the investment programme. Project screening and evaluation should be an integral part of the planning process to ensure that commercial and economic profitability criteria are met. If they are not met, at least in the short-term, other justifications for the project should be articulated: learning-by-doing, merit, need, job creation or income distribution, for example. Even then, the planner should be able to project that in the long-run the economic benefits will outweigh the costs.

C. Export promotion strategy

The export promotion approach is a universally popular means of alleviating foreign exchange constraints on industrialization. As a country industrializes, its foreign exchange gap widens because it imports more and more industrial raw materials and producer and intermediate goods. Since commodity exports cannot by themselves earn enough foreign exchange to

[14] For further details, see the annex to this chapter (shifting from import of final products to their intermediates).

sustain growth and industrialization, the export of manufactured products is a favoured solution and has many advantages, among them the opportunity for developing countries to expand their manufacturing capacities.

Besides considerably increasing the amount of value-added, the partial or complete processing of raw materials into semi-finished or finished industrial products also results in greater employment opportunities. More or less industrialized countries, such as those in group *(b)*,[15] need to aim for better integration within their export-oriented industrial sectors, such as textiles and electronics, so that they become able to produce their own industrial inputs and capital goods.

The question of which groups of products to manufacture for export calls for in-depth analysis and evaluation. In conducting the analysis, adjustments have to be made: for instance, for subsidies in the form of remission of import duties and concessional prices for infrastructural services and for transfer burdens that the export sector carries if it cannot fully recoup the investment of capital goods, including import duties. Moreover, the industrial planner should reckon with a number of problems that are likely to arise when additional production capacity for exports is brought on stream:

(a) If the non-renewable mineral resources necessary for processing commodities for export are exploited too intensively, they could be depleted;

(b) The export of processed agricultural products might create food shortages at home;

(c) The benefits of exporting manufactured products could be offset by the foreign exchange outlays for technology, machinery and equipment and spare parts, as well as for the import of intermediate, semi-processed products and foreign skills;

(d) With international markets as volatile as they are, penetration can easily slip, idling new capacity and adding to cost burdens;

(e) Protectionism in developed countries may erode the advantages of building up extra capacity for export.

Co-operation among the developing countries in the form of bilateral, trilateral or multilateral agreements could play an invaluable role in building up exports. For example, one country, having rich deposits of bauxite, could produce alumina; another country, having a surplus of energy resources, could convert the alumina into aluminium; and a third country, having a developed metal-working and engineering industry, could fabricate the aluminium into end products. This type of co-operation would allow setting up large-scale plants to take advantage of economies of scale and of natural resources.

D. Resource utilization strategy

Whether it is pursued in the context of import-substitution or export-promotion, resource-based industrialization can make it possible to strengthen a country's inter-sectoral and inter-industry linkages. Resource-based core

[15] See p. 39.

industries[18] can help to achieve self-reliance and self-sustaining growth in particular agro-based industries, and are consistent with the needs of developing countries. Indeed, they must be given priority over industries producing consumer goods and intermediate goods, because they can meet the most basic needs of the population. They can have a significant impact on the pace and pattern of economic growth and industrial development, particularly in least-developed, land-locked and island countries.

The planner should define the conditions under which resource-based industrialization would best contribute to plan objectives. Since to do so he will need good information, the country must first survey its industrial resource base, which comprises minerals; agriculture and forest products, including biomass; livestock, including cattle, sheep, fish and poultry; inland water and ocean resources; and renewable and non-renewable energy resources.

Secondly, in order to apply industrial production to those resources that are most abundant in a country, it is important that planners look carefully at not only the proposed products, but also their design and the inputs required for their production. Textiles are a case in point: they can be produced by different technologies, ranging from hand looms to highly automated looms; they can also be produced in different forms and from different materials, such as natural or artificial fibres.

Countless possibilities exist for mutual substitution, not only with respect to the inputs necessary to produce a certain commodity but also with respect to the commodities themselves. The technological revolution has dramatically increased the number of possible inputs and commodities: for example, wheat or rice straw can be used to make paper, particularly where timber is scarce and must be imported; similarly, bagasse can be used as a fuel for making bricks and other construction materials. Another example is the use of naphtha or associated gas, rather than imported coal, to make sponge iron.

Thirdly, the planner should link as many industrial capacities as possible to the raw materials that are abundant. For example, in a country rich in timber, the planner must encourage its use to produce construction materials, furniture, paper and as many other commodities as possible. Likewise, energy-intensive industries, such as iron, steel and aluminium production, as well as other metallurgical industries, may be justifiable in a country where large volumes of electrical power can be generated from existing hydro-power plants.

A resource utilization strategy is just as valid for developing countries that dispose of only a few industrial raw materials; there are even cases where new industrial capacity has been created using imported raw materials. The planner should, however, make sure that the value-added by domestic manufacture will form a relatively high proportion of the gross value of the output, and that enough of the output can be exported to pay the bill for imported materials. Here again, the pooling of resources among developing countries and the establishment of multinational industrial capacities can be the key to success.

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[18]Resource-based core industries are defined as industries using domestically available resources. They constitute a nucleus providing basic inputs into industry and other priority sectors and/or producing goods and services to meet basic needs. See "The Industrial Development Decade for Africa: review of progress and proposals on ways and means to attain its objectives", Background paper for the Fourth General Conference of UNIDO, Vienna, 2-18 August 1984 (ID/CONF/5/25), p. 12.

E. Strategy for choosing a technology

One of the crucial problems in planning industrialization is deciding on the appropriate technology. Here the planner must deal with a number of connected issues, such as the mobilization of resources, especially surplus labour; the priority to be assigned to different industries or sectors; their relative rates of growth during particular periods; and the choice between labour-intensive and capital-intensive types of production.

Labour-intensive vs. capital-intensive. Labour-intensive technology is characterized by a relatively low capital-labour ratio K/L,[17] which means that it will offer more employment opportunities for a given amount of investment than will capital-intensive technology. Labour-intensive technology is often favoured because it immediately maximizes employment. Thus, for instance, instead of buying a small number of expensive mechanical looms, this strategy would consider it preferable, from the point of view of employing many people at an early stage, to buy a large number of less expensive hand looms. This logic can be deceptive, however, for, as we shall see later, output and employment can also grow on the basis of capital-intensive technology.[18] The appeal of labour-intensive enterprises such as handicraft and cottage industries lies mainly in the fact that they can satisfy part of the need for consumer goods on the basis of local raw materials and simple production tools that are also made, by and large, by hand, locally.

Capital-intensive technology is characterized by highly productive, up-to-date machinery and equipment, and a relatively large capital outlay is needed to equip one workplace (high capital-labour ratio K/L); compared to labour-intensive technology, it is characterized by a high output-capital ratio Y/K and a high output-labour ratio Y/L. Modern technology always achieves a higher output per machine, per worker and per unit time than traditional technology. When production technology is modernized, the volume of output does not vary in linear proportion to the cost of the machinery—it increases faster. For example, while the materials and labour needed to produce a modern lathe do not differ greatly from those needed to produce an old-fashioned lathe, except for the electronic accessories, the output of the modern lathe, especially if it is semi-automated or fully automated, can be a hundred times greater.

Thus, a capital-intensive process always uses less labour, and often even less capital per unit of output, than a labour-intensive process. This means that it is possible to get more output with the same amount of investment, fewer production units and far fewer workers, and it explains why the capital-labour ratio tends to increase as a result of technological improvements, in accordance with the economic law of concentration of production and capital.

Labour-intensive technology is applicable mainly in consumer goods industries. Most basic industries require the use of machinery and equipment such as lathes, forging machines, furnaces and cranes. Iron, steel and petrochemicals

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[17] See annex to this chapter.

[18] The problem of employment in connection with the choice of technology should not be regarded solely within the context of direct productive activity, for employment usually grows much faster within the industrial and social services that are built around industry. In some countries the ratio of the labour force in such services to that in direct production is 8:1. What really matters here is the replacement of capital by labour due to the scarcity of capital in the initial stages of industrialization. This problem will be elaborated as the discussion proceeds.

cannot be produced by labour-intensive methods; mechanical engineering requires at least some mechanization to ensure minimum quality. Nevertheless, some commodities, for example, building materials such as bricks and lime, can still be made by labour-intensive methods.

The fact that labour-intensive technology is applied primarily to the consumer goods industries would seem to imply that such industries are preferable because they encourage consumption and inhibit investment. In the long run, however, this slows the increase of output and hinders the establishment of the basic industries that are needed for self-reliant and self-sustaining growth. If, instead, basic industries are chosen, the supply of capital goods will grow faster, leading to a higher investment ratio, and the greater stock of physical capital can be used to put more people to work. Eventually, therefore, capital-intensive technology maximizes both output and employment.[19]

For each developing country there is, in line with the country's economic indicators and its stage of development, an optimal set of technologies to produce an appropriate array of products. These technologies will combine the country's resources—its labour force, its financial means, particularly foreign exchange, and its natural resources—in the best possible way. In making this choice of technology, a planner must also take into account other factors, such as the size of the market, and he will want to consider introducing technological innovations that improve the efficiency of production with relatively small capital outlays.

The latter consideration, technological innovations, can be pivotal for agro-based industries. For example, the introduction of emerging knowledge in biotechnology and genetic engineering can sharply improve the productivity of labour and capital. It is very important from the point of view of dynamics that the new technology increase the productivity of labour and capital. Developing countries that want to expand employment should think carefully before they opt for labour-intensive technology. Any labour-intensive technology that does not generate surplus revenues cannot be recommended in the long run except, maybe, in the case of a particular region, since it is only from surplus revenues that new investments can come; if there is no surplus, the economy will stagnate.

Issues influencing the choice of technology. The proportion of capital-intensive to labour-intensive capacities will vary, of course, from country to country. In developing countries with very high per capita incomes, such as small OPEC countries, and where the national incomes far exceed the countries' current and future requirements, there is obviously no place for labour-intensive technology. However, in developing countries with very low per capita incomes, large surpluses of labour and well-established traditional sectors that make consumer goods, the planner might want to think along the following lines:

(a) In the early stages of industrialization, capital-intensive technology should be introduced mainly in the basic and capital goods industries. Any surpluses in foreign exchange or financial assistance from abroad should be channelled to the sub-sectors that can expand the domestic stock of physical capital;

[19] See discussion on the choice of technology in the annex to this chapter.

(b) The traditional sector, which is labour-intensive, can continue to play its time-honoured role in the economy, but it should be made more efficient. Research institutions and information services at the national and regional levels would probably be a good way of encouraging research and development;

(c) Consumer goods should insofar as possible be made by labour-intensive processes. Consumers should be persuaded to choose goods whose manufacture maximizes labour inputs. For example, instead of producing luxury consumer durables, such as automobiles, washing machines and air-conditioners, which call for capital-intensive processes, it may make more sense to produce simpler substitutes, such as bicycles, laundry machines and fans and coolers, the assembly of which is less capital-intensive;

(d) Some capital goods and intermediates can be made by less capital-intensive processes. In rural areas and even in some urban areas, lime, bricks and wood should be used instead of cement, and clay roof tiles should be used instead of galvanized iron or synthetic materials;

(e) Another way of encouraging labour-intensive technology would be to focus, as some newly industrialized countries already do, on goods such as textiles and electronic equipment, whose competitiveness in world markets depends on high labour content.

For countries with surplus labour in industries where there is no choice but to use capital-intensive technology, particularly basic industries, it is important to mitigate the adverse effects of such technology by "stretching" it so it provides the employment required. There are, in fact, always ways in which labour can be efficiently substituted for capital, even with a capital-intensive technology, and the planner must encourage engineers and technicians to explore these possibilities. For example, early on in Japan's industrialization, when wages were comparatively low, textile machinery was utilized to its utmost by running extra shifts. Certainly there were more frequent halts for repair, but since repair was itself a labour-intensive activity, the overall effect was a greater use of labour and a more efficient use of all resources.

Thus, even where mechanization is necessary, double and triple shifts can greatly decrease the overall capital-labour ratio. It should be pointed out, however, that stretching capital-intensive technology requires a good maintenance and repair capability; otherwise, down-time costs will start to affect the benefits. Similar capital-stretching, labour-intensive techniques are being used in some South-East Asian countries for their textile, electronics and wood-working industries.

Considerable scope for maximizing the use of labour does in fact exist, if only the appropriate process or product mixes can be found, and it is the task of the planner to spread awareness among engineers and technicians to help them come up with ideas. Even where the main production processes are technically rigid, there are always peripheral processes, such as materials handling and packaging, that can be carried on efficiently with labour-intensive methods, so that, overall, some of the production can probably still tolerate greater labour-capital substitution. There are also a number of assembly operations where more labour could be introduced if the work were parcelled out on a sub-contracting or auxiliary basis, as proved feasible, for example, in the electronics industries of some labour-surplus countries.

Finally, the planner should bear in mind that there is an interrelationship between the production process and the product. As soon as an established process is modified, the product usually must be modified as well, making fine distinctions less critical and frequently lowering the general quality of the product. In this respect, the available potentials within a developing country should be considered. Some adaptations have been innovated in developing countries, and there are many cases of developing countries having altered machinery or processes brought from developed countries to suit their own local conditions.

Integration of technology planning and industrial planning. Most developing countries, particularly the least-developed, lack experience in technology planning, which is a vital component of the overall industrial planning process. The introduction of such planning is a complicated task calling for a number of organizational measures, some of which are outlined below:

(a) Integrating science and technology into the overall management and planning process necessitates the establishment of a central board for science and technology, to work with the central planning body. By harmonizing efforts, such a board would avert wasteful duplications in research and development. It would also encourage innovation in production methods and products;

(b) Research and development centres should be established at the larger industrial complexes, where they would serve to master, maintain, modify and, possibly, further develop or copy imported technology. These centres would also be charged with organizing the production of spare parts;

(c) Most developing countries face a shortage of spare parts for their industries, a situation that reflects the lack of domestic capital goods industries and dependence on scattered foreign sources of supply. One solution to this problem is to centralize the supply of spare parts; other solutions include more standardization of spare parts, the production of spare parts locally or changes in the design of production equipment.

The technological plan should be worked out in advance of the production plan, because the latter depends on the choice of technology, including the type of product to be manufactured and the appropriate inputs. The technological plan must address itself to standardization and spare parts. In countries with relatively diversified industrial raw materials, the plan must seek to gear output to these materials.

The planner should also explore, and then narrow down, the possibilities of acquiring and adapting industrial technology in joint efforts with other developing countries; these efforts could avert the increased dependence on external sources that often accompanies technological advances. Since developing countries share problems in information collection, forecasting, and technology assessment, selection and acquisition, as well as in the endogenous development and application of the new technologies, they should exchange experience in this field. Co-operation could even extend beyond this exchange of experience to the collective negotiation for and acquisition of technologies and the setting up of common production facilities, technological institutions and programmes. Equally important, developing countries may have to consider a collective strategy for their response to technological changes.

F. Economies-of-scale strategy

In industrialized countries, production has been concentrated in large-scale plants that use modern capital-intensive technology and that need a continuous supply of raw materials, energy and labour as well as vast markets. Large-scale plants dramatically increase the ratios of output-capital, capital-labour and output-labour because, with them, physical capital, labour, energy and raw materials increase more slowly than output. At the same time, their costs for design and civil engineering and for links with power and transport networks are often not much greater than those of smaller plants.

Indeed, physical capital does not vary in linear proportion to productive capacity. In the chemical, iron and steel, food processing and cement industries, among others, capital equipment is largely in the form of tanks, compressors, furnaces, gas holders and columns etc. When capacity is increased it is essentially a matter of enlarging the equipment. Here, the cost of the equipment is mainly a function of the surface area of the material needed to enclose a given volume of reactant or product, whereas output is a function of the volume. In other industries, such as metal-working, increasing the capacity means a quantum jump to equipment that is more specialized, more productive and more capital-intensive. Such specialized equipment cannot be used for small-scale production because of its higher output and its need for flexibility to produce a wider variety of products. However, when specialized equipment is introduced for large-scale production, the tempo of production increases faster than the cost of the equipment.[20]

Economies of scale may be achieved by de-bottlenecking of production equipment, resulting in balanced production lines. The economies of scale come not only in the main production units but also in auxiliary units, such as those that generate steam, and in repair shops and storage areas, as well as in the industrial infrastructure, for example, access roads, railroads, freight stations, ports, electric power installations and sewage systems.

It should be pointed out that, in calculating economies of scale, the planner must not fail to take into account the incremental costs that naturally arise as capacities increase, such as transport costs of raw materials and finished goods, for it is these which usually set upper limits to the scale of production.

There are three main problems in setting up large-scale plants in developing countries. First, large-scale production of a particular item presupposes an easily accessible and sufficiently large market for that item, and in a large number of developing countries, particularly the smaller ones, no such market exists.

Secondly, modern large-scale production can function properly only if there are allied sectors to provide power and the necessary intermediates, to process the by-products and to transport the output. Creating these facilities from scratch would radically increase the amount of capital for an enterprise, diverting it from other undertakings and impeding industrial diversification.

Thirdly, developing countries frequently fail to properly utilize production capacities in their modern industrial sectors because of shortages of skills, operational problems, deficiencies in the organization and management of production, insufficient inputs for industrial processing or insufficient demand

[20]See the discussion on the relationship between industrial capacity and production costs in the annex to this chapter.

for the final products. Enormous economic losses occur when capital-intensive industrial production facilities stand idle.

Planning for large-scale plants. To determine if economies of scale are practical, the planner must first analyse the markets for those products that are most economically produced in large-scale units, especially those products with strong forward linkages. If the markets warrant large-scale projects, it may make sense to invest in a few of these, or even in only one, instead of fragmenting investments among a large number of small-scale projects. Here the planner must take into account the external factors, such as transport costs of raw materials and finished goods: in some cases, for example, that of heavy products such as cement, transport costs attributable to a concentration of capacity at only a few sites could offset the economies of scale.

Since it may be preferable to build large-scale industries in stages to avoid imbalances and bottlenecks in respect of labour and physical and social infrastructure, as well as limitations in respect of diversification of production etc., it is important that the projects be designed so they can be implemented in stages by adding units and services horizontally and vertically to the main production and infrastructural assemblages. There are many possibilities here: for instance, downstream or upstream operations can be added one at a time. This commonly happens at iron and steel complexes, where blast furnaces, steel-making furnaces, rolling mills, foundries, as well as various units for processing inputs and by-products, can be added on one by one according to a pre-set schedule.

Another way of benefiting from economies of scale is to group similar processes at a single site. If, for example, a country creates a complex to produce different kinds of electrical equipment, it can add new capacities to the complex in each medium-term plan to meet new demand. Such complexes must be planned carefully, and account should be taken of the non-productive investments that are needed, such as those for infrastructure, housing, social services and pollution control.

In planning large-scale industries in a developing country, the planner must determine the most appropriate technology. Developed countries normally apply highly sophisticated technologies for their own production and for capital goods to be exported. In many cases developing countries are not able to acquire these technologies or to master them, because they require specialized experience and highly skilled labour, as well as research and development institutions to provide technical, commercial, financial and scientific know-how.

Advanced technologies are usually patented and then offered to customers in the form of "closed packages", which are not only expensive but also conducive to dependency. They also, of course, entail expenses for maintenance, spare parts and intermediate products. Difficulties connected with mastering the technology can sometimes curtail the utilization of capacity. Developing countries would do well to think in terms of standardized methods of producing standardized products; these methods can be acquired from many different places in the world, including sometimes from other newly industrialized developing countries. Standardized technology is much easier to master, adapt and develop.

The planner must also take into account the training that is required to operate large-scale industries. For example, the future operators should be given on-the-job training during the stage of equipment installation and start-

up, although it is not always possible to do this at present: where the contracts for the supply of ultramodern technologies are on a turn-key basis, skilled labour and supplies are usually brought in from abroad.

G. Strategy for small-scale and cottage industries[21]

Small-scale and traditional industries can play a key part in the industrialization of developing countries. In the first place, each enterprise requires relatively little capital, which is important for countries with low rates of domestic savings. Small industries, set up by local entrepreneurs, provide an outlet for, at the same time as they benefit from, the locality's modest personal savings, which would otherwise be channelled into non-productive activities. Cottage industries, which need little or no foreign exchange, can supply a substantial portion of basic needs; they may also be able to manufacture intermediates for industry, relying on domestic rather than external resources and thereby saving foreign exchange.

In the second place, small-scale and cottage industries do not need large markets, so they can be easily introduced into smaller countries. Their production can, moreover, be geared to local raw materials, particularly agricultural raw materials. Indeed, small agro-based industries that process cereals, oils and fats, dairy products, fish, meat, fruit and vegetables and sugarcane and that make alcoholic and non-alcoholic beverages, directly improve the standard of living. Other agro-based industries produce intermediates such as cotton fibres, wool, hides and skins, wood and timber that also eventually satisfy consumer needs.

Lastly, unlike medium-scale and large-scale enterprises, small-scale and traditional enterprises do not depend heavily on public utilities, repair services, transport facilities, industrial buildings etc. Very small and traditional establishments generally provide their own mechanical, hand or generator power and so can be set up in many different places, including small towns and villages. This flexibility is critical, particularly in the least-developed countries. Locating small-scale and cottage industries, particularly agro-based industries, in rural areas would contribute to the social and economic development of the people there, who make up 50-70 per cent of the total population in most developing countries. It would also foster strong linkages with agriculture and could check the migration of labour from rural to urban areas. At the same time, it would of course generate income and employment in the rural sector.

In order to benefit from small-scale and cottage industries, the appropriate policies and measures must be in place. Not only must the industrial planner determine where the industries should be located to be most effective from the point of view of a country's overall development, but he must also deal with other matters:

(a) Linkages and mutually supportive relationships between modern, capital-intensive industries and traditional, small industries. It can happen that when capital-intensive technology is introduced, jobs are lost in small and cottage industries, particularly in the initial stages of development. In one African

[21] Small-scale industries are production units using capital-intensive technology. Traditional industries, such as cottage industries and handicrafts, use labour-intensive technology.

country, for example, the establishment of a shoe factory created 100 jobs but made 5,000 craftsmen redundant. Planners for the private traditional sector must therefore find niches for small-scale production within the modern sector, and they must co-ordinate their ideas with the plans of the modern sector. For example, in planning the supply of footwear, the part of demand that can be satisfied by the traditional sector must be estimated, with the rest being assigned to the modern sector;

(b) Apportionment of production between small-scale and large-scale enterprises. It is necessary to examine, at the sub-sectoral level, the economics of scaling down production that is normally carried out on a large scale. Even commodities that are conventionally thought of as basic products can sometimes be made in small-scale units. For example, the cement industry is at present promoting four sizes of plants, each of which can be economically viable under certain conditions: very large, 3,000 or more tonnes/day; standard, 2,000 tonnes/day; mini, 200 tonnes/day; and tiny, 20 tonnes/day.

Other kinds of production, particularly that of consumer goods, are in any case usually carried out on only a medium or small scale, owing to, say, storage and distribution costs or marketing considerations. Examples of scaling down can also be drawn from the mechanical engineering sector, where planners might decide on small-scale units for strategic products, even if they are uneconomic at the beginning. In weighing the pros and cons of a small-scale central forging unit, for instance, the planner must try to foresee the long-term benefits, direct and indirect: these might include the acquisition of skills, the encouragement and intensification of domestic processing, the enhancement of demand for forging, and the possibilities of expanding the unit, step-by-step, into a medium- or large-scale operation;

(c) Co-operation between small-scale and traditional industries and between these industries and the large-scale industries. It may be possible to arrange for small-scale and traditional industries to undertake special assignments for large-scale plants or enter into sub-contracting agreements with them. They could, for example, produce parts for automobiles, motors, televisions, bicycles and sewing machines, for subsequent assembly. It might also be possible for handicraft units to participate in similar schemes. The Government, however, would have to organize training to impart the necessary skills;

(d) Clustering of small industries at special industrial estates. Such estates would be connected with railroads and highways and would provide the industries with fresh water, electricity and steam from a central generating plant. They would have training centres for the trades practised at the site, as well as R and D facilities that could provide technical services; they would also have to have access to loans on concessionary terms. Such arrangements would allow small-scale and traditional industries to benefit from the same economies of scale with regard to infrastructure and services as large-scale industries, and they would induce industrial growth at selected decentralized locations.

Annex

INDICATORS FOR RESOURCE ALLOCATION

In the following we will introduce some indicators that can be used to examine the problems of resource allocation and industrial growth. With the help of these indicators, all of which are widely used in planning, it is possible to measure the dependence of manufacturing value-added on investment and on employment and to identify the types of products and inputs required. Some of these indicators can also be used to evaluate the economic effectiveness of individual projects.

The capital-output ratio K/Y, sometimes called the investment-output ratio, expresses the relationship, in a given year, between the value K of total capital used and the value Y of net output. It varies from industry to industry and it also changes over time, as a result, for instance, of technological advances. The capital output ratio for a country as a whole is the aggregate of the capital-output ratios for all of its industries, as well as for the other sectors of the economy, and one has always to remember that it may be higher or lower depending on which industries predominate in the country. The ratio is, moreover, affected by the intensity with which capital equipment is utilized. If some equipment is left standing idle or is used only intermittently, in other words, if there is excess capacity, the ratio will tend to be low.

The incremental capital-output ratio $I^n/\Delta Y$ expresses the relationship between net investment I^n, also called new investment, and the difference ΔY between the value of the output in a given year and the value of the output in the preceding year.

The capital-labour ratio K/L expresses the relationship between the value K of capital used and the number L of people employed.

The incremental capital-labour ratio $I^n/\Delta L$ expresses the relationship between net or new investment I^n and the difference ΔL between the number of people employed in a given year and the number employed in the preceding year.

The labour-output ratio L/Y expresses the relationship between the number L of people employed in a given year and the value Y of the net output in that year.

The input-output ratio W/Y expresses the value W of inputs needed to produce net output Y in one year. Reducing the inputs or increasing the net output will serve to reduce this ratio.

The reinvestment ratio I^n/K expresses the relationship between the net, or new, investment I^n and the total value K of capital used.

1. Shifting from the import of final products to the import of their intermediates

The impact of increased intermediate imports as a result of substituting the import of the final product may be demonstrated on the basis of the following equation:

$$X_i = MVA_i + W_i \qquad (3.1)$$

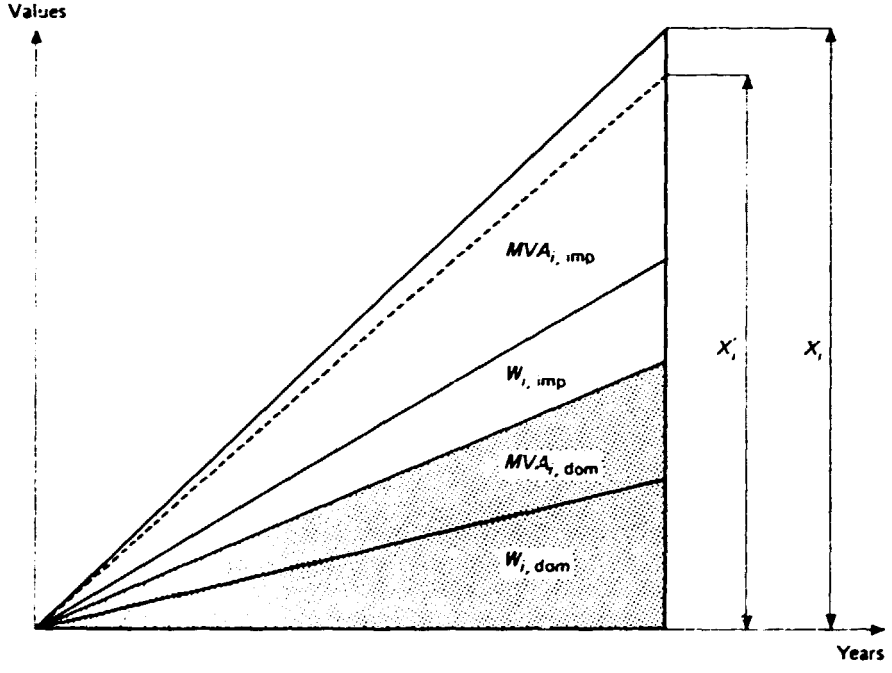
where X_i is the domestic value of the output of sub-sector i, MVA_i is the manufacturing value-added that originated in sub-sector i, and W_i is the value of intermediates consumption of sub-sector i. Part of the intermediate consumption, $W_{i,\text{imp}}$, is imported

and the rest, $W_{i,\text{dom}}$, is produced domestically. Since some of the manufacturing value-added originating in sub-sector i contains foreign exchange components, such as depreciation of imported machinery and wages for foreign skills, we again have value-added $MVA_{i,\text{dom}}$ coming from domestic sources and value-added $MVA_{i,\text{imp}}$ coming from abroad.

Now we assume that the value of the substituted product on the world market is X_i'. This value X_i' may be smaller or larger than the domestic value X_i of such products because it is determined independently. The direct benefit from import substitution is equal to the value-added originating from domestic inputs, and it is greatest when the imported components are zero and diminishes as they increase, as shown in the equation below (see also figure IX).

$$0 \gtreqless X_i' - (W_{i,\text{imp}} + MVA_{i,\text{imp}}) \tag{3.2}$$

Figure IX. Direct benefit from import substitution



2. *Choice of technology*

An analysis of the choice of technology must start with the ratio of output of means of production (capital and intermediate goods) to output of consumer goods. This ratio determines the allocation of net output Y to both final consumption C and accumulation. For convenience, we assume that accumulation is totally used in new investment I^n.

$$Y = C + I^n \tag{3.3}$$

If basic industries are chosen, the supply of capital goods will grow faster in the long run than the supply of consumer goods, bringing a higher reinvestment ratio B:

$$B = I_0^n / K_0 \tag{3.4}$$

where the subscript 0 indicates the base year t_0. Substituting $Y_0 - C_0$ for I_0^n,

$$B = (Y_0 - C_0)/K_0 \tag{3.4a}$$

In the long run, the difference between net output and consumption will be greater for basic industries than for labour-intensive industries, because there will be an increase in the output of capital goods, which has more physical investment, and fewer people will be employed, leading to lower total wages and lower consumption. Thus, the investment ratio B would change in favour of investment if the output were higher.

Let us now assume that the gestation period lasts one year. In the next year t_1, an investment of $I_0^n = BK_0$ is added to the initial stock of capital K_0. The stock of capital K_1 in year t_1 can then be expressed as follows:

$$K_0 = K_0 + I_0^n \tag{3.5}$$

$$K_1 = K_0 + BK_0 \tag{3.5a}$$

$$K_1 = K_0(1 + B) \tag{3.5b}$$

From equation (3.5b) it is obvious that channelling investment into basic industries will expand the stock of capital, which in effect means more factories, roads, ports etc. to stimulate production.

The net output or income Y_1 in the next year will be:

$$Y_1 = Y_0(1 + r) \tag{3.6}$$

where Y_0 is the value of net output in the base year and

$$r = \Delta Y_0/Y_0) \tag{3.7}$$

$$r = (I_0^n/Y_0)/(I_0^n \Delta Y_0) \tag{3.7a}$$

Substituting the value of r in equation (3.6), we arrive at the following:

$$Y_1 = Y_0 \left\{ 1 + [(I_0^n/Y_0)/(I_0^n/\Delta Y_0)] \right\} \tag{3.8}$$

From equation (3.8) it is obvious that investment in capital-intensive technology leads to a greater increase in net output because of the relatively small value of the incremental capital-output ratio $I^n/\Delta Y$.

Finally, the number of people L_1 employed in the next year will be:

$$L_1 = L_0(1 + r_L) \tag{3.9}$$

where L_0 is the number of jobs in the base year and

$$r_L = (I_0^n/Y_0)\ \frac{\Delta L_0/I_0^n}{L_0/Y_0} \tag{3.10}$$

Substituting the value of r in equation (3.9), we arrive at

$$L_1 = L_0 \left[1 + (I_0^n/Y_0)\ \frac{\Delta L_0/I_0^n}{L_0/Y_0} \right] \tag{3.11}$$

L_1 may also be calculated on another basis:

$$L_1 = (\Delta L_0/I_0^n)K_1 \tag{3.12}$$

$$L_1 = (\Delta L_0/I_0^n)K_0(1 + B)$$

Because capital-intensive technology is characterized by a low incremental labour-output ratio in the initial stages of industrialization, it would require less labour than labour-intensive technology. However, as industrialization advances, the reinvestment ratio will increase faster, causing higher employment rates.

3. *Industrial capacity and production costs*

When estimating the investments required for different capacities, industrial economists usually apply an approximation known as the "six-tenths rule". The theoretical basis for this rule is as follows: If, for example, Y_A and Y_B are the capacities of two plants A and B, and I_A and I_B are their respective investment costs, then:

$$I_A/I_B = (Y_A/Y_A)^x \tag{3.13}$$

where x is a coefficient representing the economy of scale. In this case, it is 2/3, because the area of a spherical container, and hence its cost, varies with its volume, and hence its capacity, in the ratio of 2/3, or, roughly, six-tenths.

Example 3.1. The capital investment required for constructing a steel mill with an annual capacity of 100,000 tonnes is 100 million monetary units. Calculate:

1. The capital investment I_{200} for a second mill with an annual capacity of 200,000 tonnes.

$$\begin{aligned} \ln I_{200} &= \ln 100 + 2/3(\ln 200 - \ln 100) \\ &= 4.6052 + 2/3(5.2983 - 4.6052) \\ &= 4.6052 + 2/3(0.693147) \\ &= 5.067298 \\ I_{200} &= 158,744,800.0 \text{ monetary units} \end{aligned}$$

2. The capital-output ratios I_{100}/Y_{100} and I_{200}/Y_{200} for the two mills.

$$I_{100}/Y_{100} = \frac{100,000,000.0}{100,000.0} = 1000.0 \text{ monetary units/tonne}$$

$$I_{200}/Y_{200} = \frac{158,744,800.0}{200,000.0} = 793.724 \text{ monetary units/tonne}$$

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IV. The basis for industrial planning

A. Goals, objectives and targets[22]

The normal course of plan preparation is to start by setting down goals, since there can be no rationale for subsequent actions, for instance, the choice of which resources to develop, if there are no goals towards which the actions can be directed. Many goals of a national plan, for example, "economic independence" or "more equitable distribution of national income" or "improvement of standard of living", serve as goals for an industrial plan as well. Goals must be compatible with one another; that is, no goal or set of goals should contradict another goal.

In drawing up medium-term and long-term plans, planners must transform goals into narrower objectives, but only after taking stock of the economy's ability to meet them. They would probably, for example, come up with a number of objectives for the broad goal "improvement of standard of living": an increase in the output of basic goods required by the people, an increase in productive agricultural and industrial employment, and an increase in food production through modernization of the agricultural sector.

Looked at in terms of developmental time horizons, goals remain fairly constant over a long period of time, whereas objectives are subject to change. This is because goals are meant to be achieved in the long run, while objectives must be achieved within foreseeable planning periods and must therefore be adjusted from time to time to correspond to actual development. Over time, however, as the objectives are realized one by one, they will converge with the goals.

Only insofar as objectives can be made concrete can they become guidelines for the preparation of a plan. The best way of giving them concrete meaning is to quantify them, thereby translating them into targets. If a plan's objectives are kept in largely qualitative terms, the plan will be less effective in guiding a process or production, for which specific outcomes must be laid down, not just general trends. If they remain vague, objectives will contain an element of uncertainty, and this can make it difficult, or even impossible, to achieve industrial progress through planning.

Sometimes the words that describe an objective serve to quantify it. For example, the goal implied by the words "to completely remove unemployment"

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[22]Goals are the ultimate tasks towards which planning efforts are directed. They express the long-term aspirations of the society in question and are expressed in qualitative terms. Objectives are medium- and long-term tasks of planning that are derived from the goals and are consistent with them. They are designed in accordance with a country's stage of development as well as with its capacity to meet such objectives. Targets are quantified objectives. Targets and objectives are not worked out *a priori* but on the basis of the existing level of development, the previous course of planning in the country and the achievements of previous plans.

is "100 per cent employment". On the whole, the industrial planner should quantify as many as possible of the objectives. Even qualitative objectives that are not directly susceptible to quantification, such as the achievement of a more diversified industrial output, may be quantified indirectly by, say, investment targets for the production of a few commodities or for the inputs required for these commodities.

In addition to setting a target for manufacturing value-added, an industrial plan may set investment, employment, export of output, import of input and other targets. Targets may be set for regions, for sub-sectors or for individual industries, projects or commodities; they may be set in physical units of output or input, such as kilogrammes, tonnes or kilowatt-hours, as well as in units of value such as dollars, pounds and francs.

All in all, the plan is a document that sets forth quantitative, attainable targets and the periods within which they must be attained, and it also specifies the means, such as the physical, financial and human resources, by which this can be done.

1. Practical aspects of setting goals and objectives

Industrial planners must bear in mind that by setting clear, reasonable goals and objectives in the initial stages of plan formulation, they are laying a sound foundation for the whole process of industrialization.

Precisely defined goals and objectives are, logically, the first component of an industrial plan, since they allow investment resources to be allocated among competing demands. Without them, projects and processes are likely to be chosen arbitrarily, and the measures for implementing a plan are likely to contradict one another.

Planners must constantly fine-tune their objectives in the light of experience gained during plan implementation and in cognizance of actual economic performance. In addition, they have to avoid ambiguity when setting goals and objectives, because it could lead to uncertainty about what is to be expected from a plan. They must also avoid pitfalls such as listing objectives that are mutually inconsistent, failing to give a good objective the priority it merits or confusing objectives with the strategies necessary for their achievement.

Planners must make sure there is a coherence between strategies and objectives. In a country with a very low per capita income and surplus labour, for example, a "basic industries" strategy and a "large increase in employment" objective could be incompatible, although each is logical in itself. In such a case, concentrating on heavy industries, which use less labour than light industries, would normally restrict the number of jobs, and the planner would need to resolve the conflict between the strategy and the objective. He could, for example, choose for the basic industry techniques that would create more jobs, bearing in mind, naturally, the skills and the training programmes that are available.

Above all, realistic planning calls for enough knowledge of the behaviour of the objective economic factors to be able to relate future actions to objectives.

2. *Defining and choosing goals, objectives and targets*

Who is responsible for choosing goals, designing objectives and quantifying targets?

Since a country's industrial development goals and objectives may be political as well as economic, for instance, if it aims to improve the capacity of its defence industries, the choice of goals and their order of priority must be the responsibility of the policy-makers. It is the planner, however, who advises these policy-makers on the implications of the different goals, as well as on the contradictions that are likely to arise. If information flows in the opposite direction as well, the planner will be able to take into account the concerns of the policy-makers when he prepares the plan and when he oversees its implementation.

The directives given by a country's policy-makers are generally stated in broad terms and are for the most part limited to overall goals. It is, accordingly, the duty of the country's planners to use these goals as a starting point, transforming them into objectives for both long-term and medium-term plans. Thus, if a country's policy-makers assign the planner the goal of achieving economic independence, he, in turn, articulates a somewhat more precise objective, perhaps, in this case, a restructuring of the industrial sector to increase the share of domestic basic industries relative to consumer goods industries.

Similarly, it is not realistic to expect that objectives can be quantified and elaborated at the level of a central planning body. This body should indeed set the broad outlines of objectives and tentative targets, including sectoral targets, for the draft national plan, but it is the planning department of the Ministry of Industry and the ancillary planning units that should concern themselves with details. In any event, the targets cannot usually be specified in a single operation, for their magnitudes depend by and large upon the magnitudes of many other targets. The only way to achieve consistency among all the targets is to apply iterative techniques at the various levels of the planning hierarchy, and in the course of this iteration (see chapter II) the quantification and precision of targets will eventually involve all levels of management.

Some typical goals and their corresponding objectives and targets are shown in table 1.

What is the best approach to designing objectives for industrial plans in developing countries?

It will help in preparing a realistic industrial plan to distinguish among four types of objectives (see figure X):

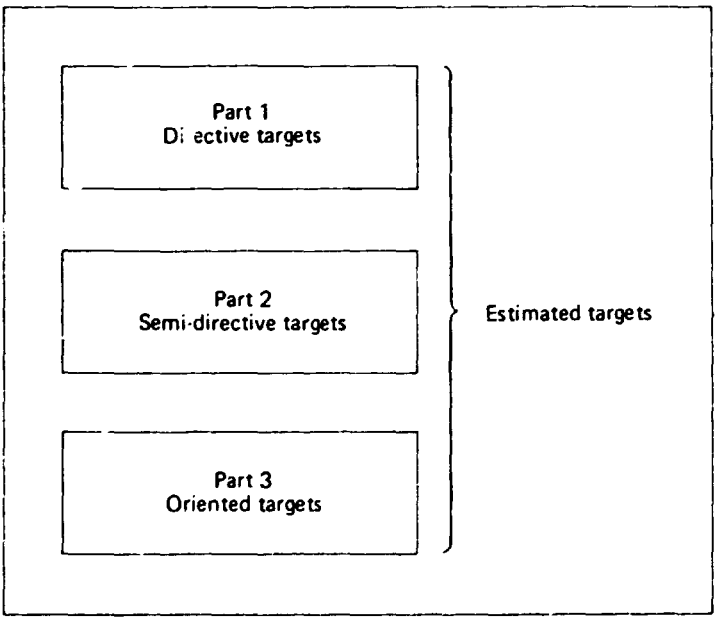
(a) Directive objectives for that part of the plan covering industry owned by the government and amenable to its control. These objectives stand a good chance of being realized because the activities lend themselves to control, and the plan under which they operate has the force of law;

Table 1. Examples of goals, objectives and targets in an industrial plan[a]

Designation	*Temporal nature*	*Typical formulation*
Goals	Long-term	Achieve economic independence Improve standard of living More equitable distribution of income
Objectives	Medium- and long-term; however, long-term objectives are subject to modification as time passes	Restructure the industrial sector Increase productivity in the traditional sector and small-scale industries Increase employment in industry Increase industrial output of goods required by a large majority of population Increase export of manufacturing goods Increase manufacturing value-added
Targets	Medium-term plans; must be consistent	Achieve . . .% growth in the . . . industry Raise the share of industrial sector (manufacturing) in GDP to . . .% Increase employment in the industrial sector by at least . . .% Improve productivity in the traditional and small-scale industries by at least . . .%

[a] The precision of target values proceeds on the basis of the iterative technique.

Figure X. Relationship among the different types of objectives



(b) Semi-directive objectives for that part of the plan covering industry owned by the government but difficult to control. Here, planners will probably have to resort to persuasion, perhaps in the form of incentives, perhaps as penalties, to get their targets fulfilled;

(c) Orienting objectives for that part of the plan covering the private sector. They may be expressed in qualitative form, for instance, the anticipated development of a process may be described in words, or in the form of parameters, such as the quantitative characteristics of a process expected to be realized during the plan period;

(d) Estimated objectives for autonomous processes or for sectors other than the industrial sector: for example, exports of manufactured goods or agricultural inputs for processing industries. Since the magnitudes of these objectives depend on factors that are difficult to control, estimation is the only way to quantify them and link them to targets. There will always be a degree of uncertainty about whether these estimated objectives can be achieved, because what happens depends either on pre-existing circumstances or on the changing magnitudes of outside factors.

The mix of these four kinds of objectives will differ from country to country, and the total number of objectives and targets will depend on the stage of development of a country, its size and its resources. Where there is little opportunity for guiding socio-economic development, even within the public sector, planners may have to be content with specifying economic policy. In such cases, the plan will consist largely of organizational and economic measures to regulate the public industrial sector, and it will try to gain some control over the private sector; the remaining objectives will be mainly in the form of forecasts. Where the State exercises more control over the public sector and where that sector is strong, the plan will probably contain a larger share of directive objectives and fewer of the less concrete estimated objectives.

Finally, industrial plan targets must be harmonized with other sectoral plan targets to ensure that the national plan is internally consistent. Targets for industrial outputs destined for agricultural use, for example, machinery, fertilizers and pesticides, must be specified based on the expected needs of the agricultural sector. Conversely, targets for industrial outputs that depend on agricultural products, for example processed food, textiles and leather, must be based on the expected output of the agricultural sector.

B. Information system for industrial planning

Industrial plans are evolved in a number of closely linked stages. The initial stage is the pre-planning stage, which consists primarily of preparing the informational and statistical base needed to analyse past and current industrial activities and to calculate the indicators that are needed for plan preparation and, later, for evaluating progress and introducing adjustments. The better the quality of the statistical information, the broader its scope, and the greater the extent to which it is expressed in operational terms, the better it can help to mold an industrial plan that is internally consistent, whose different objectives are coherent and that holds a real promise for successful industrialization.

1. Inadequacies of data in developing countries

In most developing countries planning is handicapped by the lack of a comprehensive statistical base. It is often difficult to find reliable, up-to-date information on national income, consumption, accumulation, investment, capital formation and employment, and even more difficult to find good information on the sectors, for instance, on industry, mining, agriculture or transport.

Furthermore, even if data are available, they may be inadequate for planning purposes. Data on national income may, for example, suffer from cross-sectional gaps, breaks in continuity and time lags. Or, the quality and scope of the data may not be good enough to allow long-term projections having the needed degree of confidence. It can happen, too, that population figures are unreliable: sometimes they have been overestimated for one reason or another, but in general their unreliability can be attributed to the inexperience of statistical personnel.

2. Planning in the face of inadequate data

The question facing the planner in countries where no adequate data are available is whether to start planning immediately or to delay planning until more or better information can be obtained. While some planning experts recommend that planning not be started until accurate and sufficient data have been obtained, others hold that since the planning process itself can generate quantitative and qualitative information, postponing it might be counterproductive. To avoid having to plan on the basis of insufficient or inaccurate data, the country should, when it first starts to plan, launch a population census, an industrial survey and an assessment of national resources; this preliminary work should include geological surveys, which are very important for locating industries such as paper, sugar and cement and other building materials.

3. Problems related to information and data requirements for industrial planning

Just as planning is a perpetual process that can never be complete, so also is the informational and statistical base that underlies it never complete. Once a base has been set up at the start of planning, it must be expanded and refined to serve future planning needs; it should without question be computerized.

From an organizational standpoint, several measures can be taken to facilitate the collection, flow, storage and retrieval of information.

Co-ordinating the flow of statistical information. In many developing countries there is no co-ordinated effort among the governmental bodies to produce unified data. Sometimes this is due to the existence of more than one statistical body, other times it is due to the absence of a central statistical office. Even where a central statistical office exists, there may be no mechanism to co-ordinate statistical activities; parallel government offices may produce figures independently, and the figures may not be directly comparable.

The need for co-ordination is great. Not only would it eliminate duplication and improve comparability, but it would also promote the flow of information within a government. Developing countries need to strengthen their statistical services by establishing central statistical offices, if these do not already exist, and by setting up auxiliary statistical units at ministries, departments and individual enterprises, as well as units at the regional level.

There are of course many sources of data other than statistical offices *per se*. These must not be overlooked but must instead be carefully included in the statistical network:

(a) Operating industrial enterprises;

(b) Government administration at all levels;

(c) Foreign trade organizations;

(d) Chambers of commerce and of industry;

(e) Associations of manufacturers;

(f) Plan-executing agencies;

(g) Investment agencies;

(h) Special task forces, working groups and consultants involved in specific development studies;

(i) Organizations that manage infrastructural facilities;

(j) Central banks and commercial banks;

(k) Labour organizations;

(l) International organizations such as the Organization for Economic Co-operation and Development (OECD) and, especially, those within the United Nations system, including the Statistical Commission, the United Nations Conference on Trade and Development (UNCTAD), the International Labour Organisation (ILO), the Food and Agriculture Organization of the United Nations (FAO), the World Bank and the United Nations Industrial Development Organization (UNIDO).

Integrating the central planning body and the central statistical office. Experience shows that there are significant advantages if the functions of the central statistical office are integrated within the Ministry of Planning:

(a) The heavy dependence of planning on statistics requires close co-operation between planners, statisticians and statistical services. The data must be presented in a form suitable for planning purposes, and there must be on-going efforts to improve the quality and quantity of the data;

(b) Since it is the planners who are the main users of statistical data, they will be in a better position to influence its quality and quantity;

(c) To make data preparation more efficient and minimize delays that hold up the planning process, some countries have merged the central planning body and the central statistical office; such a composite body is often able to make better progress in preparing data or deciding on priorities.

Upgrading the efficiency of statistical work. The effectiveness of statistical work depends on a number of factors:

(a) The stock of information must be tailored to the particular needs of the planning process to avoid wasting the effort of statisticians. If the planner

takes into account the scarcity of statisticians when he first sets up the information base, he can optimize their efforts by carefully specifying the kinds of data that will be needed;

(b) Statisticians should be trained on a continuing basis so as to upgrade skills and maintain an efficient service that makes use of computers and other modern equipment and facilities for processing, storing and retrieval of data;

(c) Statistical work requires continuity and should be followed up by the central planning body and other governmental organs to ensure that the information being produced is reliable, that it keeps up with advances in planning techniques and that it reaches out to cover more and more economic and social activities.

4. Kinds of data required

While the specific data requirements of an industrial plan depend to a large extent on the nature of the plan, the prevailing socio-economic conditions and the length of the planning period, it is nevertheless possible to set out some general requirements.

(a) From the statistical point of view, two types of data are required to formulate and elaborate plans: time-series data and cross-sectional data. Time-series data are needed for examining past trends and for predicting future trends. Statistical offices at different levels can be asked to forward estimates, as well as calculated indicators, to the planning bodies. Time-series descriptions of manufacturing activity would always be useful, and might even be indispensable, for effective planning. Time-series descriptions of the different industrial sub-sectors would reveal the relative importance of the sub-sectors and their similarities and differences. Cross-sectional data are needed for determining behaviour such as consumer preference, which could be very important in developing countries where demand is determined largely by market forces;

(b) From the technical point of view, industrial planning requires a large quantity of data in the form of technical norms,[23] which are indispensable for working out balances and establishing input-output tables, as well as for applying mathematical methods to the different stages of the industrial plan. Technical norms are needed for key products such as steel, chemicals and petrochemicals, and cement. Other kinds of norms are also needed, for example, the average requirements of human beings for calories and protein must be known in order to set long-term targets ensuring that industry meets the modernization requirements of agriculture;

(c) From the organizational point of view, the data must be fully adjusted to the requirements of the plan; that is, they must correspond to its targets. Experience shows that in most developing countries, it would be best to disaggregate the sectoral plan into sub-sectors in conformity with the ISIC 4-digit classification, and to collect data accordingly. Some countries may go into a more detailed breakdown, adopting a 5- or 6-digit code. The minimum number of digits should be 4, because 3 digits mixes too many branches under one code number and precludes a proper analysis:

[23] For a discussion of technical norms see chapter V.

3 digits		*4 digits*	
311/312	Food manufacturing	3111	Slaughtering, preparing and preserving meat
		3112	Manufacturing of dairy products
		3113	Canning and preserving of fruits and vegetables
		3114	Canning, preserving and processing of fish etc.

Preparation and elaboration. If the available data are insufficient or unreliable, it would be highly desirable to launch a survey to collect and organize as much of the following kinds of data as possible:

(a) Time-series data on the national economy, such as GDP, national income, consumption, investment and capital formation;

(b) Data about human resources, since people are not only the primary beneficiaries of any plan but also the source of both manpower and market demand. Industrial planning requires two kinds of data about people: (1) information about the nature and growth of population; the size of the labour force and its consumption habits and employment by sector; the nature and availability of skills; and rural and urban unemployment; and (2) information about family expenditures at different income levels and in different locations, for example, rural and urban, in order to project demand;

(c) Detailed data on each industrial sub-sector, such as available capacity and capacity utilization, employment and productivity; output; export of manufactured goods; capital formation and depreciation; consumption of intermediates such as energy, semi-finished materials and other intermediates from local or imported sources; and employment and skills, national and foreign;

(d) Detailed data on the traditional sector, especially data on output, employment and productivity, and input requirements;

(e) Information about natural resources, such as the location, size and quality of mineral deposits, and about agricultural production, including agricultural inputs for industrial processing;

(f) Relevant information on other sectors and projects, for example, the locations and capacities of hydro-electric stations and water networks; the availability of water for industrial purposes and, conversely, the water requirements of agriculture, construction and industry;

(g) Data on quantities and prices of exports and imports of manufactured consumer and capital goods. These are necessary for discerning the structure of foreign trade, the investment ratio, and consumption patterns, as well as for projecting potential markets for projects that would justify expanding production for export or for substitution of imports. Information about market conditions and their future outlook, as well as costs of production abroad, is also needed;

(h) Fiscal data, including estimates of revenues and of foreign and domestic loans and grants, to determine the amount of public investment and the current expenditures associated with a plan. Information about funds available for private investment is also necessary so as to set targets for the private sector;

(i) Data on each planned project so that the planner can estimate the required investment, in terms of both the national currency and foreign exchange, and the requirements for construction materials, machinery, equipment, supplies, manpower and skills.

Implementation. The kind of information that will be needed for controlling plan implementation depends mainly on a plan's objectives and targets. However, no matter what the objectives and targets, every plan needs information on the progress of new projects as well as the performance of existing industries.

It is crucial to a follow-up effort that the data be timely so that potential bottlenecks can be identified as early as possible. This will allow determining their causes, along with the extent to which they threaten the attainment of plan targets and any remedial adjustments to the plan.

Data on existing industries will identify trends in both the private and public industrial sectors and will assess how well these two sectors are fulfilling the plan's general objectives and how closely they are adhering to the economic policies underlying the plan. Here again, the statistical information must be provided without delay so that the planner can monitor deviations and quickly suggest corrective measures, such as raising duties on competing imports or removing bottlenecks in the supply of strategic intermediates.

Price indices. Statistical data serving industrial planning must make it possible to identify the main industrial and socio-economic trends of the preceding period, and must also provide an internally consistent basis for the plan.

Inflation in both the national economy and the world economy makes calculations based on current prices quite useless. Moreover, changes in the prices of related groups of commodities and services are often irregular and result in substantial discrepancies between magnitudes of corresponding values. The use of constant prices in plan preparation is thus of great importance for the establishment of internal consistency, for when prices change at different rates, even a consistent plan can become unbalanced.

The problem can be solved by preparing price indices with which to deflate time-series data that are expressed in current prices. Such a step makes it possible both to identify the actual indicators and to make mid-course corrections that avert imbalances in the national economy.

Data expressed in current prices can be highly misleading and can give a distorted picture of progress. This is particularly true where the development plans are essentially investment programmes. If progress is measured on the basis of current expenditures, capital investment plans often appear, as a result of price increases, to be fulfilled, or even over-fulfilled, when, in fact, they are largely unfulfilled. This must also be taken into account in setting up a reporting system.

C. Indicators for industrial planning

Indicators are important because they are a way of quantifying plan objectives. Planners at all levels of the hierarchy need indicators to elaborate

those parts of the plan for which they are responsible. They also need indicators for co-ordinating the partial plans and for following up on plan implementation.

The kinds of indicators available, as well as their number, quality and functions, vary from one developing country to another. However, the medium-term plans of almost all these countries quantify their objectives in terms of the growth rate of GDP and manufacturing value-added, as well as in terms of a few other common indicators of industrial growth, such as the share of manufacturing industries in the gross domestic product and the growth of industrial employment. If the indicators for industrial production are few in number, the scope of the plan will be correspondingly limited, and the elaboration as well as the precision of plan targets will be less rigorous.

The number of indicators needed depends on several factors, such as the level of industrial development, its structure and diversity. From the qualitative point of view, the indicators should adhere to five principles: uniformity, stability, consistency, flexibility of combination and differentiation.

1. Uniformity

All indicators that refer to the same economic phenomena must be based on a uniform régime to permit aggregation, disaggregation and harmonization among different targets. This principle is illustrated by the following example:

Example 4.1 (aggregation and disaggregation of the capital-output ratio). If the capital-output ratio at the level of the national economy is K/Y, where K is the value of total capital, or total stock of capital, and Y is the GDP, then the corresponding capital-output ratio at the level of an enterprise may be expressed as K_i^h/Y_i^h, where K is the fixed assets of enterprise h of sub-sector i and Y_i^h is the gross value-added of enterprise h of sub-sector i.

The capital-output ratio of one industrial enterprise can be compared with the capital intensities of other enterprises in the same sub-sector; for instance, the capital-output ratios of various textile enterprises can be compared with one another.

By aggregating the capital-output ratios of all the enterprises in a sub-sector, we arrive at the capital-output ratio of the entire sub-sector. Assuming that sub-sector i comprises m enterprises, its capital-output ratio can be represented as K_i/Y_i, where K_i is the total capital of sub-sector i and Y_i is gross value-added originating in sub-sector i. The planner can compare the capital-output ratios of the different sub-sectors and use this information to make investment decisions.

Finally, by aggregating all the sub-sectoral and sectoral capital-output ratios,

$$K = \sum_{i=1}^{n} K_i$$

$$Y = \sum_{i=1}^{n} Y_i$$

where $i = 1,2,3, \ldots, n$, we arrive at the average capital-output ratio K/Y for the national economy.

2. *Stability*

The indicators must insofar as possible be kept constant over the duration of at least one or two successive medium-term plans in order to permit a flow of information and its processing and transmission, and to assess past performance. For example, time-series data on capital-output ratios permit the evaluation of capital intensity at the level of enterprises, sub-sectors and the whole economy. Of great significance is the stability of GDP for the whole economy and of gross value-added originating in the sub-sectors *i* and in the major industrial enterprises *h*. Table 2 is a hypothetical example of growth of gross value-added in the sub-sectors and corresponding growth of overall GDP.

Table 2. Hypothetical time-series of gross value-added and GDP index numbers over a past ten-year period

Sub-sector	*Year*								
	−9	...	−6	−5	−4	−3	−2	−1	−0
1	100.0	...	134.8	139.9	152.3	157.9	171.9	179.9	189.8
2	100.0	...	127.9	133.2	141.6	144.2	152.0	162.4	171.0
3	100.0	...	132.6	143.1	149.8	159.9	168.1	180.2	189.8
4	100.0	...	111.4	113.0	116.1	117.6	122.1	123.7	128.0
.	.	...	.	.	.	.	.	.	.
.	.	...	.	.	.	.	.	.	.
.	.	...	.	.	.	.	.	.	.
n	.	...	.	.	.	.	.	.	.
Total for all sub-sectors (GDP)	100.0	...	134.8	145.1	151.9	160.3	172.9	181.3	193.8

A comparison between projected growth of GDP, or of gross value-added in the sub-sectors, and the corresponding historical growth is useful in two ways: as a check on actual performance and to ensure realistic planning. Table 3 shows a hypothetical comparison of this sort.

Table 3. Hypothetical comparison of planned and achieved growth rates of GDP
(Percentage)

Industrial sub-sector	*Planned growth rate*	*Achieved growth rate*	*Deviation*
1	8.5	6.0	−2.5
2	9.0	5.0	−3.0
3	7.0	6.0	−1.0
4	6.5	2.5	−4.0
.	.	.	.
.	.	.	.
.	.	.	.
n	.	.	.
GDP	8.2	6.1	−1.9

Comparing growth rates in this way will reveal over- and underestimations of the economy's performance, both as a whole and in the different sectors, sub-sectors and enterprises. It will also provoke analyses to determine the causes of less-than-expected performance and will allow taking measures to avoid this in future.

3. *Consistency*

Indicators refer to complex phenomena and must be consistent to facilitate appropriate control. This is illustrated by the following example:

Example 4.2. consistency of gross output. Gross output is a complex indicator that relates gross value-added and intermediate inputs. Gross output at market prices is equal to gross value-added at factory prices plus intermediate inputs plus direct taxes minus subsidies, and the same balance holds at all stages of aggregation. Thus, at the sub-sectoral level,

$$X_i = V_i + U_i + \text{direct taxes on sub-sector } i - \text{subsidies for sub-sector } i \qquad (i = 1,2,3, \ldots, n)$$

where X_i is gross output of sub-sector i; V_i is gross value-added of sub-sector i; and U_i is intermediates consumed by sub-sector i. And, on a national level,

$$\sum_{i=1}^{n} X_i = \sum_{i=1}^{n} V_i + \sum_{i=1}^{n} U_i + \text{direct taxes} - \text{subsidies}$$

where ΣX_i is gross value of production, ΣV_i is GDP and ΣU_i is total intermediate consumption.

4. *Versatility of combination*

Industrial planning indicators must be combinable in different ways so that targets can be quantified to the greatest extent possible, even with relatively few indicators. For example, by combining GDP with capital, we can calculate the capital-output ratio; by combining it with the number L of employed persons, we can calculate labour productivity:

$$\text{Labour productivity} = \frac{\text{GDP}}{\text{Number of employed persons}} = \frac{Y}{L}$$

Another example of flexibility is the combination of GDP with intermediates consumption, which enables us to calculate the ratio W/V.

5. *Differentiation*

Different kinds of industrial planning indicators are needed at different stages of planning and for different planning periods. The longer the planning period, the fewer indicators are required. Several kinds of data are needed for preparing a long-term industrial plan:

Gross value of production, at market prices;

Gross value-added, at factory costs;

Value of total intermediate input, imported and from local sources;

Indirect taxes and subsidies;

Investment, from foreign and local sources;

Value of exports of industrial goods;

Salaries and wages of employed personnel;

Number of employed persons, foreign and local;

Energy consumption, by kind.

The number of indicators can vary from one country to another, but those mentioned above are also essential for aggregation into a national plan. Moreover, a manifold analysis can be made on the basis of these indicators, such as: growth of total output; growth of GDP; productivity (ratio of value-added to intermediate input); incremental capital-output ratio; balance of foreign trade for the industrial sector; changes of level of wages and salaries per employee; and others.

In a medium-term plan, target indicators should be shown on a year-to-year basis and not only for the final year, because the requirements for their fulfilment in financial and physical terms also vary.

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V. Tools of industrial planning

A. Balances

1. Applications

Generally speaking, the same tools of planning are available in all countries. However, some are probably more suitable than others for a particular country. It may even be possible to introduce fairly sophisticated tools, but this will depend on the availability and quality of the statistical information, the stage of the country's development and the complexity of its economy.

Balances are an expression of the equilibrium between economic needs for goods and the availability of local or imported inputs to satisfy these needs. They can be used with plans of different time-frames, long-term, five-year and annual, but the degree of detail will differ of course. A number of different planning tasks can be carried out with the help of balances:

(a) Setting industrial targets at different levels of the planning hierarchy;

(b) Co-ordinating industrial sector targets with targets of other sectors of the economy;

(c) Allocating human, natural and capital (physical as well as financial) resources in compliance with the targets of national and industrial plans;

(d) Analysing the deployment and the geographical distribution of the labour force. Balances are easily carried out for different geographical areas and can reveal surpluses or shortages of skills by region;

(e) Allocation of capital between depreciation and new investment in all the industrial sub-sectors;

(f) Assessment of the likelihood of achieving targets under the different resource allocation schemes.

There are a number of reasons balances can be recommended for developing countries, especially the LDCs. First, they are relatively simple, flexible and effective, and they can be introduced easily and gradually into the planning process to upgrade it.

Secondly, even if statistical data are sparse or do not cover a wide range of economic activities, and this would be true particularly in the early stages of industrialization, balances can still be constructed, if only for the most strategic natural resources and products. They will be able to reveal shortages or surpluses, bottlenecks, constraints and unemployment and will also improve the allocation of natural resources, financial and physical capital and skills.

Thirdly, once a network of balances has been developed and a base of statistics has been accumulated, more sophisticated planning tools can gradually be introduced. For example, input-output tables can be added to the planning repertoire, at first for key products that have strong forward and backward linkages and then, step by step, for a wider range of products.

2. *The technique of balances*

Balances can be used to estimate a number of economic indicators, such as GDP and national income, resources and products. The technique of product balances is demonstrated below.

Product balances are worked out for intermediate goods, capital goods and consumer goods. Taking into account the consumption and production patterns revealed by these balances, it is possible to set up the material proportionality of an industrial plan. Product balances have the general form shown in table 4.

Table 4. Model product balance for intermediate goods, capital goods or consumer goods during year *t*

Sources	*Uses*
Inventory and stocks at 1 January of year *t*	Private and public consumption during year *t*
Total production during year *t*	Gross investments during year *t*, i.e. replacement of worn-out capacities and new investments
Imports during year *t*	Intermediate consumption during year *t*
	Exports during year *t*
	Balance of reserves at 31 December of year *t*
Sources (total)	Uses (total)

Balances may be expressed in either monetary terms or physical terms, for example, kilogrammes, tonnes, kilowatt hours, square metres and cubic metres. If monetary units are used, the equation is as follows:

$$X_i + \sum_{k=1}^{m} M_{ik} + R_i^{1.1(t)} = W_i + I_i + C_i + \sum_{k=1}^{m} E_{ik} + R_i^{31.12(t)} \qquad (5.1)$$
$$(i = 1, 2, 3, \ldots, n)$$
$$(k = 1, 2, 3, \ldots, m)$$

where

X_i is the value of the industrial output of product group i

M_{ik} is the value of imported products of group i from sources (countries) k

$R_i^{1.1(t)}$ and $R_i^{31.12(t)}$ are the values of stocks and reserves of products of group i at 1 January and 31 December, respectively

W_i is the value of intermediate consumption for producing the products of group i

I_i is the value of goods used for gross investment of group i

C_i is the value of final consumption of products of group i

E_{ik} is the value of exports of products of group i to destinations (countries) k

If physical units are used, the equation be s:

$$Q_i + \sum_{k=1}^{m} M'_{ik} + R'^{1.1(t)}_i = W'_i + I'_i + C'_i + \sum_{k=1}^{m} E'_{ik} + R'^{31.12(t)}_i \qquad (5.2)$$

where Q_i is the volume of industrial output of product group i expressed in physical units. The other terms of the equation are analogous to the terms of equation (5.1) but expressed in physical units.

The left sides of equations (5.1) and (5.2) show the sources of the products of group i, that is, domestic industry, imports from other countries and reserves left over from the previous year. The right sides of the equations show the uses of the products of group i, which can take several forms:

(a) Intermediate consumption by industry, for example, when coal is used in blast furnaces to produce pig iron, it is an intermediate product;

(b) Investment goods, for example, lathes, tractors or furnaces, to replace worn-out capital goods and used-up stocks or to create new production capacities;

(c) Private consumption, for example, consumer goods, as well as electricity and fuel;

(d) Social, that is, public, consumption, by which is meant consumption by the social infrastructure, for example, hospital requirements for electricity, heating, drugs, food etc.;

(e) Exports;

(f) Unused, available products $R_i^{31.12(t)}$ of group i on 31 December of the year in question. These will become part of the sources $R_i^{1.1(t+1)}$ during the next year.

For consumer goods and capital goods, the right-hand sides of equations (5.1) and (5.2) can be reduced appropriately. For example, in the case of heavy mechanical equipment, $W_i = C_i = 0$; and in the case of food, $W_i = I_i = 0$.

3. Technical coefficients

Some of the available products of group i will be consumed by industry to make final products. The total intermediate consumption of products of group i can be expressed as

$$W_i = x_{i1} + x_{i2} + x_{i3} + \ldots x_{in} \qquad (5.3)$$

or as

$$W'_i = q_{i1} + q_{i2} + q_{i3} + \ldots q_{in} \qquad (5.4)$$

where the right-hand sides of the equations are, respectively, the values and quantities of products of group i ($i = 1,2,3,\ldots, n$) consumed as intermediates by sub-sectors j ($j = 1,2,3,\ldots, n$). W_i and W'_i are the total consumption as intermediates of product i in monetary and physical terms, respectively:

$$W_i = \sum_{j=1}^{n} x_{ij} \qquad (5.3^a)$$

$$W'_i = \sum_{j=1}^{n} q_{ij} \qquad (5.4^a)$$

Here, x_{ij} and q_{ij} are calculated on the basis of the following equations:

$$x_{ij} = a_{ij}X_j \tag{5.5}$$

$$q_{ij} = b_{ij}Q_{ij} \tag{5.6}$$

where a_{ij} and b_{ij} are the technical coefficients for the value and quantity, respectively, of inputs required from industry i to produce one dollar's worth of output by industry j.

$$W_i = \sum_{j=1}^{n} a_{ij}X_j \tag{5.7}$$

$$W_i = \sum_{j=1}^{n} b_{ij}Q_j \tag{5.8}$$

In equations (5.7) and (5.8) the values of a_{ij} and b_{ij} are known and the values of X_j and Q_j are targets, which may at first be set tentatively on the basis of proposals from industrial enterprises and the Ministry of Industry or on the basis of forecasts; then, during the iterative process, they should be adjusted to achieve harmony with the other targets of the national plan.

The following examples, based on hypothetical cases for cement (examples 5.1 and 5.2) and tractors (example 5.3), illustrate the use of technical coefficients in preparing balance sheets.

Balance sheet for the cement industry. Before a balance sheet can be drawn up for a hypothetical cement industry, technical coefficients for the consumption of the intermediates, electricity and limestone must be drawn up, as is done in the following example.

Example 5.1. A developing country has three cement factories for which the following information is available for the year t:

	Output Q_c of cement (tonnes)	*Consumption of electricity q_{ec} (million kWh)*	*Consumption of limestone q_{lc} (tonnes)*
Factory 1	100 000	11 500 000	126 000
Factory 2	200 000	22 800 000	290 000
Factory 3	300 000	34 400 000	369 000
	600 000	68 700 000	785 000

Given this information, we can calculate the value of two technical coefficients:

$$b_{ec} = q_{ec}/Q_c = \frac{68,700,000}{600,000} = 114.5 \text{ kWh/tonne of cement}$$

$$b_{lc} = q_{lc}/Q_c = \frac{785,000}{600,000} = 1.30 \text{ tonne of limestone/tonne of cement}$$

where b_{ec} and b_{lc} are, respectively, technical coefficients (the quantity of electricity and the quantity of limestone needed to produce one tonne of cement).

Technical coefficients, or norms, for consumption are important for planning because they allow future needs to be projected on the basis of past consumption. For short-term purposes, private consumption can be taken as roughly equal to the historical average annual per capita consumption of the

product. A better estimate would require cross-sectional analysis to determine consumer preferences and to estimate demand for consumer goods on the basis of statistical sample families. Such an analysis would be of great importance in countries where final demand is largely influenced by market forces.

In countries where a central planning body is able to determine consumption by the population over the long run, the planner must estimate private and public consumption on the basis of clearly analysed targets that represent the satisfaction of the people's basic needs. This problem will be dealt with in greater detail in chapter VI.

Example 5.2. In a developing country in the year $t-1$, the planned output of the cement industry for the year t is 1.6 million tonnes. On the basis of the following information, calculate the amount of cement that will be needed by the country during the year t and draw up a tentative balance for cement:

(a) The constant price of cement is $60 per tonne;

(b) The available stocks and reserves of cement at 31 December of year $t-1$ are 0.1 million tonnes;

(c) The government decides to maintain the reserves of cement at 0.2 million tonnes on 31 December of year t;

(d) The domestic cement industry supplies cement to three construction material industries j, which use the cement as an intermediate. The technical coefficient a_{ij} is the value of cement, in dollars, necessary to produce one dollar's worth of construction materials of each group j; in this case, i is the cement industry. For the first industry, a_{ij} is 0.50; for the second, it is 0.40; and for the third, it is 0.20;

(e) The investment allocated for the public sector in year t is $1,000 million, of which $700 million is for five large public projects and $300 million is for all other public projects;

(f) The estimated investment of the private sector during year t is $500 million;

(g) Blueprints for the five large public projects show the following requirements for cement and for the products of the three above-mentioned building materials sub-sectors during year t:

Project	*Allocation for the project (million dollars)*	*Requirement for cement (million tonnes)*	*Requirements for the products of other construction materials sub-sectors (million dollars)*		
			1	*2*	*3*
1	200	0.30	2.0	3.2	2.4
2	150	0.20	2.0	4.0	0.08
3	150	0.12	1.6	3.6	2.4
4	100	0.10	1.0	1.6	1.2
5	100	0.08	0.8	1.8	1.0
	700	0.80	7.4	14.2	7.8

The average requirements for cement and for products of related building materials sub-sectors, all in dollars, per dollar spent for construction, are as follows:

Sector	Requirement per dollar spent for construction			
	Cement (dollars)	Product of related construction materials sub-sectors (dollars)		
		1	2	3
Public	0.10	0.010	0.018	0.012
Private	0.08	0.004	0.006	0.004

The direct investment requirements for cement (in monetary terms, I_{cem}, and in physical terms, I'_{cem}) may be expressed as follows:

$$I_{cem} = 0.10 \times 300.0 + 0.8 \times 60 + 0.08 \times 500.0 = \$118 \text{ million}$$

$$I'_{cem} = \frac{I_{cem}}{\text{price of one tonne of cement}} = \frac{118}{60} = 1{,}967 \text{ million tonnes}$$

Cement requirements for intermediate consumption (in monetary terms, W_{cem}) may be written:

$$W_{cem} = a_{cem1}X_1 + a_{cem2}X_2 + a_{cem3}X_3$$

where a_{cem1}, a_{cem2}, and a_{cem3} are the average requirements for cement, in dollars, per dollar gross output of the first, second and third construction materials sub-sectors and the gross output X_i ($i = 1,2,3$) of the three construction materials sub-sectors are:

$$X_1 = 0.01 \times 300.0 + 7.4 + 0.004 \times 500.0 = \$12.4 \text{ million}$$

$$X_2 = 0.018 \times 300.0 + 14.2 + 0.006 \times 500.0 = \$22.6 \text{ million}$$

$$X_3 = 0.012 \times 300.0 + 7.8 + 0.004 \times 500.0 = \$13.4 \text{ million}$$

so that

$$W_{cem} = (0.50 \times 12.4) + (0.40 \times 22.6) + (0.20 \times 13.4) = \$17.92 \text{ million}$$

In physical terms, the cement requirements for intermediate consumption are:

$$W'_{cem} = \frac{W_{cem}}{\text{price of one tonne of cement}} = \frac{17{,}920}{60} = 0.299 \text{ million tonnes}$$

The cement balance may be drawn up thus:

$$Q_{cem} + \sum_{k=1}^{m} Q^m_{cemk} + R'^{1.1(t)}_{ce,n} = W'_{cem} + I'_{cem} + \sum_{k=1}^{m} E'_{cemk} + R'^{31.12(t)}_{cem}$$

If we assume that the country has no export commitments for cement during the year t, that is,

$$\sum_{k=1}^{m} E'_{cemk} = 0, \text{ then:}$$

$$1.6 + \sum_{k=1}^{m} Q^m_{cemk} + 0.1 = 0.299 + 1.967 + 0.2$$

$$\sum_{k=1}^{m} Q^m_{cemk} = 0.766$$

where $\sum_{k=1}^{m} Q^m_{cemk}$ is the import requirement of the country for cement in year t.

A tentative balance sheet for cement can then be presented as shown in table 5.

Table 5. Tentative balance sheet for cement in year *t*
(Million tonnes)

Sources		*Uses*	
Inventory on 1 January of *t*	0.100	Intermediate consumption	0.299
Total production	1.600	Investment requirements	1.967
Imports	0.766	Inventory on 31 December of *t*	0.200
	2.466		2.466

The cement balance for the proposed national investment programme shows that domestic supply of cement will fall short of demand by 0.766 million tonnes in the year *t*; this shortfall might have to be balanced by imports.

In deciding how to close a gap such as that which appears in the above example, the planner must examine the following:

(a) The degree of priority to be accorded to the cement industry to help it to cope with the growing demand for cement;

(b) The possibility of increasing cement prices so as to shift part of the demand for cement to alternative materials;

(c) The possibility of reducing dependence on cement by changing the civil engineering designs of public sector projects. While this could cause delays and higher costs in the short run, in the long run it could easily be done;

(d) The availability of hard currency and the priority to be given to the import of $46.02 million worth of cement. This must be dealt with in the balance of exports and imports;

(e) The physical capacities required for importing 0.766 million tonnes of cement. Here, the planner must calculate on the basis of other balances the capacities and utilization rates of ports, roads, railroads and other transport;

(f) The possibility of postponing one of the major projects in accordance with established priorities.

The process of planning would usually also involve the calculation of other, related balances, for example, the balance of energy and the balances of limestone and clay. The energy balance can reveal the ability of the energy sector to cope with the demand for electricity from the industrial sector, including the cement sub-sector, and from other sectors, as well as private and public consumption. The limestone balance can reveal the life-span of the cement industry.

Balance sheet for tractors. Balances of durable goods such as tractors and machines differ from balances of non-durable goods because the former are used for longer than one year, which is the period usually covered by a balance. For example, the lifetime of a machine might be 10 years and that of a building might be 40. Therefore, the demand for durable goods in the form of fixed assets is either to replace worn-out fixed assets or to expand or create new fixed assets.

Demand for durable goods that are used in relatively large numbers, such as agricultural pumps, machinery and appliances, as well as lathes, tractors and lorries, can be balanced as shown in table 6.

Table 6. Model balance for durable goods during year t

Sources	*Uses*
Inventory and stocks on 1 January of year t	Local requirements during year t
Total production during year t	Exports during year t
Imports during year t	Inventory and stocks on 31 December of year t
Sources (total)	Uses (total)

The calculation of local requirements differs from one class of durable goods to another. For durable goods that are used in large numbers, such as tractors, lathes and lorries, we must know, first, the number $S_i(t)$ of vehicles or pieces of equipment of each type that are operating; secondly, the average lifetime h_i of the equipment or vehicles, usually referred to as the flow conversion factor; and thirdly, the technical coefficients k_{ij} of using durable goods i in sectors j of the economy.

The formula for calculating the additional local requirement for durable goods i in the year $t + 1$ may be stated as follows:

$$Q_{Li}(t+1) = \sum_{j=1}^{n} \frac{h_i k_{ij} X_j(t+1)}{P_i(t+1)} - S_i(t) - \frac{S_i(t)}{h_i} \qquad (5.9)$$

where

$Q_{Li}(t)$ is the additional local requirement for durable goods i in the year $t + 1$

k_{ij} are the technical coefficients for depreciation value of durable goods i per unit output of the sector j

$P_i(t + 1)$ is the estimated price of product i in the year $t + 1$

In equation (5.9), the term $S_i(t)/h_i$ is the number of units of durable goods i scrapped during year t and the term $S_i(t) - [S_i(t)/h_i]$ is the number of units of durable goods i available on 1 January of year $t + 1$. The term $k_{ij}X_j(t + 1)$ is the value of depreciation of durable goods i based in sub-sector or sector j in the year $t + 1$. The term $h_i k_{ij} X_j(t + 1)/P_i(t + 1)$ is the total number of units required to be operating in sub-sector or sector j in the year $t + 1$. The term $\sum_{j=1}^{n} h_i k_{ij} X_j(t + 1)/P_i(t + 1)$ is the total number of units required to be operating in all sectors of the economy in the year $t + 1$. The difference between the latter term and the term $S_i(t) - [S_i(t)/h_i]$ constitutes the additional local requirement for durable goods i in the year $t + 1$.

Example 5.3. In a developing country the following information on number of operating tractors is available for year t:

	Type of tractor				*Total tractor power*
	6 kN	9 kN	*14* kN	*20* kN	*(*kN*)*
Number of operating tractors $S_i(t)$	2 500	8 500	5 000	1 000	17 000
Lifetime (years)			8		
Expected price in year $t + 1$ ($/kN)			100		

The technical coefficients k_{ij} and the value of $X_j(t+1)$ are also known:

Sector j indicator	*Agriculture*	*Services*	*Industry*	*Mining*
k_{ij}	0.010	0.006	0.003	0.005
$X_j(t+1)$ ($)	150 000 000	50 000 000	60 000 000	70 000 000

Given the above information, it is possible to calculate the additional local demand in the year $t+1$. For convenience, we will carry out the calculation in terms of engine power (kilonewtons). This can be done by multiplying the number of tractors of each type by their respective engine powers:

	Type of tractor				*Total tractor power (kN)*
	6 kN	*9 kN*	*14 kN*	*20 kN*	
Number of operating tractors $S_i(t)$	2 500	8 500	5 000	1 000	17 000
$S_i(t)$, calculated in terms of kN	15 000	76 500	70 000	20 000	181 500
Ratio of each type of tractor to total, in terms of kN	8.04	41.02	37.53	13.41	100.0

Then, on the basis of equation (5.9), the additional local requirement becomes:

$$Q_{L,t}(t+1) = \frac{8 \times 0.01 \times 150{,}000{,}000}{100} + \frac{8 \times 0.006 \times 50{,}000{,}000}{100}$$
$$+ \frac{8 \times 0.003 \times 60{,}000{,}000}{100} + \frac{8 \times 0.005 \times 70{,}000{,}000}{100}$$
$$- \left(181{,}500 - \frac{181{,}500}{8} \right) = 27{,}587.5$$

Thus the additional local requirement for tractors in the year $t+1$, calculated in terms of kilonewtons, will be 27,587.5. If the same distribution of tractor types is maintained during year $t+1$, we can calculate the demand for each type of tractor as follows:

	Type of tractor				*Total tractor power (kN)*
	6 kN	*9 kN*	*14 kN*	*20 kN*	
Additional demand for tractors in year $t+1$ (kN)	2 218.04	11 316.40	10 353.58	3 699.48	27 587.5
Additional demand for tractors in year $t+1$ (units of tractors, rounded)	370	1 257	40	185	2 552

The balance sheet for tractors can then be drawn up in the same way as was done for cement.

4. The aggregation and tabulation of key balances

An important characteristic of product balances expressed in monetary units is that they lend themselves to aggregation or disaggregation. In the initial stages of industrialization, developing countries should concentrate on disaggregated balances of key products, which permit detailed analyses of certain products. At the same time, however, they should also look at some aggregated balances, for instance those in the textiles and leather industries, in order to get an overall view for these products.

The tabulation of key balances in monetary units (a model for which is shown in table 7) is an essential task for industrial planners because it permits comparison among the different key products in respect of their production capacity, demand and export possibilities. Moreover, since such a table indicates the total value of imports and exports, it will reveal any future excess of imports over exports.

Table 7. Tabulation of key balances in monetary units

Material	*Domestic demand*	*Exports*	*Total use/ total supply*	*Production*	*Imports*
Cement					
Steel					
Aluminium					
Electricity					
Coal					
.					
.					
.					
Total					

B. Input-output analysis

Experience shows that balances are a convenient means of establishing a proportional production and foreign trade structure for a national economy, particularly in the initial stages of industrialization. However, further analysis of the economy, especially of the industrial sector, must use input-output tables to identify bottlenecks that could occur as production is being expanded and to structure production so it can satisfy anticipated demand. Input-output analysis is a means of assessing direct and indirect intermediate consumption needs.

An input-output table shows how the available products of each sector are distributed among the other sectors or sub-sectors for use in their products. At the same time it shows the inputs to each sector or sub-sector from the other sectors or sub-sectors. Thus an input-output table covers the availability and utilization of all products in both forms, intermediate and final. A simplified structure for an input-output table is presented in table 8.

Table 8. Simplified outline of an input-output table

		1	2	3	.	.	.	n	
1	X_1	x_{11}	x_{12}	x_{13}	.	.	.	x_{1n}	Y_1
2	X_2	x_{21}	x_{22}	x_{23}	.	.	.	x_{2n}	Y_2
3	X_3	x_{31}	x_{32}	x_{33}	.	.	.	x_{3n}	Y_3
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
n	X_n	x_{n1}	x_{n2}	x_{n3}	.	.	.	x_{nn}	Y_n
		V_1	V_2	V_3	.	.	.	V_n	
	X	X_1	X_2	X_3	.	.	.	X_n	

where

X_i is the value of output of products of group i or sub-sector i

x_{ij} is the share of the output of industry i consumed productively by industry j; for example, x_{12} represents the value of products of group 1 necessary to produce X_2 dollars worth of products in group 2

Y_i is the final demand for products of group i

V_i is the gross value-added of sub-sector i

n is the number of product groups or sub-sectors included in the table.

Each row, reading from left to right, shows the output sold by each sub-sector. Each column, reading from top to bottom, shows the purchases made by each sub-sector, along the top of the table, from the left-hand side. Since this is a square table, there is one row to correspond to each column.

To illustrate, consider the relationship between sub-sector 3 (row 3 and column 3) and sub-sector 2 (row 2 and column 2). To find the share of the output of sub-sector 3 sold to sub-sector 2, read across row 3 until it intersects column 2. We see that sub-sector 3 sold x_{32} dollar's worth of goods for intermediate consumption to sub-sector 2 during the period covered by the table, usually one year. To find out how much sub-sector 3 buys from sub-sector 2, go over to column 3 and read down until this column intersects row 2. We see that sub-sector 3 bought products worth x_{23} dollars from sub-sector 2.

To ensure the proportionality of the production process at the level of the national economy, it is important to plan and balance the sources and the uses of gross national product, gross domestic product and national income. This process encompasses, of course, all individual products or groups of products, as well as the material structure of the gross national product and the internal flows of products (interlocking of the production process of the economy). A model input-output table for gross national product is shown as table 9. In this table, W_i is the total use of products of group i in the form of intermediate consumption; U_i is the total intermediate consumption of sub-sector j of products of group i; I_i is the value of goods of group i used for gross investment; C^p and C^g are private and public consumption; E_i and M_i are exports and imports of products of group i; and Z_i is the availability of products of group i.

Table 9. Input-output table of the gross national product

Outputs j / Inputs i	Productive economic sub-sectors 1	2	3	.	.	n	Total intermediate consumption of each economic sub-sector i	Final consumption: Additions in gross inventory	Investment (gross)	Private consumption	Public consumption	Exports	Total final consumption	Total utilization = total availability	Sources: Imports	Local production
1	x_{11}	x_{12}	x_{13}	.	.	x_{1n}	W_1	R_1	I_1	C_1^p	C_1^g	E_1	Y_1	Z_1	M_1	X_1
2	x_{21}	x_{22}	x_{23}	.	.	x_{2n}	W_2	R_2	I_2	C_2^p	C_2^g	E_2	Y_2	Z_2	M_2	X_2
3	x_{31}	x_{32}	x_{33}	.	.	x_{3n}	W_3	R_3	I_3	C_3^p	C_3^g	E_3	Y_3	Z_3	M_3	X_3
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
n	x_{n1}	x_{n2}	x_{n3}	.	.	x_{nn}	W_n	R_n	I_n	C_n^p	C_n^g	E_n	Y_n	Z_n	M_n	X_n
Total intermediate consumption by sectors j	U_1	U_2	U_3	.	.	U_n										
Gross value-added	V_1	V_2	V_3	.	.	V_n										
Production	X_1	X_2	X_3	.	.	X_n	W	R	I	C^p	C^g	E	Y	Z	M	X

To show at a glance the various elements of this input-output table, an outline of it has been constructed (table 10). The production (product group) part of the table, first quadrant, also called the "internal interlocking" part, contains the sectors and sub-sectors producing goods and services, such as agriculture, various manufacturing sub-sectors, construction, communications and the service industries. The final consumption part of the table, second quadrant, is of special importance because changes in its values transmit further effects throughout the rest of the table. The value of the production components part of the table, third quadrant, shows the building of production value. It is sometimes useful to have a detailed breakdown of the components of gross value-added, for instance, wages, depreciation and profits.

The square matrix that constitutes the first quadrant is also called the square matrix of intersectoral flows:

$$\begin{array}{ccccccc} x_{11} & x_{12} & x_{13} & . & . & . & x_{1n} \\ x_{21} & x_{22} & x_{23} & . & . & . & x_{2n} \\ x_{31} & x_{32} & x_{33} & . & . & . & x_{3n} \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ x_{1} & x_{n2} & x_{n3} & . & . & . & x_{nn} \end{array}$$

The sum of each row of the square matrix of intersectoral flows is equal to the total consumption as intermediates of each product group *i*:

$$\sum_{j=1}^{n} x_{ij} = W_i \tag{5.10}$$

The sum of each column is equal to the intermediates consumption of sub-sector *j* of products *i*:

$$\sum_{j=1}^{n} x_{ij} = U_i \tag{5.11}$$

However

$$\sum_{i=1}^{n} x_{ij} \neq \sum_{j=1}^{n} x_{ij} \tag{5.12}$$

On the basis of each row of the input-output table (see table 8 for a simplified outline of an input-output table), we can construct the following equation:

$$X_i = \sum_{j=1}^{n} x_{ij} + Y_i \qquad (j = 1,2,3,\ldots,n) \tag{5.13}$$

$$X_i - \sum_{j=1}^{n} x_{ij} = Y_i \tag{5.13a}$$

$$\sum_{i=1}^{n} X_i - \sum_{i=1}^{n} \sum_{j=1}^{n} x_{ij} = \sum_{i=1}^{n} Y_i \tag{5.14}$$

$$X - W = Y \tag{5.14a}$$

where X is the gross product, W is the total intermediate consumption and Y is the GDP.

Table 10. Outline of input-output table of the gross national product

Outputs j / *Inputs* i	*Production*		*Final demand*		*Sources*
	First quadrant "internal interlocking"		Second quadrant		
Value of production components	Third quadrant				

On the basis of each column of the input-output table (see table 8), we can construct the following equation:

$$X_j = \sum_{i=1}^{n} x_{ij} + V_j \tag{5.15}$$

$$X_j - \sum_{i=1}^{n} x_{ij} = V_j \tag{5.15a}$$

$$\sum_{j=1}^{n} X_j - \sum_{j=1}^{n} \sum_{i=1}^{n} x_{ij} = \sum_{j=1}^{n} V_j \tag{5.15b}$$

$$\sum_{j=1}^{n} X_j - \sum_{j=1}^{n} U_j = \sum_{j=1}^{n} V_j \tag{5.16}$$

where U_j is the total intermediate consumption of subsector j. Therefore,

$$\sum_{j=1}^{n} U_i = W \qquad (j = 1,2,3,\ldots,n) \tag{5.17}$$

$$X - W = \sum_{j=1}^{n} V_j \tag{5.17a}$$

Thus,

$$\sum_{j=1}^{n} V_j = Y \tag{5.18}$$

Equation (5.18) shows that gross domestic product equals the sum of gross value-added originating in all sectors of the economy.

On the basis of equations (5.13a) and (5.17a), it can be seen that an input-output table of the gross national product is a detailed balance sheet of gross national product. This can easily be shown on the basis of the bottom row of table 9.

$$M + X = W + R + I + C^{p} + C^{p} + E \tag{5.19}$$

or

$$M + X = W + R + I + C + E \tag{5.19a}$$

The left-hand side of equation (5.19a) represents the availability of gross product, the right-hand side, its utilization (see also table 11).

Table 11. Balance sheet for the gross national product

Sources	*Uses*
Gross inventory at 1 January of year t ($R^{1.1(t)}$)	Consumption of intermediate product (W)
Intermediate product (W)	GDP for domestic use, of which:
GDP originating in all sectors of the economy $\sum_{i=1}^{n} V_i$	Private consumption (C^{p})
	Public consumption (C^{p})
	Accumulation, of which:
	Gross investment (I)
	Gross inventory at 31 December of year t ($R^{1.1(t)}$)
Imports (M)	Exports (E)
Sources (total)	Uses (total)

1. Internal consistency

An internally consistent plan is a plan devoid of bottlenecks or surplus capacities. Achieving this requires, first of all, the calculation of the technical coefficients. The easiest way to do this is to divide all the entries in each sub-sector's column by the gross output X_i of that sub-sector. For this purpose, we repeat equation (5.5):

$$x_{ij} = a_{ij}X_j \tag{5.5}$$

$$a_{ij} = x_{ij}/X_j \tag{5.5a}$$

It should be pointed out, however, that one of the most serious obstacles to consistent forecasting on the basis of input-output tables is changing structural coefficients. For short-term forecasts, that is, forecasts for one or two years, it is reasonable to assume that the input coefficients will not change, or that they will not change significantly. However, for medium- and long-term forecasts, that is, forecasts for five or ten years or longer, it cannot be assumed that input-output coefficients will remain constant, and it is necessary to use estimated technical coefficients. Indeed, developing countries must rely on estimated technical coefficients to estimate for all zero entries or for sectors where interlinkages are not yet properly developed. These coefficients will change substantially over the course of a long-term forecast; agriculture, for example, will probably use more and more chemical fertilizers. The coefficients can be estimated on the basis of the targets set forth by the long-term plans or on the basis of engineering studies and technical analyses.

Example 5.4. In the draft of the long-term plan of a particular developing country, the following tentative targets have been set:

(a) The output of agriculture in the year t_{10} should amount to \$100 million, $X_A = 100$, to meet the country's basic needs for agricultural products;

(b) To achieve this target, agricultural experts have estimated that the fertilizer use should average 0.2 dollar per dollar of agricultural output, $a_{FA} = 0.2$. To permit a thorough analysis, the experts must provide the technical coefficients for other inputs as well, such as fertilizers, pesticides, irrigation and agricultural equipment and energy.

Once the technical coefficients have been estimated, the internal consistency can then be computed on the basis of equation (5.13a), as follows:

$$X_i - \sum_{j=1}^{n} x_{ij} = Y_i \qquad \begin{matrix} (5.13^a) \\ (i = 1,2,3,\ldots,n) \\ (j = 1,2,3,\ldots,n) \end{matrix}$$

Substituting equation (5.5) in equation (5.13a) yields:

$$X_i - \sum_{j=1}^{n} a_{ij}X_j = Y_i \tag{5.20}$$

The above n equations can be rewritten as follows:

$$X_1 - [a_{11}X_1 + a_{12}X_2 + a_{13}X_3 + \ldots + a_{1n}X_n] = Y_1$$
$$X_2 - [a_{21}X_1 + a_{22}X_2 + a_{23}X_3 + \ldots + a_{2n}X_n] = Y_2$$
$$X_3 - [a_{31}X_1 + a_{32}X_2 + a_{33}X_3 + \ldots + a_{3n}X_n] = Y_3$$
$$\vdots$$
$$X_n - [a_{n1}X_1 + a_{n2}X_2 + a_{n3}X_3 + \ldots + a_{nn}X_n] = Y_n$$

or more compactly, as:

$$X - AX = Y \qquad (5.20^c)$$
$$[I - A]X = Y \qquad (5.20^b)$$

where

$$[I - A] = \begin{bmatrix} (1 - a_{11}) & (-a_{12}) & (-a_{13}) & \ldots & (-a_{1n}) \\ (-a_{21}) & (1 - a_{22}) & (-a_{23}) & \ldots & (-a_{2n}) \\ (-a_{31}) & (-a_{32}) & (1 - a_{33}) & \ldots & (-a_{3n}) \\ \vdots & \vdots & \vdots & & \vdots \\ (-a_{n1}) & (-a_{n2}) & (-a_{n3}) & \ldots & (1 - a_{nn}) \end{bmatrix} \qquad (5.21)$$

The matrix $[I - A]$ is usually called the technical matrix of production. It is crucial for a consistent plan because it provides a general solution of the input-output problem.

2. *Calculation of direct and indirect intermediate consumption*

As was mentioned earlier, input-output analysis has the advantage of showing direct and indirect intermediate consumption. This is important for establishing consistency within the industrial sector. In the following paragraphs we will examine this problem more clearly and derive the necessary equations.

The input-output table shows the direct intermediate consumption by a given sub-sector of products of all other sub-sectors for each dollar's worth of current output. But this does not represent the total addition to output resulting from an additional increase in the final demand. An increase in final demand for products of group i will lead to both direct and indirect increases in the output of all sub-sectors. If, for example, there is an increase in the final demand for the products of industry 2, there will be direct increases in intermediate consumption of products of groups 1,2,3 and so on. But when sub-sector 1 channels more of its output to sub-sector 2, the demand of sub-sector 1 for the products of industries 3,4 etc. will likewise increase, and these effects will spread throughout the whole economy.

Thus, a significant task of input-output analysis is the construction of a table that shows the direct and indirect effects of changes in final demand. This can be done mathematically by multiplying both sides of equation (5.20^b) by the matrix $[I - A]^{-1}$, which yields:

$$X = [I - A]^{-1}Y \qquad (5.22)$$

The above equation can also be rewritten as follows:

$$\begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ . \\ . \\ . \\ X_n \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} & A_{13} & \dots & A_{1n} \\ A_{21} & A_{22} & A_{23} & \dots & A_{2n} \\ A_{31} & A_{32} & A_{33} & \dots & A_{3n} \\ . & . & . & & . \\ . & . & . & & . \\ . & . & . & & . \\ A_{n1} & A_{n2} & A_{n3} & \dots & A_{nn} \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ . \\ . \\ . \\ Y_n \end{bmatrix}$$

where A_{ij} are the coefficients of the matrix $[I - A]^{-1}$.

Equation (5.22) may be rewritten as follows:

$$X_i = \sum_{j=1}^{n} A_{ij} Y_j \qquad (j = 1,2,3,\dots,n) \quad (5.22^a)$$

By partial derivation of X_1 with respect to a given final demand for products of group Y_k, we obtain:

$$\frac{\delta X_i}{\delta X_k} = A_{ik} \qquad (5.23)$$

where A_{ik} is the technical coefficient for the direct and indirect intermediate consumption of products of group i required, other things being equal, to expand the output of products of group k by one dollar.

3. *Treatment of imports and exports in input-output analysis*

It is extremely important that the planner take account of the imports and exports of commodities in input-output analysis. The formula for calculating the imports of commodity i can be shown on the basis of table 9. The sources of commodity i are imports M_i and local production P_i; its uses can take the form of intermediate and final consumption. Final consumption can take the form of additions to gross inventory, gross investment, private and public consumption and exports. The total sources and uses of commodities are reflected in equations (5.19) and (5.19[a]). To calculate the sources and uses of each commodity i, we first break down the sources X_i into imports M_i and local production P_i and substitute into equation (5.13):

$$P_i + M_i = W_i + Y_i \qquad (5.13^b)$$

$$P_i + M_i = \sum_{j=1}^{n} A_{ij} X_{ij} + Y_i \qquad (5.13^c)$$

Equation (5.23) can be rewritten in detail as follows:

$$\begin{bmatrix} P_1 + M_1 \\ P_2 + M_2 \\ P_3 + M_3 \\ . \\ . \\ . \\ P_n + M_n \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} & A_{13} & \dots & A_{1n} \\ A_{21} & A_{22} & A_{23} & \dots & A_{2n} \\ A_{31} & A_{32} & A_{33} & \dots & A_{3n} \\ . & . & . & \dots & . \\ . & . & . & \dots & . \\ . & . & . & \dots & . \\ A_{n1} & A_{n2} & A_{n3} & \dots & A_{nn} \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ \\ \\ \\ Y_n \end{bmatrix}$$

The ratio of imports to domestic production should be estimated more closely on the basis of availability of the raw materials and semi-manufactures for processing, import priorities, economies of scale and availability of skills.

Net imports and exports of commodity i can be calculated on the basis of equation (5.13) and by breaking down final consumption Y_i into its components:

$$M_i + P_i = W_i + R_i + I_i + C_i + E_i \qquad (5.13^d)$$

$$P_i = W_i + R_i + I_i + C_i + (E_i - M_i) \qquad (5.24)$$

$$P_i = W_i + R_i + I_i + C_i + e_i \qquad (5.24^a)$$

In an analogy to equation (5.20) we could write the following equation:

$$X_i = \sum_{j=1}^{n} a_{ij} X_i + R_i + I_i = C_i + e_i \qquad (5.25)$$

where e_i are the trade variables. When positive, they are being used to meet foreign demand for the commodity i; when negative, they represent additional imports to supplement domestic supply. The complete set of equations may be rewritten as follows:

$$\begin{bmatrix} P_1 \\ P_2 \\ P_3 \\ . \\ . \\ . \\ P_n \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \dots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \dots & a_{2n} \\ a_{31} & a_{32} & a_{33} & \dots & a_{3n} \\ . & & & & . \\ . & & & & . \\ . & & & & . \\ a_{n1} & a_{n2} & a_{n3} & \dots & a_{nn} \end{bmatrix} \begin{bmatrix} P_1 \\ P_2 \\ P_3 \\ . \\ . \\ . \\ P_n \end{bmatrix} + \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ . \\ . \\ . \\ I_n \end{bmatrix} + \begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ . \\ . \\ . \\ C_n \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \\ e_3 \\ . \\ . \\ . \\ e_n \end{bmatrix} \qquad (5.25^b)$$

It should be pointed out that transactions with other countries involve many difficulties. While a complete exposition of these difficulties is beyond the scope of this publication, it is important to note that exports and imports have to be adjusted to a valuation basis consistent with that chosen for other entries in the input-output table. In addition, there are sometimes conceptual and statistical problems associated with the trade entries in the production accounts, and these can produce large imbalances when reconciling supply of and demand for resources.[24]

4. Dynamic input-output model

The focus of the dynamic input-output model is investment and growth. To develop this model, we introduce the technical coefficient for investment, K_{ij}. Investment in its physical form consists of the capital goods needed to maintain and expand the stock of capital K in the economy. Capital goods take the form of the production facilities and intermediate commodities necessary for expanding production capacity and output.

Thus, gross investment in the year t will be channelled into different sectors of the economy to expand production capacity and output:

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[24]For detailed information, see Thomas V. Bulmer, *Input-Output Analysis in Developing Countries: Sources, Methods and Applications* (Chichester, John Wiley, 1982), chap. 7.

$$I_i(t) = \sum_{j=1}^{n} \Delta X_{ij}(t) \tag{5.26}$$

where $I_i(t)$ is the gross investment produced in sector i and $\Delta X_{ij}(t)$ is the part of $I_i(t)$ channelled to sector j for expanding its capacity and output.

The requirements for additional gross investment produced in sector i to expand the value of the production output of sector j can be calculated as follows:

$$\Delta X_{ij} = a_{ij}(t+1)h_i[X_j(t+1) - X_j(t)] \tag{5.27}$$

where $a_{ij}(t+1)$ is the technical coefficient for the year $t+1$ and h_i is the average lifetime of the capital good i. In the case of durable capital goods, $h_i > 1$. In the case of non-durable goods, $h_1 \leq 1$. For the sake of simplicity, we will refer to $a_{ij}(t+1)h_i$ as K_{ij}, which represents the partial investment-output ratio.

From the above it follows that the total gross investment of sector i can be calculated as follows:

$$I_i(t) = \sum_{j=1}^{n} X_{ij} = \sum_{j=1}^{n} K_{ij}[X_j(t+1) - X_j(t)] \quad (j = 1,2,3,\ldots,n) \tag{5.28}$$

The complete set of equations can be rewritten as follows:

$$\begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ . \\ . \\ . \\ I_n \end{bmatrix} = \begin{bmatrix} k_{11} & k_{12} & k_{13} & \ldots & k_{1n} \\ k_{21} & k_{22} & k_{23} & \ldots & k_{2n} \\ k_{31} & k_{32} & k_{33} & \ldots & k_{3n} \\ . & & & & \\ . & & & & \\ . & & & & \\ k_{n1} & k_{n2} & k_{n3} & \ldots & k_{nn} \end{bmatrix} \begin{bmatrix} X_1(t+1) - X_1(t) \\ X_2(t+1) - X_2(t) \\ X_3(t+1) - X_3(t) \\ . \\ . \\ . \\ X_n(t+1) - X_n(t) \end{bmatrix} \tag{5.28a}$$

or

$$K = K[X(t+1) - X(t)] \tag{5.28b}$$

The solution for the increases in output in individual sectors of the economy can be found using the technique of matrix inversion by solving the equation

$$X(t+1) - X(t) = K^{-1}I \tag{5.29}$$

The complete set of equations can then be rewritten as follows:

$$\begin{bmatrix} X_1(t+1) - X_1(t) \\ X_2(t+1) - X_2(t) \\ X_3(t+1) - X_3(t) \\ . \\ . \\ . \\ X_n(t+1) - X_n(t) \end{bmatrix} = \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{1n} \\ r_{21} & r_{22} & r_{23} & r_{2n} \\ r_{31} & r_{32} & r_{33} & r_{3n} \\ . & & & \\ . & & & \\ . & & & \\ r_{n1} & r_{n2} & r_{n3} & r_{nn} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ . \\ . \\ . \\ I_n \end{bmatrix} \tag{5.29a}$$

where r_{ij} is the inverse element of the K matrix and represents the increase in the value of output of sector j in the year $t + 1$ as result of the investment of one monetary unit of products produced in sector i in the year t. Thus,

$$X_i(t+1) - X_i(t) = r_{ij} I_j \tag{5.29b}$$

or

$$X_i(t+1) = X_i(t) + r_{ij} I_j \tag{5.29c}$$

and

$$\frac{\delta X_i(t+1)}{\delta I_k(t)} = E_{ik} \tag{5.30}$$

where E_{ik} represents the increase in the value of output of sector k in the year $t + 1$, other things being equal, as a result of the investment in sector k in the year t of one monetary unit.

5. *Semi-input-output model*[25]

The semi-input-output method is designed for developing countries with open economies. It distinguishes, therefore, between domestic sectors D and international sectors F: the output of the latter can enter into international trade, while the output of the former (for example, construction) cannot. The splitting of the productive sectors N into sectors F (international) and sectors D (domestic), $F + D = N$, is facilitated by the following two equations, which are derived from the basic input-output model.

$$x_F = H_{FF}x_F + H_{FD}x_D - J_{OF} + f_F + e_F \tag{5.31}$$

$$x_D = H_{DF}x_F + H_{DD}x_D - J_{OD} + f_D \tag{5.32}$$

where

x_F and x_D are vectors of the increases in output in the international and domestic sectors, respectively, during a planning period

f_F and f_D are vectors of the increases in sectoral final demand other than for investment and export goods of the international and domestic sectors, respectively

H_{FF} and H_{DD} are matrices of technical coefficient r_{ij} and show the deliveries on both current and capital requirement for producing one monetary unit of output in the international and domestic sectors, respectively

J_{OF} and J_{OD} are vectors of the level of sectoral deliveries of investment goods from existing capacity at the beginning of the planning period of the international and national sectors, respectively

H_{FD} and H_{DF} are matrices of technical coefficients of the type r_{FD} and r_{DF} and indicate international inputs into national sectors and national inputs into international sectors, respectively

e_F is the vector of changes in sectoral exports minus imports (it appears only in the balance equation of the international sector)

[25] For detailed information see Bulmer, *op. cit.*, chap. 15; and *Industry and Development*, No. 5 (United Nations publication, Sales No. E.80.II.B.4).

The general solution for the direct and indirect increases in output of the national sectors (see pp. 89-91) caused by planned production expansions x_F in the international sectors can be found using the technique of matrix inversion by solving equation (5.32).

$$x_D = [I_{DD} - H_{dd}]^{-1}(H_{DF}x_F - j_{OD} + f_D) \tag{5.33}$$

Thus, when an investment takes place in an international sector—say, to promote exports—it may, by virtue of industrial linkages, make demands on the output of the other international sectors, although these demands may also be satisfiable by imports. Demands on the output of the domestic sectors, by contrast, can only be satisfied by increased domestic production, which requires additional investments in those sectors. These additional investments must be added to the original investment in the international sector to determine the total capital required for the undertaking, be it export promotion or import substitution.

Because increased demands on the output of the international sectors may also be satisfiable by imports, the semi-input-output model excludes their investment requirements from total capital requirements. Each international sector can then be evaluated in isolation, with complementary investments in the international sectors added only to its own capital requirements.

6. *Partial input-output model*

Most developing countries cannot yet use input-output and semi-input-output models to determine and co-ordinate indicators because they do not have a sufficient information base. As an alternative technique, partial input-output analysis has been successful in a number of developed and developing countries because it requires relatively little statistical information, and these requirements are confined mainly to the sub-sectors in question.

Partial input-output analysis enables planners to quantify interrelated objectives within the industrial sector (for example, in the chemical industry, where the inputs and outputs of chemical reactions are often highly interlinked), as well as between certain industrial sub-sectors and certain other non-industrial sub-sectors.

Example 5.5. Assuming the values of final demand and total demand in year t_0 for three industrial sub-sectors, food processing, chemicals and textiles, and for agriculture shown in table 12, we will calculate the total demand, including intermediate direct and indirect demands, in year t_5. The interrelationships between the three sub-sectors and agriculture are depicted schematically in figure XI.

The total demand calculated for year t_5 will be compared with the preliminary estimate of final demand in t_5 envisaged in the national/sectoral/sub-sectoral plans (table 13).

The first step in calculating the total demand in year t_5, including both direct and indirect demand, is to estimate the technical coefficients for consumption, which can be done on the basis of preliminary targets set in the draft industrial plan. In this example, the plan has envisaged that food processing will increase by 20 per cent between year t_0 and t_5 and that 0.2 dollars of fertilizer input, produced by the chemical sub-sector, will be used

Table 12. Hypothetical values of final demand and total demand in four interrelated sectors/sub-sectors

Sub-sector or sector	*Final demand in year t_0[a] (million dollars)*	*Total production year t_0[b] (million dollars)*
Textiles	50	50
Food processing	40	50
Agriculture	50	100
Chemicals	15	90

[a]Intermediate consumption beyond the dimension of partial input-output is in fact final demand from the point of view of the system in question.

[b]In order to meet the final demand at year t_0, a certain amount of chemical intermediates and agricultural products will have to be produced as "intermediate" input for processing/application to "final" products.

Figure XI. Schematic diagram showing direct and indirect increases in intermediate and final demand

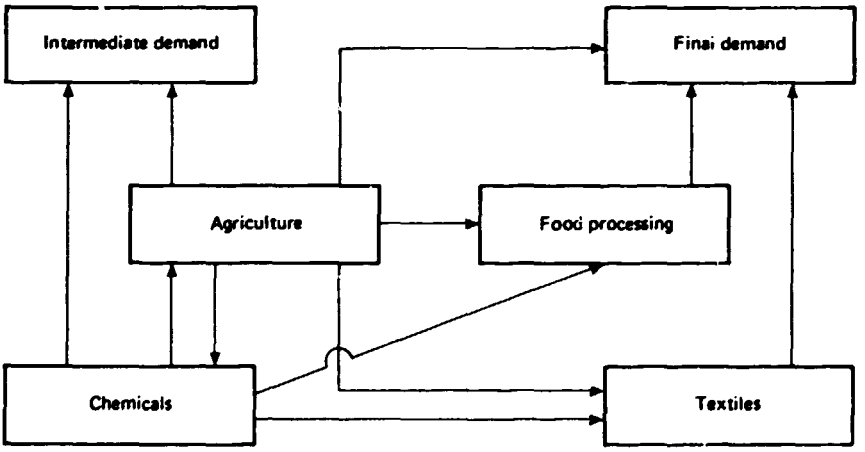

Table 13. Increase in final demand, preliminary estimate

Sector or sub-sector	*Total demand in year t_0 (million dollars)*	*Final demand in year t_5 (million dollars)*	*Change (per cent)*
Textiles	50	60	+20
Food processing	50	65	+20
Agriculture	100	125	+25
Chemicals	90	130	+45

for every dollar of agricultural output. Other preliminary targets can be taken from the national plan or the plans of other sectors, as, in this example, it is projected that final demand for agricultural products will increase by 25 per cent between the years t_0 and t_5. The technical coefficients (preliminary targets) obtained in this way are presented in table 14.

Table 14. Technical coefficients estimated on the basis of preliminary targets

	Textiles	*Food processing*	*Agriculture*	*Chemicals*
Textiles	0.2	0	0	0
Food processing	0	0.2	0	0
Agriculture	0.3	0.4	0.1	0.06
Chemicals	0.3	0.2	0.2	0.3

The second step is to compute the technical matrix of the production matrix $[I - A]$:

$$\begin{matrix} (0.8) & (0) & (0) & (0) \\ (0) & (0.8) & (0) & (0) \\ (-0.3) & (-0.4) & (0.9) & (-0.06) \\ (-0.3) & (-0.2) & (-0.2) & (0.7) \end{matrix}$$

The third step is to compute the coefficients for the direct and indirect requirements per dollar of final demand by inverting the matrix $[I - A]$:

	Textiles	*Food processing*	*Agriculture*	*Chemicals*
Textiles	1.25	0	0	0
Food processing	0	1.25	0	0
Agriculture	0.461165	0.5906148	1.1132686	0.0970873
Chemicals	0.6674757	0.5258899	0.322624	1.4563106

The inverted matrix shows the coefficients for the direct and indirect requirements for each input. These differ greatly from the coefficients for direct requirements shown in table 14. For example, the direct and indirect requirements on the chemical sub-sector for one dollar of agricultural output amount to 0.322624 dollar, that is, to increase the agricultural sector output by one dollar, the fertilizer output of the chemical sub-sector must be increased by 0.322624 dollar. These calculations also suggest how the plan should be elaborated. For example, when food output is to be increased, the targets for agriculture and fertilizer production will have to be elaborated.

The inverted matrix of the table can be used to forecast the total impact of the system due to changes in final demand in one or more components of the system. We are now able to calculate total demand in year t_5, taking into account indirect as well as direct demands, on the basis of equation (5.22):

$$X = [I - A]^{-1}Y \tag{5.22}$$

$$\begin{bmatrix} X_T \\ X_F \\ X_A \\ X_C \end{bmatrix} = \begin{bmatrix} (1.25) & (0) & (0) & (0) \\ (0) & (1.25) & (0) & (0) \\ (0.461165) & 0.5906148) & (0.132686) & (0.0970873) \\ (0.6674757) & (0.5258899) & (0.323624) & (1.4563106) \end{bmatrix} \begin{bmatrix} 60 \\ 65 \\ 125 \\ 130 \end{bmatrix}$$

$$\begin{bmatrix} X_T \\ X_F \\ X_A \\ X_C \end{bmatrix} = \begin{bmatrix} 75\,000 \\ 81\,250 \\ 220\,267 \\ 304\,005 \end{bmatrix}$$

From table 15 it can be seen that the rate of increase in total demand will be much greater than the originally projected rate of increase in final demand (table 13). This is because of the intermediate demands that are generated in direct and indirect ways.

Table 15. Increase in total demand when direct and indirect demands are taken into account

	Total demand in year t_0 (thousand dollars)	*Total demand in year t_5 (thousand dollars)*	*Change (per cent)*
Textiles	50 000	75 000	50
Food processing	50 000	81 250	62
Agriculture	100 000	220 267	120
Chemicals	90 000	304 005	237.8

The above example clearly shows why planning on a piecemeal basis cannot be successful: since it does not take account of the created intermediate demand, it almost always leads to further bottlenecks in the economy.

Computing targets on the basis of balances and computing them on the basis of input-output techniques, partial or overall, are complementary techniques. The two are usually used together to arrive at more precise figures for the targets, which are based on the relationship between supply from domestic and imported sources and demand for semi-manufactures and manufactures in respect of a number of processed products and other commodities. Assessments of possible domestic production derived from these materials balances must be compared to demands resulting from an overall disaggregation of demand as shown by the preliminary projection of the gross domestic product and its major elements. Differences in relevant estimates are eliminated through successive approximations, and thus plan targets can be co-ordinated at the aggregated, sectoral and project levels.

Because they lack a full information base, developing countries frequently apply the following method instead of the input-output technique. First, they elaborate a balance between the total savings and total investment and between export and import; then, they determine aggregate objectives for the growth of gross domestic product and targets for their manufacturing industry by means of incremental capital-output coefficients. The growth rate for manufacturing is either determined on the basis of the historical growth of domestic product or taken from empirical studies in other countries at similar stages of industrialization.

While such a procedure may be useful for developing the first draft of a national plan, a consistent, efficient industrial plan calls for a much more elaborate procedure to quantify and co-ordinate objectives. This need will be dealt with in chapter VI.

C. Statistical and econometric methods

Statistical and econometric methods are used by industrial planners to establish final plan indicators or to estimate tentative indicators that are then subjected to further iterative procedures. To be able to apply these methods

and to carry out the other analytical work connected with industrial plan preparation and elaboration, the planner must have a good knowledge of statistics and a firm grasp of economic theory.

Industrial plan indicators are calculated on the basis of information about economic variables such as output, value of intermediate inputs, investment, value of exported or imported manufactured goods, salaries, wages and prices. Economic theory is important for the analysis and quantification of industrial plan indicators because it explains the objective behaviour of the various economic variables. In fact, the entire body of economic theory is a collection of statements about the relations among these variables, based on certain assumptions or on empirical evidence.

The precondition for the application of statistical and econometric methods is the availability of two kinds of data on the economic variables in question—cross-sectional data and time-series data. Cross-sectional data consist of observations on the economic variable at a given point in time or, more often, during a given interval of time. To illustrate the difference between cross-sectional data and time-series data, let us take the case of a country having ten soft drink factories. The output of one factory for one year is an observation for a single interval of time, and the outputs of all the factories for that same year form a set of cross-sectional observations at different places. Time-series data, on the other hand, consist of observations of a variable at different points in time or during different intervals of time. The outputs of one factory in successive years form a set of times-series observations at the same place. Each succeeding observation is distinguished by its occurrence at a different time rather than at a different place. A set of economic variables, for instance, employment, savings, production or cost, whose values are ordered with respect to time is called an economic time-series.

1. Regression analysis

The most important tool for statistical and econometric methods is a regression equation model that postulates a causal relationship between a dependent variable and one or more independent variables. A dependent variable is functionally dependent on the independent variables; for example, quantity of demand for a product may be regarded as a function of price, disposable income and prices of related commodities.

A regression model attempts to explain the observed changes in a dependent variable as being caused by changes in the independent variables. Most often, the form used to express the causal relationship between a dependent variable and independent variables is the linear form. The linear causal relation between the dependent and independent variables may be expressed as follows:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \ldots + \beta_k X_{kt} + U_t \qquad (t = 1,2,3,\ldots,n) \quad (5.34)$$

where Y_t is the dependent variable; X_{1t}, X_{2t}, X_{3t}, . . ., X_{kt} are the independent variables; β_0, β_1, β_2, β_3, . . ., β_k are the parameters of the equation; and U is a stochastic variable that indicates the amount by which the sample observations of the dependent variable in question exceed or fall short of the mean value of all possible observations at certain levels of the independent variables. Here, the variables are not necessarily economic variables, as, for example, output and consumption.

The main aim of statistical methods is to quantify the above model on the basis of empirical data. This quantification is usually done by the least-squares method:

$$\hat{Y} = \hat{\beta}_0 + \hat{\beta}_1 X_{1t} + \hat{\beta}_2 X_{2t} + \hat{\beta}_3 X_{3t} + \ldots + \hat{\beta}_k X_{kt} \tag{5.35}$$

where Y is the estimated value of Y and $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, \hat{\beta}_3, \ldots, \hat{\beta}_k$ are the estimated values of the parameters of the equation.

A regression equation with more than one independent variable is referred to as a multiple regression, and one with a single independent variable is referred to as a simple, or bivariate, regression. A simple regression equation is expressed as follows:

$$Y_t = \beta_0 + \beta_1 X_{1t} + U_t \tag{5.36}$$

Since the least-squares method is sufficiently described in the literature on statistics and econometrics, only its main features and its applicability to the field of industrial planning are presented below. Readers can refer to the books cited in the bibliography for the complete mathematical derivation.

Least-squares estimation involves minimizing the sum of squared deviations of the observed values Y_t from their estimated values $\hat{Y}_t$. That is, we have to find the values $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, \ldots, \hat{\beta}_k$, that make the required sums as small as possible.

$$S = \sum_{t=1}^{n} (Y_t - \hat{Y}_t)^2 - \min. \tag{5.37}$$

The result is a formula to compute each estimated parameter in terms of the observed Y_t and X_{it}.

2. *Time-series analysis*

One use of a time-series analysis is to smooth a time series—that is, to reduce the period-to-period irregularities. One technique, called trend analysis, removes all but linear variation. It seeks to establish an average line between quantities used over a certain number of years. The future behaviour of the variable in question can be projected following the historical trend shown by this line. The trend line is determined by the least-squares method described above, where the linear trend is estimated on the basis of the following equation:

$$\hat{y}_t = \hat{a} + \hat{b}_t$$

where

$\hat{y}_t$ is the estimated value of the variable in question

t is the time, in months or years

$\hat{a}$ is the estimated value of the intercept of the estimated trend line with the Y-axis

$\hat{b}$ is the trend, that is, the amount by which the variable in question grows during one time period

$\hat{a}$ $\hat{b}$, and t are β_0, β_1 and X_1, respectively, of the least squares model

Some applications of trend analysis to industrial planning are described next.

Evaluating past development. Trend analysis is useful for evaluating the past development of industrial sub-sectors and for comparing them with regard to changes in value-added, cost of inputs, installed capacity, utilization of installed capacity, output, employment, productivity, energy consumption per output etc.

Past trends of economic variables can be analysed for an industrial sector, a sub-sector, or even an individual enterprise. Such an analysis provides industrial planners at different levels of responsibility with preliminary information about the dynamics of their sector. It should be pointed out, however, that the analysis is merely indicative and does not tell the planner the real causes of change in the variable over time.

Because the above-mentioned variables grow over time, it is important to examine past growth rates. The general formula for estimating the compound growth rate is the exponential function:

$$Y_t = A(1 + r)^t_{\exp}(U_t) \tag{5.39}$$

where

Y_t is the variable in question

A is a constant, the initial value of the variable in question

r is the compound growth rate

t is the number of years

One way to derive r is to take the natural logarithms of equation (5.39) and estimate the following equation:

$$\ln Y_t = \ln A + t \ln(1 + r) + U_t \tag{5.40}$$

For convenience, we will assume that $\ln Y_t = Y'_t$, $\ln A = a$ and $\ln(1 + r) = b$. Thus, equation (5.40) can be rewritten as follows:

$$Y'_t = (a + b)(t + U_t) \tag{5.40a}$$

The parameters a and b are then estimated as shown above.

Projecting industrial planning indicators for autonomous processes. Most industrial planning indicators are determined by known and predictable factors; for example, the factors that determine demand for cement within a country might be the price of cement and the price of alternative construction materials. However, the factors determining demand for a country's cement on international markets are not so easy to predict.

As was already mentioned, a number of processes related to industrial activities are difficult to quantify, and the only way to link them to targets is to estimate their indicators. This can be done by extrapolating trends.

It should be counselled, however, that such extrapolation should be relied on only sparingly. Industrial plan targets cannot be set on the basis of extrapolated time trends. Doing so would contradict the principles of planning, which aim at restructuring an economy to enhance socio-economic progress. To quantify targets simply by extrapolating past trends would be to suggest that the same factors will influence development that have always influenced it. Rather, targets for a five-year plan should be quantified on the basis of balances and iterative techniques. In particular, they should respond exactly to the overall targets of the development plan. For example, if the plan decides on

increasing industrial output by x per cent, of which metallurgy by x_m per cent and engineering by x_{eng} per cent, then the increase in the generating capacity of the electricity sub-sector, x_{elc}, must meet not only the development requirements of these industries but also that of all other sectors. The increase in the generating capacity of the electricity sub-sector will in this case of course differ from that estimated on the basis of an extrapolated time trend.

The use of trend projection in long-term planning. Trend projection is often useful for long-term planning, which focuses on broad targets rather than precise details, and deviations can be corrected in the course of short-term planning.

In preparing long-term plans, a number of variables can be examined by projecting trends, for example, the availability of specific types of labour, the life of mineral deposits, industrial demand for water and the danger of pollution.

In applying trend projection, the industrial planner has to look for the best fit. This may be linear or exponential, as in the case of compound growth, but it may also take other shapes. There are a number of models that can reflect changes in the magnitude of a variable with time. One is the quadratic model:

$$Y = C_t = C_2 t + C_3 t^2 \tag{5.41}$$

Also of significance for long-term planning are the saturation model and the logistic curve, which are presented below, for they can tentatively predict the levels of saturation over a long period of time. The saturation model is written as follows:

$$Y_t = e^{\alpha - \beta/t} + U_t \tag{5.42}$$

where e^{α} is the saturation level and the point of inflection where $t = \beta/2$. To the left of this point, the slope increases with t; to the right of it, the slope diminishes. As $t \to a$, $Y \to e^{\alpha}$. Curves of this type are usually used for the analysis of consumer budget data.

The logistic function is formulated as follows:

$$Y_t = \frac{a}{1 + be^{-ct}} + U_t \tag{5.43}$$

where a is the saturation level and is called the parameter of saturation. The initial value of the logistic curve is $a/(1 + b)$.

It is necessary to warn that time trend projection is beset by some statistical and economic deficiencies. The method assumes implicitly that the factors that have determined the growth rate of production and consumption in the past will continue into the future, i.e. that their average effect on the activity in question will be the same as in the past. This assumption, which might be called the hypothesis of mutually compensating effects, implies that changes in factors affecting the variable will cancel out, so that the combined effect of the factors will be the same as in the past; it is, on the whole, rather indicative and of doubtful validity.

Experience shows that extrapolating time-series data works reasonably well in the case of a few well-behaved variables, such as population or income during periods of stability.

3. *Econometric models*

A complete exposition of econometric methods and models is beyond the scope of this publication, which will confine itself to defining their aims and to briefly showing their application to industrial planning.

Econometric models are abstract representations of how economic forces operate in the real world. They tend to be more accurate than time-series analyses since they are based on economic theory and contain explanatory variables that reflect their individual impact on the independent variable in question. Using econometric models, a planner can quantify the influence of economic factors on a particular variable and he can trace the features of an economy, its links, structure and tendencies to change.

Some economic relationships can be expressed by a single equation, others by simultaneous equations, that is, systems of equations solved all at once. In this way, both the resulting estimated parameters and model prediction are consistent with the economic thought.

When applying these methods, a planner proceeds as follows: First, he studies the variables that explain the change in the variable in question, for example, GDP and the ratio of investment and exports. Then he constructs an explanatory model, estimating and testing it to determine the degree of confidence that can be placed in the relationships.

The industrial planner will need models to analyse factors affecting the demand for manufactured goods as well as factors affecting the growth of manufacturing value-added in single sub-sectors or across the whole industrial sector. Models can be used to assess new developments in technology. In addition, in industrial planning practice, forecasts based on econometric models can reveal factors needed for setting long-term targets and can provide information that might be useful for future planning purposes.

Of special significance for industrial planners is the ability to estimate elasticities, which are a means of calculating interdependent targets. An example is elasticities of output with respect to capital and to labour. Both can be estimated using a regression analysis of the Cobb-Douglas function. The equation for time-series data usually takes the following form:

$$P_t = aK_t^{\alpha}L_t^{\beta}e^{U_t} \qquad (5.44)$$

where

P_t is the output or value-added of the industrial sector, sub-sector, or individual enterprise in physical units or monetary units

a is constant

K_t is the stock of capital of the industrial sector, sub-sector or enterprise in monetary units

L_t is the size of labour force measured in man-hours

α is the elasticity of output in respect of capital, defined as the per cent increase in output if the stock of capital is increased by 1 per cent, other things being equal

β is the elasticity of output in respect of labour, defined as the per cent increase in output if the number of employed is increased by 1 per cent, other things being equal

On the basis of these estimated elasticities of output with respect to capital and labour, the planner can project the additional capital and labour that will be needed to increase the output of a given sector, sub-sector or enterprise.

Another typical use of elasticity models is for analysing the relationship between demand for a given manufactured good and its price, income levels and the prices of alternative commodities. This relationship may be estimated on the basis of the following equation:

$$D_I = KC^a P_I^{-b} P_{II}^{d} e^{U_i} \tag{5.45}$$

where

D_I is the demand for the commodity in question

K is a constant

C is income, overall or per head

P_I is the price of the commodity in question

P_{II} is the price of the alternative commodity

a is income elasticity E_c, which is defined as the per cent by which demand for the commodity increases if income increases by 1 per cent, other things being equal

b is the price elasticity E_p of the commodity in question, which is defined as the per cent by which demand for the commodity decreases if its price increases by 1 per cent, other things being equal

d is the elasticity E_{PA} of the commodity in question with respect to the price of the alternative commodity, which is defined as the per cent by which demand will increase if the price of the alternative commodity increases by 1 per cent, other things being equal

The versatility of elasticities can be seen from the following examples. Knowing the income elasticity of a commodity, a planner can get an idea of how an additional dollar's worth of income would be spent. Knowing its price elasticity, he can set an appropriate price or he can formulate policies for tariffs and taxes, which are price components. On the basis of the price elasticity of a commodity with respect to the price of alternative commodities, the planner can, for instance, manipulate prices to shift consumption towards the alternative commodities, as, for example, towards commodities that can be produced from local raw materials or by the traditional sector. The relationship between demand D for a commodity and its price P_I, the price P_{II} of the alternative commodities and income C may take a linear form.

$$D = h + aC - bP_I + dP_{II} + U_i \tag{5.26}$$

where

h is a constant

a shows the increase in demand due to income increase by one monetary unit, other things being equal

b shows the decrease in demand due to price increase by one monetary unit, other things being equal

d shows the increase in demand due to price increase in the alternative commodity by one monetary unit, other things being equal

The average elasticity of prices and demand for the period under study may then be calculated as follows:

$$E_P = b\overline{P}_I/\overline{D}$$

$$E_{PA} = d\overline{P}_{II}/\overline{D}$$

$$E_C = a\overline{C}/\overline{D}$$

where

E_P is the price elasticity of the commodity in question

E_{PA} is the elasticity of the commodity in question with respect to the price of the alternative commodity

$\overline{P}_I$ is the average of price observations, i.e. $\Sigma P_I/n$

$\overline{P}_{II}$ is the average of the price observations of the alternative commodity

$\overline{C}$ is the average of income observations

$\overline{D}$ is the average of demand observations

$\overline{E}_C$ is the elasticity of income

When analysing price time-series, planners must make sure that they use constant prices, because inflation, both within the national economy and on the world market, makes estimations based on current nominal values useless. In this connection, developing countries should encourage the preparation of realistic price indices for deflating time-series data, which are expressed in current prices.

There is ample scope for estimating different elasticities in the everyday work of the planner, provided he has sufficient and relatively reliable statistical data on the treated economic variables. It should be noted, however, that while econometric models need not be carried out by the planners themselves, it is they who should tell the statisticians and econometricians what kinds of econometric analyses are needed.

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VI. Stages in the preparation of industrial plans

A. Evolution of an industrial plan from a draft national plan

As has already been pointed out, a national plan, in whatever depth, is a prerequisite for an industrial plan. The national plan sets the overall objectives and specifies the role of each economic sector in the development process. It allocates the nation's financial resources, its labour force and natural resources, and it co-ordinates sectoral targets. To facilitate sectoral planning, the draft national plan must provide, at the very least, the following indicators for ten to fifteen years:

(a) Growth of population and the labour force, as well as distribution of the labour force among different sectors of the economy;

(b) Growth of national income and the shares thereof of consumption and of savings;

(c) Estimation of financial resources and the allocation of investments among the sectors;

(d) Growth of stock of capital and its main structural components and changes in the capital-output ratio;

(e) Growth of exports and imports.

A decisive influence on growth is, of course, the savings rate of a country. Savings are a prerequisite for expanding productive capacities. They come into existence when some part of the national income is not used up by current consumption but is used instead for expanding national production, or kept in inventory to be consumed later. It is also possible for savings to be borrowed from other countries or to be received as gifts. Savings can be hoarded or loaned out; they can also be used immediately to form capital.

The part of savings required for adding to the existing stock of capital K and for working capital during one year is called current investment I^n, or new investment. If, for convenience, we assume that savings are equal to new investment, we can express the national income Y as follows:

$$Y = C^p + I^p + C^g + I^g + E - M \tag{6.1}$$

where C^p is private consumption, I^p is private new investment, C^g is public consumption, I^g is government new investment, E is exports and M is imports.

$$B = E - M \tag{6.2}$$

where B is the savings from abroad. New investment can then be expressed as follows:

$$I^n = I^p + I^g \tag{6.3}$$

$$Y = C + I^n + B \qquad (6.1^a)$$

where C is total consumption. If we add to both sides of equation (6.1^a) the value I^r of investment required for replacement of worn-out fixed assets, we get the following:

$$Y = I^r + C + I^n + I^r + B \qquad (6.4)$$

$$N = C + I + B \qquad (6.4^a)$$

where I is gross national investment and N is gross national income.

The greater the ratios I^n/Y and I/N, the greater the investment that can be channelled into capital formation. The central planning body must estimate the above-mentioned ratios, and it must also project the availability of foreign loans and the costs of debt servicing to have an idea of the financial resources, in local and foreign currencies, that will be available for national development in general and for the industrial sector in particular, both public and private. Tables 16 and 17 are suggested models for tabulating some of this information.

Table 16. Sources and applications of investment for the industrial sector
(Million dollars at t_0 prices)

	Year											
Item	t_0	t_1	t_2	.	.	.	t_{13}	t_{11}	t_{12}	t_{13}	t_{14}	t_{15}
Applications												
Gross domestic capital formation												
Gross domestic investment in fixed capital												
Increase in inventories												
Sources												
Financing of capital formation												
Gross national savings												
Provision I^r for consumption of fixed capital												
Net savings I^p in private sector												
Net savings I^g in public sector												
Savings from abroad B (net position in current balance of payments account)												

Table 17. Investment requirement for the industrial sector
(Million dollars at t_0 prices)

	Year											
Item	t_0	t_1	t_2	.	.	.	t_{10}	t_{11}	t_{12}	t_{13}	t_{14}	t_{15}
Public												
In local currency												
In foreign currency												
Private and traditional												
In local currency												
In foreign currency												

1. Analysis of industrial production

The planned gross investment ratio decides the proportion of supply of consumer goods to capital goods in a country. This can be easily explained on the basis of equation (5.19).

$$X = W + R + I + C + E - M \qquad (5.19^a)$$
(repeated)

where X is gross product, W is total intermediates consumption, I is gross investment, C is total consumption, E is exports and M is imports. If we assume that total exports equal total imports, then equation (5.19[a]) can be rewritten as follows:

$$X = W + R + I + C \qquad (6.5)$$

If we further assume that gross inventory remains constant, then equation (6.5) can be simplified as follows:

$$X = W + I + C \qquad (6.6)$$

Since $N = X - W$, then:

$$N + I + C \qquad (6.7)$$
(repeated)

If we assume a closed economy situation, then the structure of the industry will take the following form:

(a) The output of consumer manufacturing industries will be equal to what is spent in the country on manufactured consumer goods and services;

(b) The output of capital goods industries will be equal to the gross investment I; and the intermediate goods industries will meet the total requirements of the economy for intermediate goods W.

However, because the capital and intermediate industries are weak in most developing countries, their economies are distorted. They depend by and large on developed countries for their means of production and for intermediate goods, and to balance imports of the latter they must export raw materials and agricultural products. If their economies are to be restructured, there must first be an analysis of the existing structures.

It is important in the first place to discover the weaknesses of the industrial sector by comparing the demand for key products with the supply. The data may be tabulated in the form suggested by table 18.

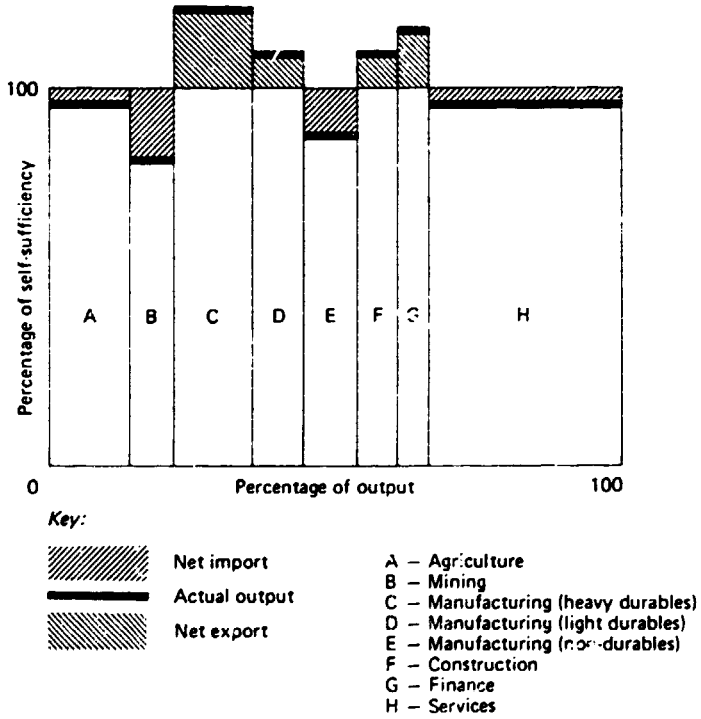
It would also be useful for a planner to compare the structure in his country with structures in other developing countries and in developed countries, especially those of similar population and natural resources. For this,

Table 18. Model for analysis of the structure of industrial production

Industrial product	*Demand*	*Local production*	*Local production less demand (+ = exports, − = imports)*	$\frac{\text{Exports/imports}}{\text{demand}} \times 100$

he can use "skyline" charts,[26] two hypothetical examples of which, one for a developed country and one for a developing country, are presented here as figures XII and XIII. However, it should be pointed out that this method of comparison has only relative meaning. For example, just because there are agricultural exports from a developing country does not mean that it enjoys food self-sufficiency; likewise, the net export of minerals may simply be due to a general weakness in the manufacturing industries.

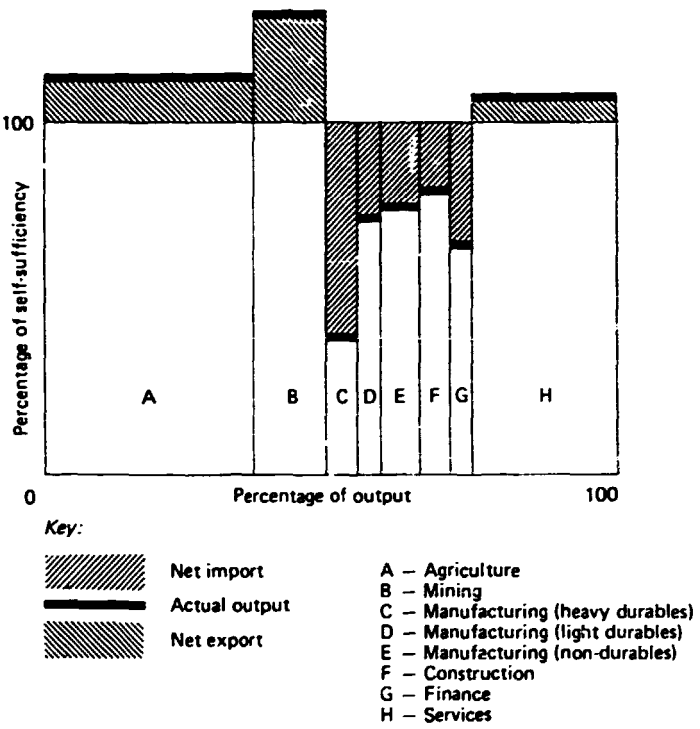
Figure XII. Self-reliance and self-sufficiency chart for an industrialized country



Input-output tables, if they are available for successive years, are a good tool for analysing an economy's initial state, particularly the structure of its industry, for they can reveal interlinkages among sub-sectors as well as the economy's dependence upon foreign countries. They show how the structure is changing and the extent to which the economy is moving from relatively weak interdependence to strong interdependence. Using input-output tables to compare the structure in one developing country with that in other developing countries and in developed countries is also very useful, for it can reveal possibilities for increasing intermediate products.

[26] Skyline charts for developed and developing countries were given by W. Leontief in "The structure of development", *Scientific American*, vol. 209, No. 3 (September 1963), p. 162.

Figure XIII. Self-reliance and self-sufficiency chart for a developing country



A useful technique for revealing weaknesses in the industrial structure of a developing country is for the planner to triangulize the disaggregated input-output table. A triangulized, disaggregated table is one rearranged so that the zero entries are concentrated within a single angle of the table. The technique may be illustrated by the following example. Table 19 is a hypothetical matrix of the economy of a developing country. In this form the table shows little or no particular pattern of either dependence or independence among sub-sectors. Once it has been triangulized, however (see table 20), the structural weaknesses become clear.

Table 19. Hypothetical input-output table for the economy of a developing country

	Uses of product i							*Sources of product i*		*Total availability of product i*
	Consumption as intermediate				*Final demand*					
Sub-sector	*1*	*2*	*3*	*4*	*Total*	*Local consumption*	*Exports*	*Imports*	*Local production*	
1	3	2	0	4	30	20	10	10	29	39
2	0	2	0	0	40	15	25	0	42	42
3	1	6	2	2	10	10	0	11	10	21
4	0	5	0	3	30	30	0	24	14	38

Table 20. Triangulized hypothetical input-output table for the economy of a developing country

Sub-sector	Uses of product i: Consumption as intermediate				Final demand			Sources of product i		Total availability of product i
	2	4	1	3	Total	Local consumption	Exports	Imports	Local production	
2	2	0	0	0	40	15	25	0	42	42
4	5	3	0	0	30	30	0	24	14	38
1	2	4	3	0	30	20	10	10	29	39
3	6	2	1	2	10	10	0	11	10	21

Table 20 reveals that structural interdependence is rather weak. It shows other structural features as well. The sub-sector producing product 2 has highly backward linkages, and its output goes almost entirely to final demand, particularly exports. The sub-sector producing product 3 has no backward linkages but very strong forward linkages, and half of its production goes to final demand; half of product 3 is imported. One fourth of the products of sub-sector i are imported and one-fourth are exported; this would be typical of a sector with a wide variety of products, such as agriculture, where certain products are exported and certain other products must be imported.

To permit a detailed analysis, the table should be disaggregated to show which products are exported and which are imported, although this can also be done on the basis of balances. Comparing the triangulized tables over time makes it possible to evaluate changes in structure, particularly to learn if the import-substituted and export-promoted industries have developed backward linkages with the primary sector. If, for example, the sector that comprises import-substitution industries does not develop backward linkages with the national economy, it will not be of any use in restructuring the national economy.

Of similar interest is evaluation of the development of basic and intermediate industries and their interlinkages with the rest of the economy. Supplies of consumer goods and services and capital goods must stay in the same proportion to each other, as set by the gross investment ratio I/N. If, for example, the gross investment ratio is 0.2, then the ratio between the net value of supply of capital goods and the net value of supply of investment goods must be kept at 1:4. As long as the planned investment ratio does not change, supplies of both kinds of goods must grow at the same rate. If, however, the gross investment ratio increases as income grows, then the supply of capital goods will increase relative to the supply of consumer goods and services.

Analysis of the production of capital goods (means of production and intermediate goods). Durable capital goods maintain and expand the stock of capital in an economy. They usually take one of the following forms:

Buildings
Installations
Power machinery and power equipment
Installations for storing and transmitting
Machine tools and other technical equipment
Tools, devices and models

Lifting gears, conveyors

Vehicles for rail and road; ships and aircraft

Laboratory instruments, measuring instruments, testing apparatus and weighing machines

Factory and office apparatus and equipment

Some commodities can be used interchangeably as durable capital goods or as intermediate goods. Steel, for example, is an intermediate product if processed by the mechanical industries but a capital good if used in construction. The most precise way of analysing demand for capital and intermediate goods is, of course, through balances. In the initial stages of industrialization, developing countries must concentrate on balancing the key capital and intermediate products, such as cement, steel, oil products, sulphuric acid, fertilizers, tractors, lorries and agricultural pumps.

As was discussed at the beginning of chapter V, balances should be used for sub-sectoral planning. Cement, for example, should be balanced in connection with the planning of the building and construction materials sub-sector. Such a plan must examine the possibilities of using alternative materials, for example, bricks, lime and tiles; it should recommend the most practical design for different constructions, and it must take into account the availability of raw materials.

Analysis of the production of consumer goods. The ultimate goal of a country's planning process is to raise the standard of living of the people by better satisfying their basic needs for consumer goods. With this in mind, the national plan should address the question of standard of living.

Basic needs must be analysed in packages. For example, in elaborating the need for food, a planner must seek the optimal combination of nutrients: proteins, including both animal and vegetable proteins, fats and carbohydrates, and also mineral salts and natural vitamins. This combination, or package, must accord with the tastes, traditions and customs of the people and of course with the availability of food. Moreover, the value of total basic needs satisfied in a country during one year must equal the value of manufactured and non-manufactured consumer goods and services from both local and imported sources.

Work on a draft national plan should begin with an analysis of the past living standards of the population. This would of course mean calculating historical per capita consumption for basic needs, such as food (not only in terms of processed and unprocessed foodstuffs, but also in terms of protein and calories), textiles, footwear and housing. It would be useful to determine these past per capita consumption figures, or norms, in the form of time-series so as to assess the progress, or lack thereof, in satisfying the basic needs of the population. To understand the needs of the poorest people, it is important that the planner disaggregate consumption according to income, and that he do this for both urban and rural populations. Table 21 is a sample table for this exercise. It would be useful, too, to compare these norms with those of other countries, developing and developed.

It is essential that the planner solicit the ideas of public officials and of representatives of different social groups when he sets the levels of consumption that are to be considered acceptable. He should also identify the essentials for achieving these levels: investment, mastery of technologies, manpower, industrial infrastructures, imports, financing etc.

Table 21. Model table for per capita consumption by different income groups (urban/rural)

Item	Income group							
	1	2	3	4	...	...	...	n
Protein								
Calories								
Footwear								
Textiles								
.								
.								
.								

The following indicators will help the planner in elaborating the section of the draft national plan on the standards of living. They should be worked out as carefully as possible and made consistent on the basis of balances:

(a) General indicators of the well-being of the population: the share of consumption in the national income; resources available for consumption; real per capita income, if possible, real per capita income for different strata of the population; indices for cost of living;

(b) Consumption: daily per capita consumption of the main foodstuffs (grain and grain products, milk and dairy products, meat and meat products, fish and fish products, vegetable oils, sugar and potatoes—an average ration of about 3,000 calories per person per day); yearly per capita consumption/acquisition of the main (non-foodstuff) consumer goods, such as fabrics, knitted goods, leather, footwear; the number of durable consumer goods, such as radios, bicycles and television sets, per family or per 100 families;

(c) Housing and municipal services: the average living space per person; the amount of housing construction in progress in rural and urban areas; the number of new housing units; the availability of municipal services, consumption of electricity, gas, water; the volume of work on domestic services rendered to the population;

(d) The type and frequency of transportation services provided to the population;

(e) Education: the number of primary, secondary and vocational schools per 10,000 population; planned additions in staff, students and schools;

(f) Health care: the number of hospital beds, doctors etc., per 10,000 people;

(g) Culture: the number of libraries and recreational facilities; the number of books, magazines, newspapers per capita etc.

On the basis of these indicators, the industrial planner can calculate balances for processed foods, textiles, leather and other non-durable consumer goods, as well as for durable consumer goods, such as televisions, bicycles and furniture.

The products of light industry and the food industry make up over 75 per cent of the total volume of consumer goods in most developing countries, and the main supplier of raw materials for these industries is the agricultural sector,

the processed products of which account for about two thirds of all consumer goods. Given this close relationship, the production of consumer goods and the production of agriculture and of other raw material sectors must be harmonized in such a way that the people's requirements are met.

In order to eventually meet the anticipated demand for manufactured goods, the planner has to calculate and meet, by domestic production or import, the demand for the associated intermediate goods. Since a large part of these intermediates will be drawn from agriculture, this sector itself may have to be modernized, expanded and intensified, a task that requires capital inputs such as tools, machines and fertilizers from the industrial sector. In drawing up balances for the basic industries that are interlinked with agriculture, a planner needs to know the effect of investment in one industry on output in other industries. For example, what is the investment required to produce 1 kilogram of fertilizer and what is the effect of 1 kilogram of fertilizer on agricultural output? Technical coefficients that quantify these effects would enable a planner to calculate how much investment is necessary in one industry, say, fertilizers, to increase output by one unit in another, say, agriculture.

Though it may seem obvious, one more piece of advice should be given: before committing financial resources, which are limited, the planner in a developing country should first exhaust all possibilities for improving the standard of living in other ways. For example, it might be possible, during initial periods of industrialization, to increase productivity without large financial investments, by simply reorganizing production.

Analysis of manpower. Planning is always carried out with one main goal in mind: to raise the standard of living of the people and to create productive jobs for them. Surplus population and unemployment and underemployment are the most intractable socio-economic problems faced in the great majority of developing countries. Accordingly, draft national plans should come to grips with manpower planning. and for this the following information should be available:

(a) Present socio-demographic indicators: population size, including urban/rural proportions; social composition of the population, including numbers of employed, unemployed and non-working women;

(b) Long-term projections of size and structure of the population;

(c) Medium-term estimates of labour resources and skills, as well as their distribution by economic sector and by region.

The economic demand for skilled workers and experts may be determined from two balance calculations: the demand for skilled workers and sources for meeting this demand; and the demand for engineers and experts with higher specialized education and sources for meeting this demand, such as universities and colleges.

The technical coefficient a_i, the number of man-hours of labour required to produce one dollar's worth of output by sub-sector i, can be estimated, on the basis of experience, as follows:

$$a_i = \frac{L_i}{X_i} \tag{6.8}$$

where L_i is the total annual labour, in man-hours, needed to produce the planned annual output X_i of sub-sector i.

Because the coefficient a_i is based solely on past experience, its application could lead to poor results, for it does not reveal hidden unemployment. Hidden unemployment must be eliminated in developing countries, otherwise the labourer will consume more than he produces, production will become unprofitable and the economy will stagnate. It would therefore be preferable to adjust the coefficient a_i to reflect international norms.

The total requirements L_{ind} of the industrial sector for labour may then be calculated as follows:

$$L_{ind} = \sum_{i=1}^{m} a_i X_i / \text{average number of working hours per person per year} \qquad (6.9)$$

The industrial plan must ascertain the requirements for skills by group, e.g. turners, welders, carpenters and drivers. For this it can use the following formula:

$$L^*_{ind} = \sum_{i=1}^{m} a^*_i X_i / \text{average number of working hours per person per year} \qquad (6.10)$$

where L^*_{ind} is the requirement of industry for the group of skills * and a^*_i is the number of man-hours of skills * required to produce one dollar of output in sub-sector *i*.

The overall labour force and the various skills should also be disaggregated by industrial sub-sector, taking into account the peculiarities of the branches of the sub-sector, as well as by type of ownership, that is, public or private and by modern vs. traditional. One way of planning the amount of manpower in management and administration at the sectoral and sub-sectoral levels is to estimate it on the basis of a regression analysis of the Cobb-Douglas function.

Planning for the teaching skills is also extremely important. This effort should include the upgrading of existing skills and the training of young people taking up their first jobs. Such planning must be done on a regional basis; it must take into consideration the skills requirements common to all the sectors and it must include on-the-job training, particularly at construction sites. Experience shows that the process of building industrial capacities, particularly large industrial complexes and the associated infrastructural facilities, can serve as a mass on-the-job training scheme.

The balance of labour for a sub-sector can be estimated, given information on planned output and using employment coefficients, as outlined in table 22. The requirements for specific skills in each sub-sector can be estimated in the same way.

Table 22. Model table for estimating the labour requirement of a sub-sector

	Branch of sub-sector									
	Modern sector[a]									
	1		*2*		...		*n*		*Traditional sector*	*Total for sub-sector*
Item	*P*	*G*	*P*	*G*	*P*	*G*	*P*	*G*		
Output of branch *i* (dollars)										
Average labour requirement per dollar output of branch *i* (man-hours per dollar)										
Total labour required by branch *i* (man-hours)										

[a] P = private, G = public.

Regional manpower balances assume importance because manpower planning for the country as a whole does not necessarily reveal surplus labour deficits of certain skills in a particular region. These balances may be used to determine the advisability of encouraging people to move to economically more promising areas. They may be drawn up as follows:

Labour force as per 1 January of year *t*

\+ New entrants into economic activities, including young people taking up jobs

\+ Graduates of universities, colleges and technical schools

− Departure by reason of death

− Retirements

\+ Employed people coming from other regions to work

− Employed people going to other regions to work

= Working people as per 31 December of year *t*

The labour force of a region on 1 January of any year, for example *t* + 5 or *t* + 10, may be calculated on the basis of labour technical coefficients for the different sectors of the economy within the region. The information shown in model table 23 will be required.

Table 23. Model table for estimating the labour requirements of a region

	Sector			
	Agriculture	*Industry*		
Item	*Different agricultural sub-sectors*	*Different industrial sub-sectors*	*Other sectors*	*Total in the region as per 1 January*
Output of sector or sub-sector *i* (dollars)				
Average labour requirement per dollar output of sector or sub-sector *i* (man-hours per dollar)				
Total labour required by sector or sub-sector *i* (man-hours)				

The difference between the labour requirement and the number of people who are able to work is indicative of unemployment (or, possibly, of a labour shortage) in the region.

Shortages or surpluses of qualifications or skills can be revealed in the same way. It is advisable for developing countries to strengthen their regional planning by creating specialized units for this, as was suggested in chapter II. These units can also concern themselves with skills or with the distribution of natural resources, such as minerals, water and soil, within the regions. Regional planning is a prerequisite for locating new industrial projects and ensuring supply, and it can play a decisive role in averting pollution and other problems, such as road congestion and bottlenecks in public transport.

2. *Planning the growth rate of the industrial sector*

The growth rate of overall GDP or of GDP originating in the industrial sector is determined mainly by the following relationships: *(a)* the investment ratio I^n/K; *(b)* the incremental capital-output ratio $I^n/\Delta Y$; and *(c)* the output-capital ratio Y/K. The first two ratios reflect growth due to new investment; the third ratio reflects growth due to the improved utilization of the existing stock of capital, with no new investment. Before setting a target growth rate for the industrial sector, planners should take into consideration the historical performance of the sector (for details see discussion on stability, chapter IV, p. 70).

Growth of the industrial net output. The growth rate $r^n_{ind}(t)$ of GDP originating in the industrial sector and attributable to new investment in this sector may be expressed as follows:

$$r^n_{ind}(t) = \frac{\Delta Y^n_{ind}(t+1)}{Y_{ind}(t)} \tag{6.11}$$

where $\Delta Y^n_{ind}(t+1)$ is the increase in GDP originating in the industrial sector in year $t+1$ attributable to new investment and $Y_{ind}(t)$ is GDP in year t.

The incremental output of industry can be estimated by elaborating the industrial plan at different levels of the hierarchy using iterative procedures. It should be pointed out that only on the basis of iterative procedures can we estimate the value of the incremental capital-output ratio and only, of course, after having decided on the technology, the intermediates to be used, the design, and types of output etc. The construction periods and potential capacity utilization should also be taken into account.

The capital-output ratio K/Y, as was explained in chapter III, expresses the relationship between the value of total stock K of capital used and the value Y of national income in the year t. It represents an aggregate of the ratios of all the sub-sectors, and one has always to remember that this aggregate ratio may be high or low according to which sub-sectors predominate. Capital-output ratios may be affected by the intensity with which capital equipment is utilized: if some of it is standing idle or is used only intermittently, in other words, if there is excess capacity, the ratio will tend to be high. If, on the contrary, the equipment is used effectively, the ratio will tend to be low.

It is important that the planner consider the possibility of increasing income by improving the utilization of available capacities and raw materials so as to increase the output-capital ratio. This can usually be achieved by re-organizing production in order to increase output with little or no additional investment.

The rate of growth r^e_{ind} GDP originating in the industrial sector and attributable to better utilization of existing capacities may be expressed as follows:

$$r^e_{ind}(t) = \frac{\Delta Y^e_{ind}(t+1)}{Y_{ind}(t)} \tag{6.12}$$

where $\Delta Y^e_{ind}(t+1)$ is the increase in GDP originating in the industrial sector in the year $t+1$ due to the improved utilization of existing capacities and materials.

The total growth rate of industry r_{ind} is the sum of the rate of growth due to new investment and the rate of growth due to improvement in capacity utilization:

$$r_{ind} = r^{n}_{ind} + r^{c}_{ind} \qquad (6.13)$$

Not only must one calculate the total rate of growth of gross value-added originating in industry as a whole and in the various industrial sub-sectors, but one must also calculate the rates of growth for the different sections (see table 24). It will be remembered that an industrial plan is divided into three sections: *(a)* the section covering activities owned by the government and completely controlled by it; *(b)* the section covering activities owned by the government but difficult to control; and *(c)* the section concerned with private activities. Because these three sections are relatively homogeneous, their individual rates of growth for gross value-added can be estimated more accurately than the growth rate of the entire industrial sector.

Table 24. Rate of growth of GDP originating in the industrial sector in the medium-term[a]

Plan section j	*Industry sub-sector i*						*Section average*
	1	*2*	*3*	*4*	. . .	n	
Section 1 (activities owned and controlled by the government)	r_{11}	r_{21}	r_{31}	r_{41}	. . .		
Section 2 (activities owned by the government but difficult to control	r_{12}	r_{22}	r_{32}	r_{42}	. . .		
Section 3 (activities of the private sector)	r_{13}	r_{23}	r_{33}	r_{43}	. . .		

[a] r_{ij} is the rate of growth of sub-sector i of section j (j = 1,2,3).

This procedure is referred to as bottom-to-top planning and is complementary to top-to-bottom planning, which starts with the first draft of the national plan. The planner can also distinguish between growth rates for different periods, such as the medium term and the long term, although the growth rate for a long-term plan may not necessarily benefit from the bottom-to-top approach.

B. Sub-sectoral planning

1. Analysis of the sub-sector's initial state

The sub-sectoral plan, irrespective of scope and period, has to be founded on an analysis of the sub-sector's initial state as well as its potential state in the future. The quality of the plan depends, however, on the quality of the information available on the current performance of the sub-sector. If a workable planning process is already in place, then the economy's initial state with respect to a new plan will be identical to its final state under the current plan. In practice this is not quite so straightforward because work on the new plan must start at least a year or two before the current plan terminates. Planners must therefore estimate the extent to which the current plan will have been implemented, and they will have to predict its probable outcome.

Countries that lack adequate information on the initial state of industry must organize a sub-sectoral survey. This is usually the case in developing countries, where despite relatively long planning experience, there are often large gaps in knowledge.

A good grasp of the current state of industry and an understanding of its past development make it possible to identify the main trends as well as the bottlenecks and disproportions that impede industrialization. Such kinds of analysis are necessary not only for the preparation of new plans but also for their elaboration and follow-up.

The starting point for information-gathering is an evaluation of existing sub-sectoral capacities, which can usefully be described from four standpoints: theoretical output capacities; rates of utilization; type of ownership; and, in the case of the traditional sector, possible output (see table 25, a model table for arranging this information).

Table 25. Sub-sectoral capacities and their rates of utilization

Products of group i	*Public sector*		*Private sector*		*"Possible output" of traditional sector*	*Total available capacity*	*Average rate of utilization*
	Capacity	*Rate of utilization*	*Capacity*	*Rate of utilization*			

Information on inputs for different manufactured goods and on their sources, reveals consumption patterns, the role of domestic industries in meeting demand, and the extent to which a country is dependent on foreign sources for meeting final demand. This analysis, which may be organized as suggested in table 26, must also take into account the exports of local industries.

Table 26. Sources of manufactured goods

Products of group i	*Local production*			*Sources of manufacturing goods for domestic consumption*		*Exports*
		Private				
	Products	*Industrial*	*Traditional*	*Local*	*Imports*	

An assessment of the natural resources and intermediates required for the production of the sub-sector in question is needed for deciding the direction, and the limits, of its expansion. The natural resources, both renewable and non-renewable, that must be assessed can be grouped as follows: *(a)* energy resources; *(b)* timber and minerals; *(c)* agro-biological resources.

Agricultural surveys should be conducted for those sub-sectors of light industry that depend by and large on agriculture for their inputs, so as to find out the types, qualities, quantities, costs and locations of natural resources and agricultural products that are potentially available or currently being exploited and whether they are being used locally or being exported. Similar surveys should be conducted to quantify forest and fishery resources, and their maintenance and reproduction.

The surveys should disclose the yields of each crop in each region, as well as the consumption of inputs such as fertilizers and pesticides, and the different levels of technology, which will permit a restructuring of the agricultural sector to improve its productivity and help it to better satisfy the needs of the industrial sector. The surveys should also identify the potentials of each region and should find the reasons for discrepancies between actual and potential outputs as well as the reasons why some techniques are more effective than others.

To secure the agricultural inputs for industrial processing it is important that the planner analyse the pricing of inputs and outputs, the factors explaining this system of prices, for example, the need to keep urban wages low or the need to meet external competition, and their consequences for agricultural development.

2. Concentration of production

One of the advantages of sub-sectoral planning, as was noted in chapter III, is that it allows the production of a certain product or group of similar products to be concentrated at a single producing unit so as to benefit from economies of scale. In calculating potential economies of scale, the planner must take into account the disadvantages of increasing production at a single site. For instance, one cannot locate all tomato processing in a centralized unit because the cost, including that of wastage, of transporting the tomatoes from different agricultural areas and back to the markets, would be too high.

The same consideration does not apply, however, to iron and steel, where concentrating production in one complex is justified, unless, of course, demand is so great that it exceeds the optimum capacity of that particular kind of production unit, in which case a second complex could be considered in accordance with the availability of raw materials, energy resources, markets etc. When the concentration of production is planned, the planning should also cover the private sector, where licences for production units should be issued in accordance with the results of such analysis.

3. Specialization

When planning the sub-sectors of an industry that produce heterogeneous products, such as the mechanical and electrical industries, existing production capacities should be reorganized and restructured in harmony with planned ones, with the aim of concentrating the production of similar goods in single units. For example, a large number of factories in the engineering industries commonly produce similar products, such as gearboxes and bolts.

Example 6.1. In a certain developing country there exist three mechanical engineering factories, A, B, and C, each producing three types of gears, 1, 2, and 3, with the following yearly output:

Type of gear	*Yearly output (thousand units)*			
	A	*B*	*C*	*Total*
1	20	40	10	70
2	20	10	100	130
3	30	20	20	70

If production is reorganized, each factory will be able to substantially increase the productivity of its machines and labour by specializing in one product:

Type of gear	*Yearly output (thousand units)*			
	A	*B*	*C*	*Total*
1	—	70	—	70
2	—	—	130	130
3	70	—	—	70

Higher productivity of machines in these three factories may mean additional output could be produced with little or no additional investment. As shown in the above example, the batch sizes of the products increase, so it may be possible to achieve economies of scale and thus the same volume of production at reduced unit cost.

The private sector must not be forgotten in such a rationalization process. In the first place, licensing policies should be completely in line with the sub-sectoral plan. Policy should discourage duplicate production. It is common in developing countries to license a number of assembly factories for television sets, radios, automobiles etc., but the limited sales market prevents these factories from mass-producing certain components that are usually mass-produced. It might, accordingly, be more economical for a country to concentrate investment/production, be it private or public, in a single, say, car factory or television factory, so as to achieve economies by mass-production of components. In the second place, the planner should explore possibilities for creating core industries to serve relatively small (national) markets. In the mechanical engineering sub-sector, for example, a centralized foundry or forging factory, as well as the production of standardized parts, can play a key role in industrialization. For this purpose, the planner should collect information on production volumes and arrange it as suggested in model table 27.

Table 27. Production volumes by producing unit and product group

Producing unit	*Product group*				
	1	*2*	*3*	...	m
1					
2					
3					
.					
.					
.					
n					
Total output					

4. Product mix

In planning a sub-sector it is important to combine different kinds of production in an optimal way. For example, in planning the iron and steel industry we must decide which stages of production and services to include at each production site, so as to maximize utilization at the site of all by-products generated there and to reduce the cost of transporting intermediates from one site to another. Combined production also plays a key role in the chemical industry, where the inputs and outputs of many chemical reactions are strongly interlinked. Here especially it would be desirable to create complexes that bring together the different branches of the industry.

5. Complementarity

The sub-sectoral planner needs to survey the producing units of the sub-sectors to uncover possibilities for co-operation between small-scale and traditional industries and large-scale industries. It may be possible to integrate small-scale industries within the larger industries by assigning them to carry out special operations or to produce parts as sub-contractors. Components that require labour-intensive operations and assembly of segments could be handled by the small-scale and traditional industries, enabling these industries to participate actively in industrialization and widening reinvestment possibilities and employment opportunities. It should be pointed out, however, that to get co-operation between handicraft and small-scale industries on the one hand and large-scale industries on the other, the government will have to organize training in the necessary skills.

6. Integrated demand forecasting

Long-term forecasts are an important component of industrial sub-sectoral plans. They usually look ahead ten or fifteen years and are routinely applied in a number of cases: *(a)* in analysing demand for the major groups of commodities, for example, steel, sulphuric acid and processed food; *(b)* in analysing demand for labour, strategic raw materials and energy; and *(c)* in estimating the depletion of non-renewable resources. Demand for some materials should be analysed on an integrated basis. For example, demand for food must be analysed on the basis of a whole group of food products because demand for one product could easily be upset if consumers switched to another product. Integrated demand analysis is also called for in the cases of construction materials and energy.

Sub-sectoral planning requires qualitative information on the most economic way to satisfy demand for different commodities. This need can be illustrated by looking at the building materials industry, where the planner must try to identify the types of construction. He should seek ways to expand the output of certain construction materials, and he should also design policies to encourage their use. Where limestone is available, building designs that use limestone should be encouraged; and where bamboo and wood are available, these should be used as much as possible. At mines and mineral processing sites, it might be feasible to make masonry mortars, flooring tiles and the like from the usually abundant fine silicons and dolomitic wastes that would otherwise be disposed of.

C. Preparation of new projects and their integration in the industrial plan

1. Iterative procedures for industrial planning and the role of project preparation

As chapter II pointed out, comprehensive planning begins with the draft national plan, which is divided first by economic sector and next by sub-sector. The planners then elaborate the sub-sectoral plans, their aim being to make optimal use of the country's resources. This approach is referred to as top-to-bottom planning.

A good industrial plan consolidates the findings of the separate sub-sectoral analyses, which in their turn must seek to co-ordinate the capacities of the sub-sector as well as to illuminate the interlinkages with other sub-sectors and other sectors. The benefits of this kind of planning can be impressive, since the plans will have been laid with regard for what is actually taking place in the sub-sector. Well-prepared sub-sectoral plans are, accordingly, the foundation of the overall industrial plan.

After having analysed the existing capacities of a sub-sector, the planner can proceed with drawing up balances of its key products over different periods—that is, for one year and for both the medium and long terms. The left-hand sides of these balances, that is, domestic production, imports and inventory and stocks (see equation (5.1) and examples 5.1 and 5.2), are the most important consideration. If there is uncovered demand, it would be preferable to increase domestic production rather than to increase imports. This can be done by improving the utilization of existing capacities and by increasing capacity through new investment. The new investment needs will tentatively determine the nature, size and scope of new projects or expansion of the existing capacities. If balances have been drawn up for the individual regions, they will suggest where the new capacities might be located.

In order to calculate the investment requirement for the industrial sector, each sub-sectoral planning unit or its equivalent must tabulate incremental capital-output ratios I^n/Y, designated here as S, for all its branches. Calculating these ratios for alternative technologies (see model table 28) will facilitate the choice of technology. Rows 2 and 3 of the table show how to determine the investment requirements when the three alternative technologies permit the

Table 28. Model for calculation of investment requirements for additional output via alternative technologies

	Technology j		
	I	*II*	*III*
Incremental capital-output ratios for alternative technologies j (j = I, II, III) in a given sub-sector	S_I	S_{II}	S_{III}
Envisaged additional production	ΔY	ΔY	ΔY
Investment requirements for additional output	$S_I \times \Delta Y$	$S_{II} \times \Delta Y$	$S_{III} \times \Delta Y$
Envisaged additional production to be equipped with technology j (j = I, II, III)	ΔY_I	ΔY_{II}	ΔY_{III}
Investment required for the envisaged additional production capacity in a given sub-sector	$S_I \times \Delta Y_I$	$S_I \times \Delta Y_{II}$	$S_I \times \Delta Y_{III}$

same additional production volumes. However, if some of the technologies are traditional and small-scale and some are advanced and large-scale, additional production volumes will probably not be the same; in this case rows 4 and 5 will apply.

The planner must not forget to compare these average incremental capital-output ratios with the corresponding ratios for the traditional technologies of a sub-sector. He must also clearly distinguish between activities that should be expanded within the public sector and those that should be expanded within the private sector, in line with the plan; having done this, he will be able to assign the required investments to one or the other sector.

The investment requirement I_i^n for additional output of sub-sector i can be calculated as follows:

$$I_i^n = K_j \cdot \sum_{j=1}^{m} Y_{ij} \qquad (6.14)$$

where K_j is the incremental capital-output ratio for the technological alternative j and Y_{ij} is the planned additional output of sub-sector i that would be based on technology j.

The investment requirement for additional output must be broken down into yearly requirements $I_i^n(t)$. This calculation provides for the preliminary estimation of investment required from public and private savings (see table 29).

Table 29. Model for calculating investment requirement

		Private			
Sub-sector i	*Public*	*Modern*	*Traditional*	*Total private*	*Total sub-sector i*
Industry sector as a whole					

If the projected investment requirements for the public industrial sector exceed the sector's allocation foreseen by the draft national plan, then more licences could be issued to the private sector, providing, of course, that the planned allocation of private savings for the industrial sector has not already been exceeded. If the capital requirements of both the private and public sectors exceed the planned savings, then the planner has to reduce the former; this can be done by opting for more labour-intensive processes wherever possible, bearing in mind that both labour and training facilities must be available, or by postponing projects that are less urgent.

In a similar manner, the planner may calculate the labour requirements of the sub-sectoral plans, after adjusting these to the capital available. This exercise should be carried out on a regional basis. If some regions are seen to suffer from a shortage of labour while others have a surplus, the planner should consider either shifting the surplus labour to labour-short regions or shifting some capacities to surplus-labour regions. Special emphasis should be given to the problems of education and training. Similar exercises should be carried out for the requirements of the planned industrial capacities for energy. If, as can

happen, the energy balance shows supply bottlenecks, it may be necessary to postpone some energy-intensive projects and to give priority to establishing energy-generating projects, such as thermo- and hydroelectric power-stations, including electricity distribution systems, and to establishing refineries for processing natural oil or coal mines that would provide coal for thermoelectric power plants.

Backed by these iterative techniques, the planner can arrive at a more-or-less-balanced industrial plan that indicates *(a)* which existing capacities could be better utilized, and how, and *(b)* what new capacities could be created, where, and with what technologies, inputs and outputs. These new capacities will then become the departure point for project preparation. The costs of new projects must be carefully estimated so that their foreign exchange and domestic financial requirements can be included in the medium-term plan.

With detailed sub-sectoral plans in hand, it becomes possible to explore the further potentials of the industrial sector, as suggested by the available resources, and to integrate new and existing industrial projects. The individual projects contained in the sub-sectoral plan should be technically feasible and economically justifiable. The preparation of technically and economically well-conceived industrial projects constitutes "bottom-to-top" planning.

Industrial projects should be prepared systematically. Just as industrial planning is a continuous process, so also is the preparation of industrial projects. Indeed, the two processes are mutually reinforcing. Information generated by sub-sectoral analysis, as, for instance, the capacities to be added and the preferred technologies and sites, are valuable inputs for project studies. In the same way, information generated during project preparation, such as available technologies, alternative inputs, outputs, by-products, necessary skills and investment, is indispensable for sub-sectoral analysis.

Developing countries will be better able to prepare and implement sound industrial projects if they can establish and strengthen their consultancy engineering capacities, for it is expertise of this kind that is needed to assess the feasibility and commercial profitability of the projects.

2. *Financial and commercial evaluation of industrial projects*[27]

Investment profitability analysis focuses on the ratio between profit and capital. It is extremely significant for identifying commercially sound projects. No production capacity, whether owned by the public sector or the private, can ever recapture the original investment if it cannot cover the cost of production and provide a net profit.

The financial evaluation of industrial projects helps to reveal profitable investment opportunities; it also points out the measures and policies that will be needed to cover the losses of projects that, however essential they are for the country's economy, are commercially unprofitable under the prevailing market conditions.

Industrial projects should be evaluated from a financial standpoint as they are being prepared, with the evaluation being repeated, in accordance with iterative techniques, to reflect information received from the updated sub-

[27]For more details see *Manual for the Preparation of Industrial Feasibility Studies* (United Nations publication, Sales No. E.78.II.B.5).

sectoral plans. Financial evaluation is the key to choosing among the various alternatives. which usually present themselves in the following areas:

Type of process, with respect to technology or intermediates

Scale of production

Combinations of output

Location

The commercial evaluation makes use of discounting methods based on net present values or on internal rates of return. The net present value (NPV) of a project is the value obtained by discounting, separately for each year, the difference of all cash outflows and inflows occurring throughout the life of the project at a fixed, predetermined interest rate. This difference is discounted to the point at which the implementation of the project is supposed to start. The NPVs obtained for the years of the life of the project are added to obtain the project NPV.

The ratio of the NPV and the present value of the investment (PVI) required is called the net present value ratio (NPVR). The NPVR can be greater than, equal to or smaller than zero. When there is only one project in question, it should be gone ahead with only if the NPVR is greater than or equal to zero. When there is more than one project, the one with the highest NPVR should be chosen.

The internal rate of return (IRR) is the discount rate at which the present value of the investment is equal to the present value of cash flows. The procedure used to calculate the IRR is the same as that used to calculate the net present value. However, instead of discounting the cash flow at a predetermined cut-off rate, several discount rates may have to be tried until the rate is found at which the NPV is zero. This rate is the IRR, and it represents the exact profitability of the project.

Commercial profitability can also be assessed by simpler methods that look at the pay-back period and the simple rate of return. The pay-back period is defined as the period required to recapture the original investment outlay through the profits earned by the project. Profit is defined as net profit after tax, including financial cost and depreciation. The simple rate of return is defined as the ratio of the profit in a normal year of full production to the original investment outlay (fixed assets, pre-production capital expenditures and net working capital).

Finally, when planners are dealing with an investment under conditions of uncertainty, because of inflation, changes in technology, unpredictable demand, and hard-to-estimate construction and running-in periods, they should also examine sales revenues, capacity utilization and investment costs. These factors can be examined by uncertainty analysis, which is undertaken in three steps:

(a) Break-even analysis determines the break-even point, i.e. the point at which sales revenues equal production costs in one year;

(b) With the help of sensitivity analysis it is possible to show how the profitability of a project changes as different values are assigned to unit selling prices, unit costs and sales volume. This method is frequently used even if the simple and discounted evaluation methods do not show satisfactory profitability, and if an improvement is felt to be possible by changing some of the variables;

(c) Profitability analysis is carried out in the context of project preparation with the objective of improving the accuracy of cost estimates and, in turn, of profitability forecasts.

3. *National economic evaluation of industrial projects*[28]

The criterion of commercial profitability has a serious limitation in that it does not reveal the contribution of industrial projects to the national economy. For that purpose, a method known as social cost-benefit analysis was developed. It is an approach that can be used to maximize economic benefits in the same way that commercial profitability analysis can be used to maximize profits.

Commercial profitability analysis is based on existing costs and prices. Economic and social benefit analysis is based on costs and prices that reflect the scarcity of goods and services in the economy. These latter may differ from existing costs and prices, in which case they are called "shadow", or accounting, prices. Accounting prices represent a set of equilibrium prices associated with an efficient allocation of scarce resources and maximum output. They can also be used to express social values when these are different from market values.[29]

Indeed, when projects are being selected, both their commercial, that is, financial, and economic benefits, expressed as rates of return, must be considered. In calculating the commercial rate of return of a project, its existing costs and benefits, over the lifetime of the project, are discounted; in calculating the economic rate of return, it is the shadow costs and benefits that are discounted. Nor, of course, are rates of return the only criteria on which projects are evaluated. Other criteria that must be considered include the appropriateness of the technology and the timing of project implementation.

Since in developing countries, public investment predominates, it is the planner who must decide among the various investment alternatives. To do this, he must assess considerable data on existing and new projects to ensure consistency between the investment programme and the target rate of growth laid down in the national plan, and he must see to it that feasibility studies are carried out. National economic plans set out national objectives and represent a starting point for planners, but they must be enriched by the detailed feedback from economic evaluations and feasibility studies. In effect, plans must be related to projects and projects, to plans.

Because developing countries are constrained in using fiscal and monetary policies alone to influence the rate of economic growth, efforts directed at project selection assume relatively more importance. Not only can the right project make a big difference in achieving national objectives, but the efforts that go into the selection can themselves help bridge the gap between planning at the macro level and project programming at the micro level.

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[28]Those interested in reading further on this subject may refer to *Guidelines for Project Evaluation*, Project Formulation and Evaluation Series, No. 2 (United Nations publication, Sales No. E.72.II.B.11).

[29]The problem with social cost-benefit analysis is that it is difficult to apply in practice, mainly because of the uncertainties inherent in constructing shadow prices. For this reason the methodology cannot claim to be policy-prescriptive; it is, nonetheless, suggestive of policy in that it can indicate whether the economy of a given country would head in the right direction if a certain set of projects were implemented. Moreoever, because of its demands for information and for rigorous analyses, it breeds discipline and order in approaches to project development. This, without doubt, is a very good thing, especially in view of the considerable time and money that are spent on feasibility studies in developing countries. Ideally, accounting prices are determined using linear programming within the framework of a general equilibrium solution. However, since linear programming is difficult to apply, partial solutions are resorted to to construct the required parameters.

Example 6.2.[30] A project entitled "Fibreboard manufacture in Ruritania"[31] has been developed to illustrate in a simplified way the computations involved in social cost-benefit analysis. It follows the approach of the *Guidelines for Project Evaluation.*[28]

Basic information. Studies and surveys carried out in Ruritania in the year t_0 led to the formulation of a project that would establish a fibreboard mill in a rural area of the country some 200 kilometres from the capital city. The area can maintain an adequate supply of seven-year-old softwood thinnings for operating a small- to medium-sized fibreboard mill. The potential mill sites are all near the main railway line connecting the most important consumption centres. There are adequate supplies of labour, land, electricity and water for industrial use in the area.

The demand for fibreboard in Ruritania is not currently great enough to absorb the entire output of the proposed mill, which is 6,150 tonnes per year of fibreboard, hardboard as well as softboard. The increases in demand are such, however, that by the year t_5, the earliest that the mill could come into full production, the Ruritanian market should be able to absorb the total output. The pre-feasibility study had explored the commercial viability of the project on the basis of two-shift-a-day and three-shift-a-day outputs. On a three-shift-a-day basis, the mill will be working at 85 per cent of its absolute capacity, i.e. at the rate of 5,260 tonnes per year. Commercial analysis has established the viability of the project at this level of output.

The break-even point could be reached with an output of 2,820 tonnes, i.e. at 46 per cent of absolute capacity, while the pay-back period is 3.3 years when the mill operates at 85 per cent of capacity. The commercial study gives much data that could be used to test the sensitivity of various shortfalls in output, increases in costs or reductions in world prices, but the analysis here will concern itself with converting the commercial figures for an output of 5,260 tonnes into social accounting values.

Methodology. As set forth in the *Guidelines for Project Evaluation*, the two principal objectives of investment in developing countries are aggregate consumption and redistribution of income. These objectives capture most of the other objectives explicitly or implicitly cited in development plans and strategies. For example, valuing outputs (exports) and inputs (imports) using a shadow price for foreign exchange when selecting a project could serve to achieve the goals of an improved balance of trade and an improved balance of payments. Similarly, using a shadow price for savings when selecting a project would take into account the project's effect on the savings rate, and using a shadow price for labour could achieve two other goals: a reduction in unemployment and the redistribution of income. The choice of objective settled, the evaluation of national economic profitability simply becomes an exercise in assessing consumer willingness-to-pay for goods and services.

The direct benefit of the project is that it saves foreign exchange since it replaces imports. An indirect benefit is the effect on consumption and investment in a situation where the savings rate is sub-optimal. An attempt

[30] This example was developed on the basis of a paper to the Symposium on the Use of Socio-Economic Investment Criteria in Project Evaluation, Washington, D.C., 1973.

[31] Ruritania is a hypothetical country.

has been made to calculate reinvestment benefits on the basis of the following formula:

$$RB = [S(p^k - 1] \tag{6.15}$$

where RB is the reinvestment benefit, S is the total saving generated by the project in one year and p^k is the social opportunity cost of capital.

The costs to be attributed to the project are the resources used to put up the mill and operate it. A distinction needs to be made between domestic and external resources. Further distinctions must be made between skilled and unskilled labour in the case of domestic resources and between loan and equity in the case of external resources.

Since we are not concerned in this analysis with a ranking of projects but simply with establishing whether the project under consideration should or should not be included in the stock of projects to come under the scrutiny of the government's project evaluators, our calculation is limited to assessing the present value of the stream of net benefits of the project over its operating lifetime.

We therefore express the net aggregate consumption benefits over the lifetime of the project as follows:

$$NPV = \sum_0^t \frac{(B - C)t}{i + 1} + \sum_0^t \frac{S(p^k - 1)}{i + 1} \tag{6.16}$$

where NPV is the net present value, B are the social benefit streams, C are the social costs, t is the operating life of the project and i is the social rate of discount.

Valuation of output. Fibreboard in Ruritania is mainly used in the construction industry but also to a lesser extent in furniture-making and packaging. The pre-feasibility study stated that CIF prices increased appreciably in Ruritania between t_{-1} and t_0/t_1, despite the fact that world production has been continuously expanding and that substitute materials are available. As a result of domestic production, consumers will have command over a sum of saved foreign exchange that they will be able to spend for other goods. We shall use CIF as the unit of account for valuing output since in this project it represents the amount of utility derived by consumers from the operation in the mill.

Valuation of direct material inputs. The main inputs are thinnings, sawmill waste and eucalyptus for which there are alternative uses in the project area, especially for construction and firewood. We shall therefore assume market prices as reflecting their opportunity costs. The study posits that the Ruritania Power Company could supply all the electricity required by the mill at the established tariff rate. Since there is no subsidy element in electricity pricing, nor is there a rationing in electricity supply, the market price will be used for valuing electricity costs. Market prices will also be used for water and fuel. The latter is also a domestic input, in that supply is obtained from the Ruritania Oil Refinery.

Shadow price of labour. The mill will have a small labour force. Working three shifts a day, it can employ 106 persons, 88 of whom are unskilled or semi-skilled. The mill, which is to be located in a rural area, will withdraw labour from the agriculture sector. Because there is unemployment and underemployment in Ruritania, this withdrawal of

labour will not reduce output in agriculture. In other words, the marginal productivity of labour is zero, provided we ignore the disutility of work. It could, accordingly, be argued that labour should be taken as costless when the social costs of the project are being evaluated. However, in an economy where the savings rate is not optimal, i.e. the social discount rate is lower than the rate of return on investment, we should place extra weight on a unit of investment compared to a unit of consumption. The project would generate additional employment, which is likely to increase the total consumption of the community. Unless the increase in output exceeds the increase in consumption, labour is not, therefore, costless.

Since we assume that the worker's propensity to consume is constant, whether or not he is employed, market wages are taken to reflect the social cost of unskilled and semi-skilled labour. Nor do we propose to use an accounting rate for skilled labour, since we feel that in the Ruritanian economy the wage rate reflects the equilibrium level of demand and supply in the skilled labour market.

Shadow price of savings. Partly to simplify the calculations in this exercise and partly because it would seem realistic to do so, we will calculate the shadow price of savings according to the formula that represents the value of the marginal unit of investment in terms of present aggregate consumption:

$$p^k = r/i \tag{6.17}$$

where p^k is the shadow price of savings, r is the social rate of return from investment and i is the social rate of discount.

Shadow price of foreign exchange. Foreign exchange in Ruritania, as in other developing countries, is not freely available at the official exchange rate. It is subject to controls which seek to ration its use. Therefore, the marginal willingness-to-pay for foreign exchange exceeds its value at the official rate. The shadow price of foreign exchange, which is a means of measuring this excess, is a key parameter in social cost-benefit analysis. In practice, however, it is difficult to determine this price, although we need not go into these difficulties here. For our present purpose we will use the *Guidelines for Project Evaluation* formula to get a first approximation of the shadow price U of foreign exchange:

$$U = r\left(1 + \frac{\text{Tariff revenue}}{\text{Import expenditure}}\right) \tag{6.18}$$

where r is the official exchange rate.

Social rate of discount. We have already observed that the social rate of return r in the private sector exceeds the social rate of discount i. This is a typical phenomenon in developing countries and poses a problem in choosing the rate for discounting future benefit streams to the present. A lower social discount rate would mean the diversion of resources from profitable private sector investments to public sector investments. But there is need for adopting uniform treatment in both sectors, since governments in developing countries usually shoulder the responsibilities of both sectors. In the case of the fibreboard project, for example, the government is expected to contribute 57 per cent of the equity capital through its financial institutions.

We shall therefore use a social discount rate of the social time preference variety to derive present value. To determine the social rate of time preferences, we will use Ragnar Frisch's formula:

$$s = \frac{D}{1 - D} \tag{6.19}$$

where D is $1 - (1 - B)[1 - y(-w)]$, B is the pure social time preference, y is the growth rate of per capita income and w is the elasticity of the marginal utility of income with respect to income.

Taking w as equal to -2, following Frisch, B as 0.05 and y as 0.02 yields a social time preference of 10 per cent, which we shall use for discounting benefit streams.

Table 30 summarizes our calculations of parameters based on the assumptions and observations made hitherto.

Table 30. Value of parameters

Parameter	*Value/converting factor*
Output	0.81
Direct material inputs	1.0
Unskilled and semi-skilled labour	1.0
Skilled labour	1.0
Foreign exchange	1.28
Social return on investment r	20%
Social rate of discount i	10%
Shadow savings rate p^k	2.0

The result. Table 31 presents the resource flows over a period of 12 years, based on the parameters established in table 30 and corrected by the shadow price of foreign exchange. The total net benefits are discounted using a social discount rate of 10 per cent to derive the net present value, which equals 5,887,843 Ruritanian dollars. On the basis of this positive result, the project can be recommended for inclusion in the stock of candidate projects.

Table 31. Resource flows[a]
(Ruritanian dollars)

	Years											
	1	2	3	4	5	6	7	8	9	10	11	12
Output			3 926 336	5 891 200	5 891 200	5 891 200	5 891 200	5 891 200	5 891 200	5 891 200	5 891 200	5 891 200
Costs												
Equipment and engineering (foreign exchange)		7 616 000										
Land	21 000											
Construction												
Foreign exchange	776 600	302 720										
Domestic	659 750	263 500										
Interest and contingencies												
Foreign exchange[b]	283 264	687 424										
Domestic	175 000	375 000										
Working capital	–	1 291 000										
Material inputs												
Foreign exchange			1 123 584	1 568 592	1 568 592	1 568 592	1 568 592	1 568 592	1 568 592	1 568 592	1 568 592	1 568 592
Domestic			431 713	997 463	997 463	997 463	997 463	997 463	997 463	997 463	997 463	997 463
Management and labour inputs												
Foreign exchange			199 680	199 680	199 680	199 680	199 680	199 680	199 680	199 680	199 680	199 680
Domestic			271 690	323 800	323 800	323 800	323 800	323 800	323 800	323 800	323 800	323 800
Total costs	1 915 714	10 535 644	2 026 667	3 089 535	3 989 535	3 089 535	3 089 535	3 089 535	3 089 535	3 089 535	3 089 535	3 089 535
Net direct benefits	−1 915 714	−10 535 644	1 899 669	2 801 665	2 801 665	2 801 665	2 801 665	2 801 665	2 801 665	2 801 665	2 801 665	2 801 665
Indirect benefits[c]	–	–	200 836	487 318	487 318	487 318	487 318	487 318	487 318	487 318	487 318	487 318
Total net benefits	−1 915 714	−10 535 644	2 090 505	3 288 984	3 288 984	3 288 984	3 288 984	3 288 984	3 288 984	3 288 984	3 288 984	3 288 984
Discount factor	1.0	0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505
Net present value	−1 915 714	−9 577 954	1 727 593	2 471 014	2 246 376	2 042 130	1 856 631	1 687 907	1 534 311	1 394 858	1 267 903	1 152 788

Total net present value = 5,887,843

[a] All foreign exchange flows have been corrected by the shadow price of foreign exchange.

[b] Only the foreign exchange component of interest and insurance charges are included because domestic interest payments are considered as transfers within the economy.

[c] This is calculated assuming S = 50 per cent of commercial profits after tax and are reinvested. Hence RB = [5 Profits ($PA' - 1$)].

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