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06670

Distr.
RESTRICTED

UNIDO/IPPD.195
22 October 1975

ORIGINAL: ENGLISH

UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANIZATION

# MANUAL FOR THE PREPARATION OF PRE-INVESTMENT STUDIES 1/

(Working draft)

Prepared by the
UNIDO Secretariat

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id.75-7966

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# PART I. INTRODUCTION

## Chapter 1. Phases of Industrial Project Development

### The Perspective

Concomitantly with the acceleration of the pace of industrialization in all developing countries, the need for and the number of industrial pre-investment studies have expanded substantially. With the complexity of industries and of the agencies involved, their variety has also correspondingly widened.

The quality of pre-investment studies does not, nevertheless, appear to have kept pace with the multi-dimensional demands made on them. The standard and depth of the studies are often not of a level and sophistication which may ensure rational decision-making at various stages of the investment process.

It is recognized increasingly that success of industrial planning requires dovetailing of project programming with macro-economic planning. Notwithstanding the genesis of industrial programmes at one or the other end of the development process, sectoral planning, project identification and project programming have to be integrated, each one being an organic component of the same mechanism. As a corollary, on the adequacy of pre-investment studies, among other things, depends the efficacy of national economic plans.

Identified - intuitively or rationally - industrial plans for a given period have, in many instances, been degraded to be a catalogue of project ideas which have not been studied in any meaningful detail; when studied, they are based on inadequate data; when the data are adequate, these are unadapted, unrefined or misapplied. Many investment programmes have been frustrated because of high over-runs both in terms of time-scheduling and capital costs. Others have floundered on unrealistic estimation and projections of market size.

It is not seldom that pre-investment studies have been prepared unaided by an engineer, an economist or a market research expert. In such cases, the studies are widely divergent in their contents, conceptual comprehension, conclusions (or recommendations) and presentation. The decision-maker, be it the investor, the project evaluator, the license granting agency or the lending institution, finds itself confused rather than enlightened.

Called upon and directed by official regulatory agencies, financing institution and international collaborators, promoters of industrial ventures in developing countries have rushed into commissioning quick studies. These studies are often a half-hearted exercise deficient in structure, inadequate in dependability, speculative in hypotheses and sweeping in conclusions. The inadequacy of pre-investment studies has resulted in substantial mis-allocation of resources, long gestation periods, high rates of industrial infant mortality or mutilated and lop-sided growth.

The formulation of sound projects and their careful and systematic scrutiny represent the foundation of industrial development under any economic system. Industrial projects can vary widely in size, character and complexity; they can involve the creation of entirely new industries, the construction of new plants or the expansion of the productive capacity of existing ones.

Because of the strong desire of developing countries to industrialize, it might appear that project formulation would be easy. Yet, the fact is that there are few well-formulated industrial projects in developing countries. This has been attributed not only to mechanical problems of preparation but to other unfavourable conditions such as the absence of a properly qualified entrepreneurial class prepared to take initiatives and assume risks and to an inadequate economic policy on the part of governments.

Planners in any developing country could conceive of literally thousands of projects that the country might undertake. However, the possibility of undertaking them successfully may not exist. Thus, it is essential to determine objectively whether a particular project is feasible under the conditions prevailing in the country.

The particular project must be not only feasible but also consistent with the country's overall industrial programme. For example, it might be feasible for a particular country to build a plant to manufacture plastic toys, but this might contribute nothing to further development; on the contrary, the plant would consume scarce resources that might better have gone into some other activity more closely related to the country's general strategy of industrial development. To avoid this situation, industrial priorities must be established for a prescribed period of time. Programmes ought to have a logical and chronological priority over projects.

No project, therefore, can be examined in isolation; rather, it must be studied in relation to the economy and to other projects in the development programme. The importance of macro-economic planning and of sectoral programming must be emphasized, but broad sectoral targets still have to be translated into specific projects. In turn, an analysis of project proposals can lead to the modification and adjustment of broad sectoral programmes and of the overall plan.

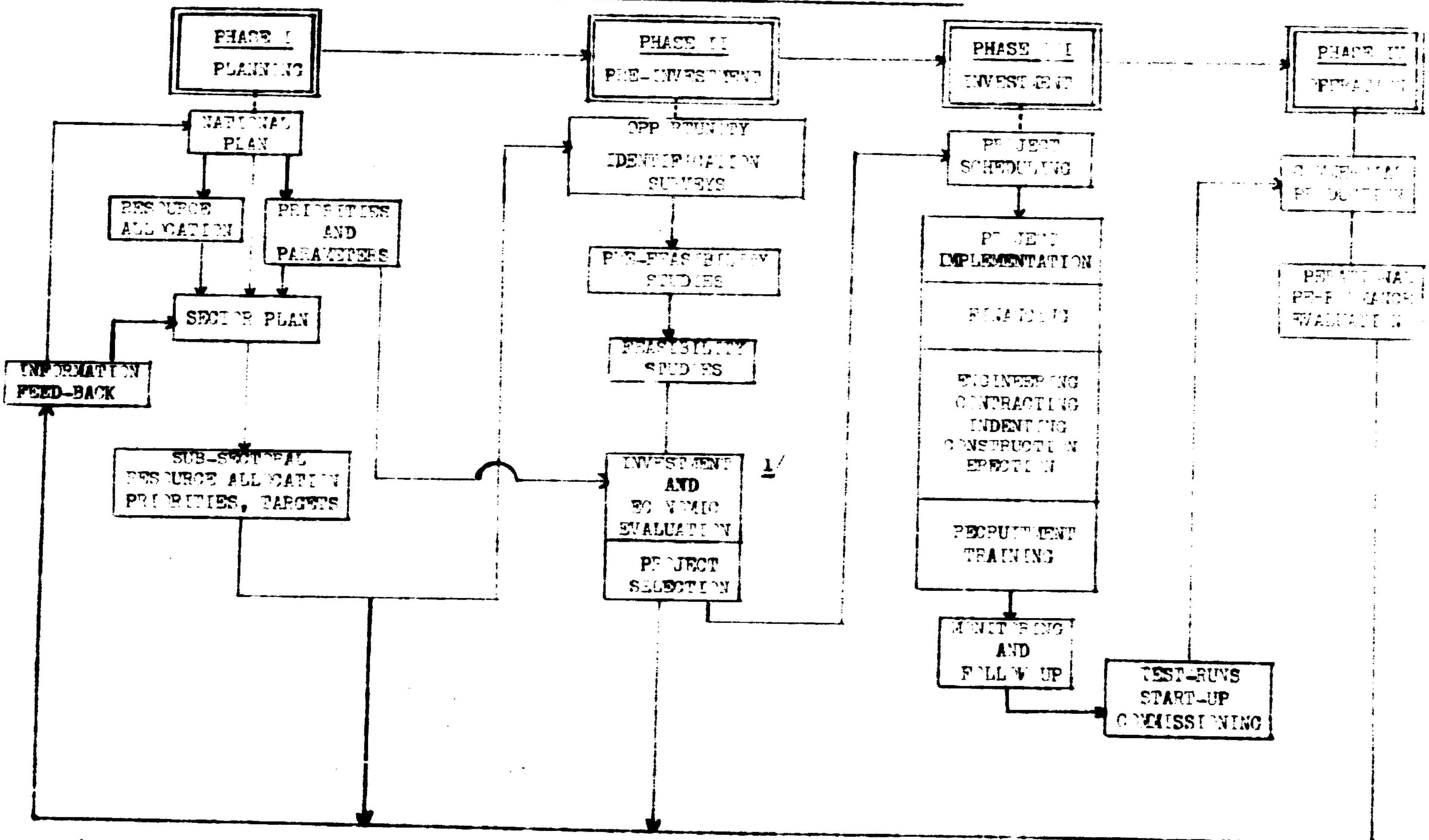
Normally the planning and programming of industrial development passes through a number of distinct phases which can be presented as one cycle (see Table 1): macro-industrial planning phase; pre-investment phase (identification of investment opportunities, project preparation and evaluation); investment phase; operational phase.

The industrial planning cycle may originate either at the national planning level permeating eventually to the micro-project level, or emerge at the project level and travel upwards contributing to the formulation of national industrial programmes at the macro level. All four phases are basically sequential, one activity leading to the other; but nonetheless, the activities, mutually dependent, have multi-directional inter-actions.

During the four developmental phases, a multitude of concepts are developed and evaluated, decisions made, contractual relations promoted and established, financial commitments planned and lined up, and promotional and constructional activities carried out. The elaboration of the project undergoes a number of operations with elements spelt out, refined, matured and evaluated emerging from or leading to investment decisions. The preparation of an investment project may be visualized as a series of activities which require a variety of pre-investment studies facilitating the decision-making process and culminating in documented programmes for the realization of the project.

**Table 1.**

INDUSTRIAL PLANNING AND PROGRAMMING CYCLE




1/ Financial.

Projects are developed within a certain institutional framework which pre-determines the range of possible economic agents involved in the project. The types and sequence of decisions on the feasibility of the project, such as on location, financing, contracting and other aspects, depend on, among other things, the industrial regulations and licensing policy, the role of the banking system, the legislative procedures and other institutional configurations. The scope and depth of information necessary for decisions at various stages of project development, is also a function of the type of the project itself, its scale and complexity, its inter-linkages - backward and forward, and the sector and the industry it belongs to, their structure and dynamics.

Each of the four major phases is divisible into minor stages, some of which constitute important industrial activities. A few of the minor stages may have relatively phenomenal significance when viewed from the standpoint of specific projects and individual promoters. An attempt is made here to refer briefly to some of these stages as an aid to a better understanding of the problems encountered in carrying out the various tasks under the pre-investment phase of industrial projects, the major objective of this manual.

## Macro-planning Phase

An industrial development plan should normally incorporate an explicit overall strategy for industrialization. This provides the basis for planning industrial sector programmes and specific projects. All too often, the overall strategy is missing, and industrial plans are formulated as a conglomeration of plans for individual projects. The result is that investments are not correlated; even individual projects may fail because of the absence of complementary inputs, infrastructure and foreign-exchange allocations, for all of which a plan could have provided.

A basic requirement of a well-formulated plan is the systematic consideration of the interdependence of economic activities, particularly inter-industry relationships. Another basic requirement is consistency. Contradictions between different targets and between different instruments of the plan, and contradictions over time must be avoided or adequately reconciled.

A plan ought to be formulated to achieve a reasonable balance between available resources and economic targets; this would encourage policy-makers and investors to think along similar lines. Although this direct confrontation of means and ends is sometimes evaded in actual plans, those who formulate plans should attempt to bring it about.

Finally, a well-formulated plan should decrease economic uncertainty. This is not a whimsical and economically irrelevant requirement. Indeed, it may be of crucial importance to the success of a plan in an economy where individual expectations have been shaped by a long history of stagnation and low-level economic equilibrium. Unless entrepreneurs know that other projects are also going forward, that purchasing power will be expanding, and that essential infrastructure will be provided, they may not undertake a promising project even though it would be commercially, as well as nationally, profitable. Thus, an effective information programme is needed so that those who make individual economic decisions in the country will have a clear notion of the goals incorporated in the plan and have some assurance of complementary action should they in fact behave as the plan indicates they should.

It is not the time or place here to go into further details with regard to the macro planning phase. Only in order to show the interdependency between the macro-sectoral planning phase and the pre-investment phase, a possible general list of planning stages can be outlined as follows:

<u>The macro-stage:</u>

- Elaboration and transmission of instructions on basic development aims from the Government to the planning agency;
- Collection of statistics and forecasts on supply and demand;
- Macro-forecast;
- Confrontation of forecasts with development aims;
- Formulation of the macro-economic plan.

<u>The sectoral stage:</u>

- Collection of estimates on income elasticities of demand;
- Collection of sectoral data on resources and evaluation of overall technical possibilities;

- Translation of macro-economic targets into sectoral targets;
- Confrontation of sectoral demand and supply estimates and forecast with the sectoral targets;
- Formulation of the sectoral programmes.[1]

The prescription of developmental strategies and the assignment of priorities in industrial development plans are functions of macro-economic planning. At the project programming level, these should be taken as a hypothesis, outside the domain of the project planner and should normally not be questioned by him. This approach is even more so warranted since all project proposals should also be evaluated from the national economic point of view utilizing accepted national parameters such as weights (distribution of income, social rate of discount and merit wants) and shadow prices of investment, labour and foreign exchange.[2]

## Pre-investment Phase

The pre-investment or "the conception"-phase includes the identification of investment opportunities, the preliminary selection stage (pre-feasibility studies), the project formulation stage (techno-economic feasibility studies) and the final evaluation and decision stage.

Once it has been determined that the project idea is in compliance with the goals of the government strategy and plans, and it appears, *prima facie*, as a result primarily of an opportunity study, technologically and economically promising enough to deserve a more detailed study, a pre-feasibility study may be undertaken. If this study demonstrates a high potential, the commissioning of a complete techno-economic feasibility study will be initiated.

When an opportunity study has indicated a distinct possibility of the investment programme being viable, the pre-feasibility stage is by-passed. A pre-feasibility study is a half-way exercise between an opportunity and a full techno-economic feasibility study. A pre-feasibility study is called for when some basic issues remain to be investigated (basic raw materials warrant elaborate pilot plant tests).

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1/ See *Industrial Planning*, UNIDO Monograph Nr. 17, page 5 pp.

2/ UNIDO *Guidelines for Project Evaluation*, page 135 pp.

A pre-feasibility study may, e.g., become a must when the project is too large, such as a two-million-ton steel plant or a half-a-million-ton naphtha cracker. It is not unlikely that the pre-feasibility study (a less expensive exercise) would demonstrate that the project is not viable and the (costly) full techno-economic study need not be undertaken.

The primary function of a techno-economic feasibility study is to appraise - from technical, commercial, financial, economic and management points of view - all the alternative ways of accomplishing the project idea and to present the findings and supporting data in a logical and systematic sequence. A complete feasibility study incorporates a series of partial (market, technological, locational, management) studies in such depth and detail as may conform to the subject matter.

At the final evaluation stage, the decision is taken on making financial commitments for the execution of the project. A thorough and complete evaluation of the project does not only involve an appraisal both in terms of commercial and national economic profitability - by means of social cost-benefit analysis - but also the assessment whether the project is technically viable and that it has selected the best size, product-mix, market segment, location, raw materials, technology, equipment, etc. At this stage the decision will be taken on making financial commitments for the execution of the project. This is a point of no return since, from here onwards, any discontinuation of the project is very costly. A fairly detailed implementation programme should also be available at this stage since the dynamics (time requirements for the execution of the project) greatly influence the profitability of the project. All the stages of project preparation are a part of a continuous decision-making process in order to enable the investor to proceed from one to the other or even to short-cut some of the stages.

The types of decisions vary from stage to stage since project preparation is not only conceived with the techno-economic viability of the project proposal in mind, but prior to this decision also with the choice of technology, processes, raw materials, location, etc. Each stage of project preparation has its typical decision-making pattern which will be elaborated in the manual.

The four stages enumerated under this phase distinguish themselves by their similar economic functions. They can be characterized as being of a preparatory nature. All activities within this phase do not involve heavy financial commitments and therefore constitute the pre-investment phase.

Parallel to the pre-investment phase several other activities are being initiated which reach into the following investment phase. Investment promotion, which occasionally already starts during the preparation of pre-feasibility studies, definitely reaches its peak during the final evaluation stage. All possible economic, financial and technological options are still open, the project is still on the market to find domestic and for foreign investors. Implementation planning and follow-up is sometimes already initiated parallel to the preparation of pre-feasibility and feasibility studies leaving, however, the main thrust to the final evaluation stage and of course to the entire investment phase.

Investment Phase

This phase comprises the negotiation and contracting stage, the project design stage and the construction and start-up stage.

The function of the negotiation and contracting stage is to fix by legal obligations areas of responsibility for the implementation of the project. This stage covers negotiations and the signing of contracts between the investor (or the company), on the one hand, and the financial institutions, consultants, architects and contractors, engineers and equipment suppliers, patent holders and licensors, collaborator, local or foreign, suppliers of input materials and utilities, on the other. This stage involves a host of procedures and efforts which often present in developing countries serious problems and pitfalls. Therefore, more often than not, contracting and negotiations take place at all stages of the investment phase. Only turn-key contracting, a relative less troublesome but a more expensive way of implementing projects, generally limits contracting to this stage.

The project design stage consists of a number of activities, such as time scheduling, site prospecting and probing, preparation of blueprints and other plant designs, development of construction plans including selection and contracting for supply of equipment, negotiations with technical and financial collaborators and lending agencies.

The construction stage involves activities such as site preparation, erection of buildings and other construction work, delivery of equipment, its installation and start-up. Proper programming, phasing, scheduling and effective implementation are vital to this aspect. Overruns may jeopardise the entire economics and viability of the project, which has been the experience of a number of industrial projects in developing countries.

The start-up, or "the delivery"-stage, is a brief but technically a critical span in project development. It provides the link between the preceding phases and the following operational phase. The success achieved at this point demonstrates the effectiveness and success of the planning and execution of the project and is a harbinger of the projected performance of the programme.

These three stages constitute the investment phase of the project and cover the major part of the implementation planning and follow-up. They are characterized by some common features. First of all, these activities involve heavy financial commitments as distinct from the previous pre-investment phase. There are few possibilities open to changes of the project without involving heavy financial loss. Bad time phasing, delays behind the schedule in construction and delivery, start-up, etc., inevitably result in an increase of capital costs and consequently affect the viability of the project. Whereas the time factor does not play such an important role in the pre-investment phase, it is profitable to trade off time for the quality of the concept of the project, in the investment phase time becomes a crucial factor.

The direct costs in terms of money and time should not, however, relegate the pre-investment phase to a position of insignificance. A deficient and faulty pre-investment study is often a major source of post-investment aberrations leading to financial and technical bottlenecks and crises, not merely higher costs.

Operational Phase

The final stage of project development is the factory operation. With the commencement of this phase, the project is delivered, consummated.

A new life is born. The initial factory operations are often beset with many teething troubles some of which are an extension of the problems of the gestation period. The new infant demands all the nursing and nurturing. It is during this phase that the contractual obligations are evaluated and settled in terms of commitments and standards laid down. The guarantees secured from suppliers of know-how and processes, engineers, architects, contractors are released. Some activities initiated earlier, such as pre-operational market promotion, training of personnel, preparation of operational maintenance and management manuals, project into this period.

## The Scope

The present manual on project preparation is basically limited to the pre-investment phase of the entire industrial project development cycle, although some aspects of the investment phase will be briefly dealt with.

The manual is addressed to industrial project programmers, state organisations, planning and development agencies including development banks, consulting organisations and industrial enterprises. It is intended also to assist international field experts in improving their understanding of the pre-investment process and the nature, scope and contents of the studies which they are called upon to design, prepare, supervise or evaluate.

The manual is directed more to the public sector since it is assumed that private entrepreneurs are in a better position to identify investment opportunities and to transform them into project proposals and investments. This need not, however, imply that the standard of pre-investment studies emanating from the private sector is any better. Indeed, some of the studies presented to industrial licensing agencies and financial institutions in developing countries are perceptibly flimsy, perfunctory and incomplete. These have been responsible for dilatory clearances of projects by official and lending agencies. Indeed, in most developing countries, the primary motivation for commissioning or carrying out pre-investment studies has only been the requirements prescribed by the official and financial agencies.

The manual covers all types of industrial projects:

(a) Projects in public, private and joint sectors;

(b) Heavy and light industries;

(c) Producer and consumer goods industries;

(d) New ventures and expansion programmes of existing units;

(e) Programmes of plant modernization and rehabilitation;

(f) Projects sponsored by local and foreign promoters; and

(g) Projects jointly promoted and financed with international collaboration.

It is fully recognized that each category of projects has its own distinct problems. The distinctions, wherever necessary, in the design, development and treatment of the studies, and the tools and techniques therefore are appropriately delineated.

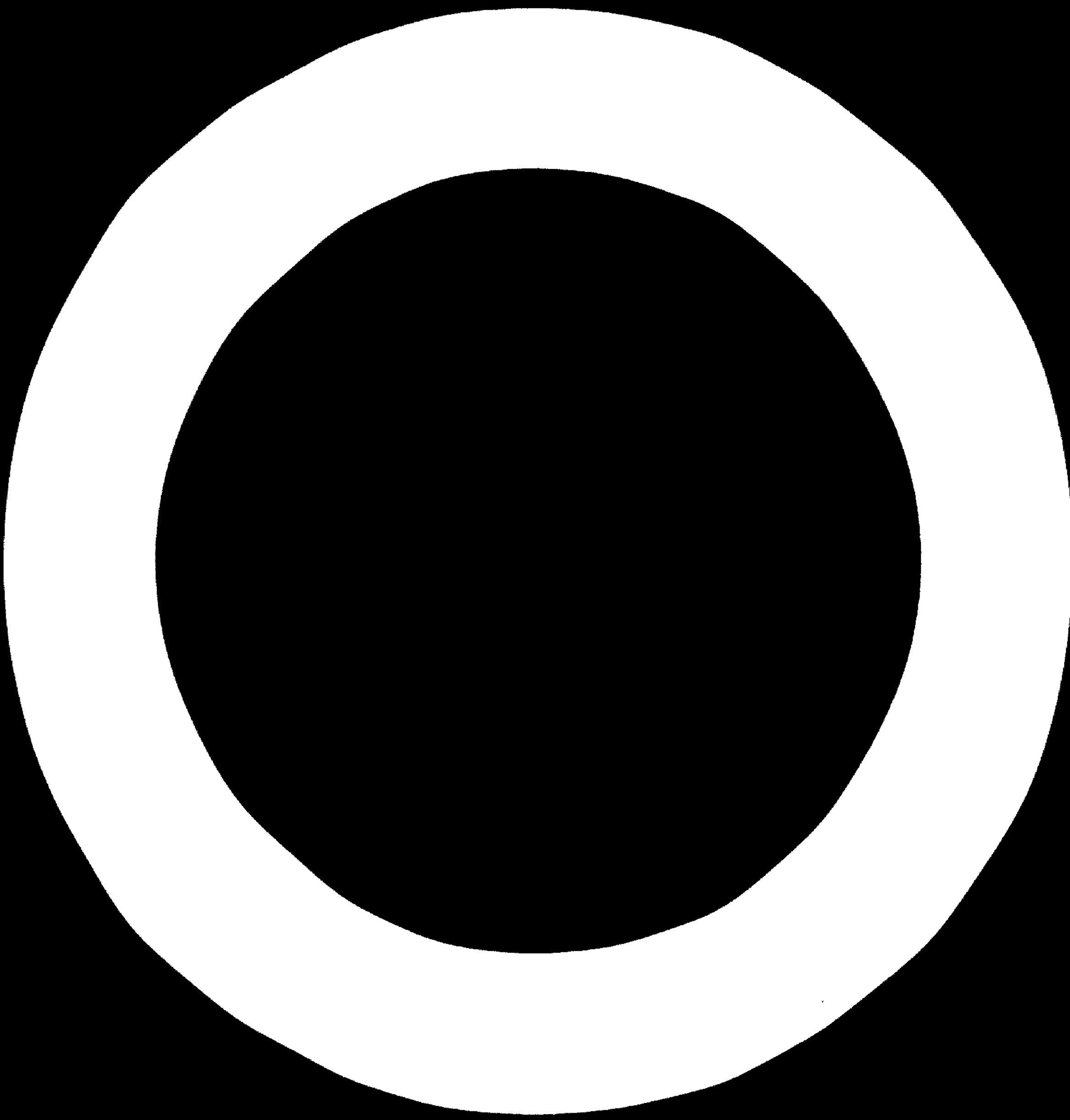
**The design**

The manual is divided into four parts. Part I is introductory in nature. Chapter 1 reviews the different phases of industrial project development process and sheds some light into the importance of the pre-investment phase.

In Part II, chapters 2-6 deal with the types of pre-investment studies, their classification, contents and the caution to be taken when preparing such studies. The difference between opportunity, pre-feasibility, feasibility and supporting studies is elaborated in detail. Chapter 7 shows the role to be played by the various development agencies in accelerating industrial development in general and industrial project development in particular. The costs of the different types of pre-investment studies are also touched upon.

Part III is to be considered as the centre of the manual. It gives a very minute description of the main items of techno-economic feasibility studies. Chapters 8-10 deal with demand studies and market surveys, demand forecasting techniques, market strategy, price policies and product costing. The close relationship existing between the selection of technology and equipment (chapter 11) and the total investment requirements (chapter 12), is shown in detail. The impact of investmnet cost, raw material (chapter 13) and manpower requirements (chapter 14), on production costs (chapter 15) is high-lighted. A brief introduction to problems related to financial planning (chapter 16) concludes Part III.

Part IV concludes the manual by paying some attention to the various types of commercial profitability calculations (chapter 17).



# PART II. TYPES OF PRE-INVESTMENT STUDIES

## Chapter 2. Classification and Types of Pre-investment Studies

### Classification of Studies

At the pre-investment phase the principal studies to be undertaken are:

(a) Opportunity studies for the identification of investment proposals;

(b) Pre-feasibility studies;

(c) Supporting and functional pre-investment studies;

(d) Techno-economic feasibility studies.

With a wide spectrum of project planners and promoters spread all over the world, the basic terminology has acquired variable meanings. The lack of standardization has led to confusion among those concerned. It may, therefore, be fruitful to define some of the basic terminology used for various types of pre-investment studies which will be further elaborated in Chapters 4, 5 and 6. Table 2 shows the screening process which takes place when proceeding from the opportunity to the pre-feasibility and the feasibility stage giving due account to the types of decisions to be taken at the end of each.

### Opportunity Study

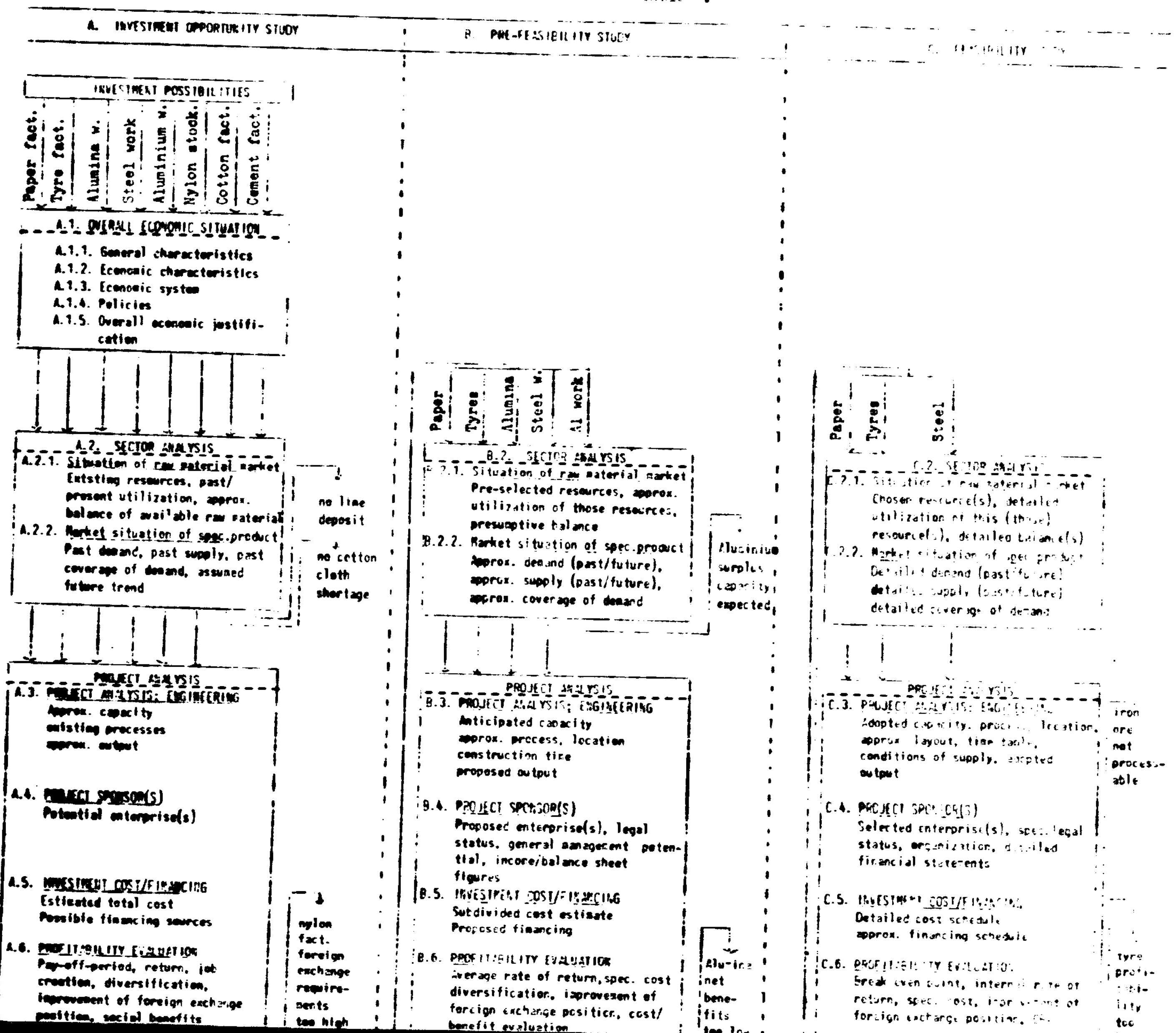
Opportunity studies are normally conducted in order to reveal investment possibilities for certain geographical areas, the same or different industrial sectors for available resources or for specific industrial investment proposals, the latter case being the most common one. It is often believed that opportunity studies are broad profile-type skeleton studies. Opportunity studies for an area or even an industrial sector may, on the contrary, be a far more extensive exercise than a single feasibility study. Each opportunity study is evaluated in an approximative manner based on the preliminary data collected at this stage.

### Pre-feasibility Study

Pre-feasibility studies are confined to particular project proposals

"Stages in the screening process"

Table ?.



and are no longer concerned e.g., with an entire sector or sub-sector. They are prepared with the objective of advancing the project screening process further. The information needed for this type of pre-investment study is more refined than in the case of the opportunity study since the evaluation criteria are less simple.

Techno-economic Feasibility Study

A complete and acceptable feasibility study is a document which provides a dependable and concrete base - technical, economic, commercial and managerial - on which the promoter is in a position to make his investment decision for a project of a given size, at a given location, adopting a given technology, using a given set of raw materials, and providing a given product-mix. Any other choice of any of the elements would give him, in the context of the anticipated conditions, less than the identified return.

An inadequate feasibility study would lead to over-runs, losses or loss of profit, technological problems, financial difficulties, accumulation of inventories.

It has been noted often in developing countries that feasibility studies are presented in a skeleton form. Project profiles based on general technical literature or borrowed from unadaptable conditions, have been entitled or re-phrased as feasibility studies. The sources of data are dubious and the analysis is based on imperfect techniques open to variable connotations and conclusions. There have also been cases in which feasibility studies have been formulated to suit the demands of or to please promoters, who in turn wish to please - or mislead - financial institutions or official agencies regulating industrial development.

All techno-economic feasibility studies have, by and large, the same scope of coverage. However, the scope does, sometimes differ with the sponsoring agency, the nature of the industry, the size of investment and the objective for which the study is prepared. Many techno-economic feasibility studies have been found wanting in the treatment of national economic benefits when those are sponsored by private investors. Similarly, in studies sponsored by foreign technical collaborators, the local raw materials and location receive less than adequate treatment. All techno-economic feasibility studies end up in a final decision about the investment to be undertaken.

Supporting Studies

Supporting pre-investment studies may be defined as exercises which are undertaken to identify, evaluate or to select one or more characteristics of an industrial project. These may deal with, or yield critical phenomena of, a project or programme, but do not cover the entire project, its manifestations or ramifications. These studies help to identify some significant project bases but do not permit full evaluation of the investment, which the principal studies - opportunity, pre-feasibility and techno-economic feasibility studies - alone render possible.

These studies may be qualified as supporting studies since their basic objective is to support principal pre-investment studies and identification of certain leading characteristics of the project. Some of these precede main pre-investment studies, others follow them. Examples of supporting studies are:

(1) Locational studies;
(2) Site selection studies;
(3) Market surveys;
(4) Demand projections;
(5) Raw material selection studies;
(6) Technology and process selection analyses;
(7) Pilot plant studies;
(8) Equipment selection studies;
(9) Studies on economics of size;
(10) Production cost analyses;
(11) Capital outlay studies.

Project Reports

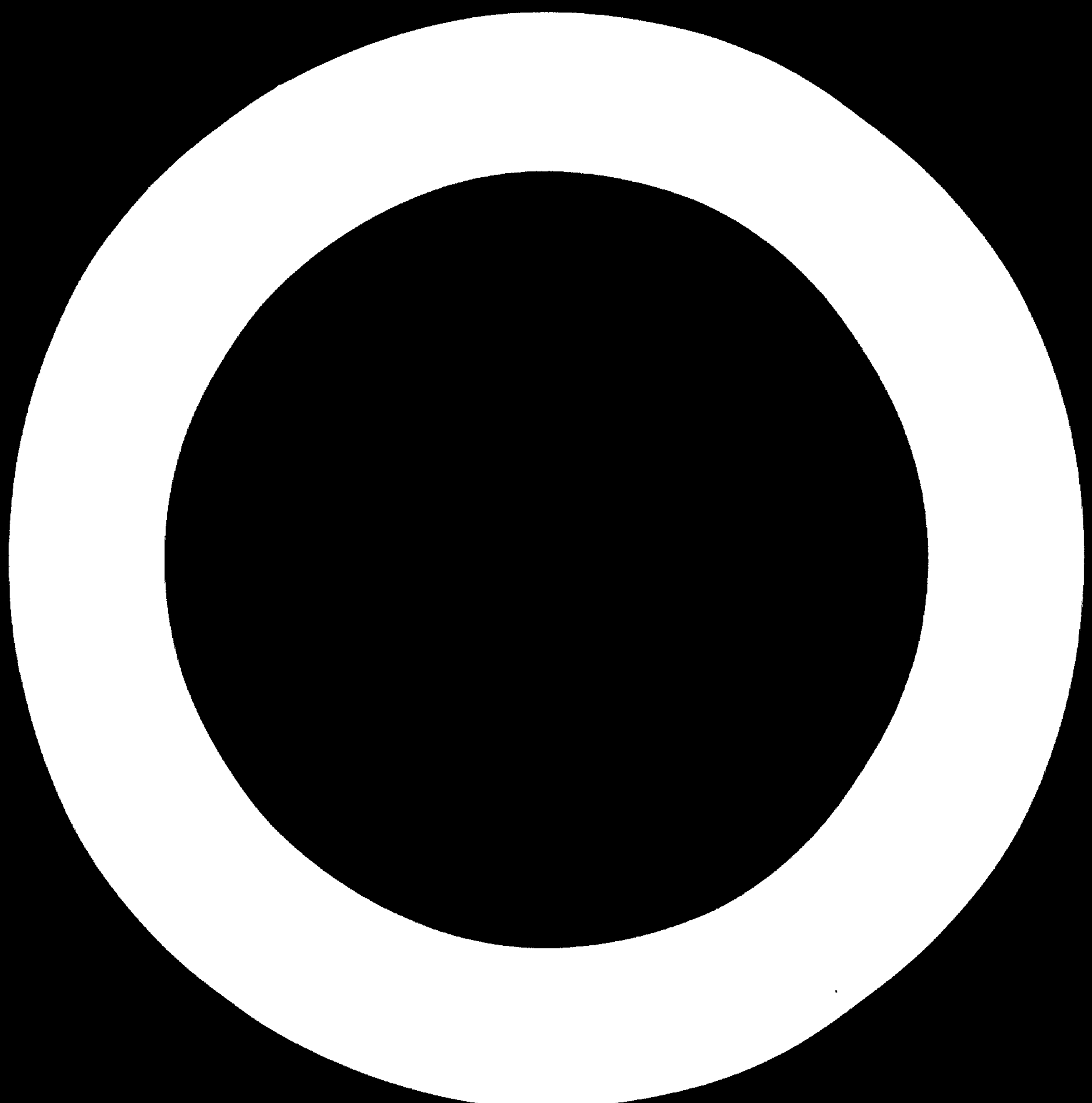
In some countries, project reports or detailed project reports (briefly called DPR) are prepared. Project studies and project reports are not synonymous. All pre-investment studies are covered by the broad title of project studies. Project reports, however, are documents which are prepared to serve as a detailed guide for project implementation.

These are prepared after the investment decision has been taken following the evaluation of the feasibility study and include project scheduling and detailed engineering work, such as drawings, designs, and specifications of process and technology, plant and equipment, utilities, civil works and buildings, manpower requirements, capital budgeting and financial plans.

Other Studies

Besides the enumerated principal studies and supporting studies, there are a number of other variants of pre-investment studies, such as pre-investment data studies, model plant schemes, industrial profiles.

It was earlier noted that there are a number of cases in which the viability of a project is established by a pre-feasibility study, and the impatient industrial strategist, endeavours to combine feasibility studies and project reports. For a fertilizer plant, sponsored by four leading companies, one from India, one from the Netherlands and two from the USA, an ingeniously titled"Project Economic and Engineering Report" was prepared. It was a case of telescoping the process of feasibility studies into what may be termed "a partial project report, which was required to suit the specific conditions of the project".



# Chapter 3. Basic Cautions and Constraints

## Precautionary Steps

Before commencing a study, a precise delimitation of the objectives must invariably be attempted. The focus of the entire exercise must be directed towards these objectives.

Pre-investment studies and project reports govern and guide crucial and substantial investible resources. The task, therefore, in conducting such studies is a highly responsible activity. This calls for a considerable amount of precaution on the part of the individual or agency producing the document. A few of the cautions are enumerated here.

## Classification of Projects

Each type of industry presents its own distinguishing problems. Before designing the study, therefore, the following differences should be noted at the very outset:

(i) The nature of product use: Investment good, industrial intermediate, durable consumer or non-durable consumer;

(ii) The character of industry: heavy, light or mixed;

(iii) The size of industry: Large, largish, medium, small, smallish;

(iv) The age of industry: (Internationally and in the country) traditional, mature, new;

(v) The priority of industry: Core industry, high and low priority industry;

(vi) The structural-operational nature of the industry: Manufacturing, engineering, metallurgical, process, packaging, assembly, service;

(vii) The source of the main feed-stock: Agro-industry, mineral-based industry, animal products industry; marine products processing industry;

(viii) The end-use of products: Food, textile, chemical, metal-based, synthetic products industry;

(ix) The promoter or sponsor of the project: A new entrant, an existing private industrial enterprise being a partnership form or a joint-stock company, the State (or local body), a statutory or public corporation, a co-operative, a foreign company, a multi-national.

Perspective Appraisal of Economic and Policy Background

Before launching a study, an enumeration and a review should be made of the following to develop the basic perspective:

(a) Geographical data, such as severe climatic conditions manifest in extremes of temperatures, too high or low rainfall and relative humidity, occurrences of strong winds hot or cold, typhoons or tornadoes, possibilities of volcanic eruptions and earthquakes, freezing of waterways, proximity to severe competition; proximity to hills, rivers and the sea;

(b) Demographic data - population, regional distribution, age structure, education;

(c) Basic economic characteristics - demographic structure, vital statistics, GNP, per capita income, growth rates, balance of payments position, external debt and sources of international financing;

(d) Economic system - private vs. state property, overall economic planning;

(e) Fiscal and taxation policies of Government with special reference to corporate or business taxes, tariff protection, taxation of foreign capital and know-how and patent fees and incomes of expatriates;

(f) Constraints of economic history, such as political prohibition of trading with certain countries, restraints to mobility of labour, capital and natural resources, special trading preferences, regional or racial;

(g) Socio-political, legal and official policy constraints, such as those relating to development of specified industries or use of institutional instruments, prohibition to establish units in certain specialized industries, restrictions on use of expatriate labour, legislative regulations including the requirements of licensing laws, labour and factory laws; factory legislation, contract law;

(h) Institutional and legal framework, such as those relating to formation of joint stock companies and dispersal of capital, systems of arbitration and for settlement of disputes;

(i) International economic co-operation - multilateral and bilateral, with special reference to trade treaties, double taxation relief treaties, sources of foreign financing of industrial projects, regional and racial or other types of trade groupings and trade preferential systems;

(j) Natural resource endowments - scarce and surplus;

(k) Technological sophistication of industry - to determine the kind of technology and scope for adoption, availability of maintenance facilities;

(l) Availability of technological and economic information, including data bank facilities, public and private;

(m) Availability of manpower - and skills and their mobility and characteristics;

(n) The standards of productivity and labour response to work in industry;

(o) Nature of infrastructure, such as availability (and cost) of means of transport and communications, power and water, the systems of power supply such as voltage systems;

(p) Standards of environmental pollution and regulation governing the same including regulations concerning effluent disposal.

General Guidelines

The national economic priorities and policies evolved by the national planning agency should be accepted and these must provide the starting point. The socio-cultural framework and traditions should be taken as a hypothesis. The existing institutional framework should be fully recognized. If any deviation is considered imperative, the report should be appropriately qualified.

In employing international generated and other reference and simulated data, necessary adjustments should be made to provide for local conditions. When such discounts cannot be quantified, results should be qualified by the enumeration of the divergencies.

All sources of information should be faithfully and scrupulously acknowledged.

The assumptions made in delineating trends or estimating the results must be clearly stated. Illustrations "Inflationary impacts on prices of inputs' have been ignored. Consequential changes in the product prices are expected to neutralize the effects".

All statistical results should be based on conservative estimates, indicating the necessary sensitivities. Sensitivities should be out in unambiguous terms.

No categorical and unqualified statements should be made about future expectations.

The conclusions of the study should be decision-oriented and not shrouded under uncertainties and reservations; but nonetheless, where reservations are unavoidable, these must be stated categorically and expressly.

All adverse factors which may impinge on the successful execution or profitability of the project should be clearly defined. An attempt should be made to anticipate likely factors of technological obsolescence. The risks of the existing or potential competition should be identified.

It should be recognised that there is no need to oversell the project; reservations about technical, commercial or economic non-feasibility should be prominently displayed.

No pre-investment study should endeavour to rationalise, support or reject a pre-conceived hypothesis or assumption. The results obtained empirically and objectively on the basis of facts, unadulterated from accepted positions should be stated without reservations.

# Chapter 4. Scope and Contents of Opportunity and Pre-feasibility Studies

## Approaches to Identification of Opportunities

As was pointed out earlier, a major constraint of industrial development is the dearth of knowledge of investment opportunities that can be developed into investment projects. The fact that many developing countries export capital (or expertise) despite the pressing requirements at home, is partly due to the unawareness among local investors about potential investment opportunities. It is, therefore, a major task of development organizations to help potential investors in locating and identifying such opportunities; when identified, these may be promoted by the government or agencies sponsoring the studies or by private investors.

The identification of investment opportunities may be based on or adopt one or more of the following approaches:

(a) An analysis of natural resources which have potential for processing and manufacture, such as forest products for paper industry;

(b) Projection of present demand of specific goods which have the potential of expansion as a result of population growth, expansion of purchasing power or the emergence of new uses, such as textiles and refrigerators;

(c) Identification of new areas of demand as a result of new discoveries and sophistication of socio-economic life, such as for electronic calculators;

(d) An analysis of imports to locate areas having potential for import substitution, such as for sheet glass in a country having no or only inadequate production of sheet glass;

(e) Discovery of areas of manufacture successfully adopted in other countries and especially the countries with similar stages of development, factor endowments and economic background, such as fertiliser industry in an oil-producing country;

(f) Establishment of interlinkage with other industries, indigenously or internationally, such as sanitary fittings in a country producing ceramics sanitaryware;

(g) Extension by backward or forward integration of existing lines of manufacture, such as downstream petrochemicals industry to a refinery or electric arc steel plants for a steel rolling mill;

(h) Identification of the potential for diversification, such as drugs industry to a petrochemical complex;

(i) Programming for expansion of existing industry capacity to utilize increasing flow of a basic raw material or to attain a more economic size of a plant;

(j) Analysis of the general investment climate;

(k) Analysis of the industrial policies;

(l) Analysis of cost and availability of production factors.

Comprehensive industrial surveys (sectoral or comprehensive census of manufacturing industry) provide the base for opportunity studies by analyzing a number of economic-industrial characteristics. The results of industrial surveys provide pointers and are useful tools for identification of new opportunities. The surveys throw revealing light on industrial structure indicating potential for heavy and light industries and providing directions to new industrial activity. The surveys disentangle existing and potential industrial interlinkages and thereby indicate the scope for developing ancillary, feeder and forward-linkage industries. They are reservoirs of information and provide tools for discovery of opportunities by other devices. An industrial survey, for example, may show a high proportion of import content of certain components of an item of equipment. This will lead to _a priori_ consideration that there is the need for establishing capacity for manufacture of the component. Again, a survey showing the critical character of spare-parts availability may indicate scope for manufacturing facilities for machine tools. Similarly, poor instrumentation in certain industrial undertakings may generate interest for the creation or expansion of an instrumentation industry.

Export surveys become frequently essential to counterbalance the feeble domestic market. Comprehensive studies of imports of manufactured goods are undertaken to identify products for import substitution. Surveys of natural resources may yield useful pointers leading to their exploitation and utilisation.

When identifying investment opportunities on the basis of inter-linkages of industrial activity, it is preferable to consider a group of industrial projects which are interlinked. It might not always be easy, however, to generalize on this principle due to technological divergencies.

The location and availability of natural resources have a close bearing on potential for industries which mainly process primary products, such as food industries. The availability of the relevant technology is equally basic to a project. Other important considerations include the existence and possibilities of developing necessary infra-structure. Thus, electrolytic plants (such as of aluminium) have to be supported by large supplies of cheap power. A 50,000-ton aluminium plant was established in Bahrain based on thermal power although the country does not possess bauxite reserves and has a very small market.

For identification of a number of industrial opportunities, sub-sectoral opportunity studies are required. These are undertaken when it is necessary to identify opportunities based on an abundantly available natural resource as process material. The opportunity study undertaken in the Kingdom of Saudi Arabia for industries based on date palm cultivations belongs to this category. It may include a complete down-line processing possibilities with varying priorities, investment magnitudes and technological viability, such as in the case of petrochemical industries.

Sectoral studies aiming at import substitution are another type of opportunity studies. An example of such studies is provided by the Saudi Arabian building materials industries. The study attempts to analyze size and growth rate of the construction industries, the nature and quantum of input requirements and their potential for development.

Backward area development programmes seek to achieve nationally what is sought to be accomplished internationally by accelerated growth of developing countries. These programmes seek to achieve more balanced social and economic development. Several such studies have been under-taken in a number of developing countries. The primary object of these studies is to identify new investment opportunities. Area studies are limited not merely to the least developed areas, they have been con-ducted for better developed areas to secure accelerated pace of develop-ment and diversification.

Types and Contents of Opportunity Studies

Following the possible approaches, the opportunity studies may be classified as:

(i) Area studies - those seeking to identify opportunities in a given area, such as an administrative province, a backward region or the hinterland of a port;

(ii) Sectoral studies - those seeking to identify opportunities in a delimited sector, such as building materials, food processing;

(iii) Resource-based studies - those seeking to unfold opportunities based on the utilization of a specific natural, agricultural or industrial product, such as industries based on forest products, refinery down-line petrochemical industries, metal-working industries;

(iv) Specific project studies (the most common case) - the opportunity for investments in which may be revealed by one of the approaches outlined in the preceding section and may be the result of:

- An industrial survey;
- An import-substitution study;
- The experience of continued shortages or erratic supply;
- The high foreign exchange expenditure in its importation;
- Need for backward or forward integration or interlinkage;
- The prevalence of high trading profits in the commodity;
- The need for diversification of the product-mix;
- Special demand from a foreign country;
- An outstanding technological advance of break-through;
- Increased input requirements of other industries or sectors (such as fertilizers and pesticides for the agricultural sector).

Outlines of Opportunity Studies

The outline of an area study may be designed on the following pattern:

(i) The basic features of the area: the area size and leading physical features, with maps showing the main characteristics;

(ii) Population, occupational pattern, per capita income, socio-economic background, all set in the context of the country's socio-economic structure and showing especially the divergencies with other areas;

(iii) Leading exports from and imports to the area;

(iv) Basic exploited and potentially exploitable factor endowments;

(v) Structure of existing manufacturing industry utilising the local resources;

(vi) Infrastructural facilities especially of transport and power conducive to development of industries;

(vii) A comprehensive check-list of industries which may be developed on the basis of the available resources and infrastructural facilities;

(viii) Revised check-list purging the one under (vii) by a process of elimination and excluding:

(a) Industries of which present local demand is too small and transportation costs too high;

(b) Industries which offer too severe competition from adjoining areas;

(c) Industries which are relatively more favourably located in other areas;

(d) Industries which require feeder industries not existent in the area;

(e) Industries based on substantial export markets while candidate area is located in the interior and transportation to the port is difficult and freight costs are high;

(f) Industries for which markets are distantly located;

(g) Industries which are geographically not suited to the area;

(h) Industries which do not fit in with national plan priorities and allocations;

(ix) Estimation of present demand and identification of opportunity for development based on other studies or secondary data such as trade statistics for the residual list of industries, residual after the purge under (viii);

(x) Considering economic size of plants and transportation costs, identification of approximate capacity sizes to be examined for development either as new units or as expansion of the existing units;

(xi) Estimated capital costs of selected industries (lump sum)

(1) Land;

(2) Buildings and civil works;

(3) Erected plant and equipment;

(4) Utilities;

(5) Miscellaneous of fixed assets;

(6) Preliminary and pre-production costs;

(7) Working capital requirements;

(xii) Sources of major inputs requirements (approximately):

(1) Raw materials (existing resources, past and present utilization, approximate balance of available raw material(s) vs. present utilisation)

(a) Local;

(b) Shipped from other areas of the country;

(c) Imported from abroad;

(2) Existing (known) technology and process;

(3) Machinery and equipment;

(4) Manpower;

(5) Utilities, especially power;

(xiii) Project sponsor(s) - organisational and management aspects, potential enterprise;

(xiv) An indicative time-schedule for implementation;

(xv) Total investment contemplated in projects and peripheral activities, such as development of infrastructure;

(xvi) Projected and recommended sources of financial resources (estimated);

(xvii) Estimated foreign exchange requirements and earnings (including savings);

(xviii) Commercial profitability: pay-off period, approximate rate of return.

Employment of product-mix, increased profitability and other advantages of diversification (if applicable);

(xix) An analysis of overall economic benefits and especially those related to national economic objectives, such as balanced dispersal of economic activity, estimated saving of foreign exchange, estimated generation of employment opportunities, diversification.

A perusal of the outline would show that it is not necessary for opportunity studies (a) to compute definitive figures of demand estimates based on a specially organized market survey, (b) to conduct extensive mineral or forest surveys, (c) to test the raw material by pilot plant tests, (d) to obtain quotations for ascertaining cost of machinery, and (e) to calculate precisely the operational costs. Indicative figures based on reference programming data, such as other surveys and studies, secondary data, performance of other similar industrial establishments, knowledge-experience, direct or by consultation, of the analysists would be found sufficient. In fact, the two distinctions between the opportunity studies, on the one hand, and of pre-feasibility and feasibility studies on the other, are:

(i) The opportunity studies are generally sweeping in scope, that is, they can even cover several industrial projects at the same time; and

(ii) The opportunity studies are based on broad estimates geared to secondary sources of data, while the pre-feasibility and feasibility studies are based on more definitive, direct and often primary data, especially financial data.

The <u>outline of a sector opportunity study</u> (such as building materials industries) may take the following form:

(i) The place and role of the sector in industry;

(ii) The size, structure and growth rate of the subject sector;

(iii) The present size and rates of growth of demand of different items:

  (a) Of those which are not imported;

  (b) Of those which are wholly or partially imported;

(iv) Rough projections of demand for each item;

(v) Identification of the items in short supply, which have future potential of growth and/or exports;

(vi) A broad survey of the raw materials indigenously available;

(vii) Identification of opportunities for development based on (ii), (v) and (vi), and over-riding factors such as transport costs, available or potentially available infrastructure;

(viii) Considering economic size of plants and transportation costs, identification of approximate capacity sizes to be examined for development either as new units or as expansion of the existing units;

(ix) Estimated capital costs of selected industries (lump sum):

(1) Land;

(2) Buildings and civil works;

(3) Erected plant and equipment;

(4) Utilities;

(5) Miscellaneous fixed assets;

(6) Preliminary and Pre-productive costs;

(7) Working capital requirements;

(x) Sources of major input requirements (existing resources, past and present utilization, approximate balance of available raw material(s) vs. present utilization):

(1) Raw materials

(a) Local;

(b) Imported;

(2) Existing (known) technology and process;

(3) Machinery and equipment;

(4) Manpower;

(5) Utilities;

(xi) Project sponsor(s) - organisational and management aspects - potential enterprise;

(xii) An indicative time-schedule for implementation;

(xiii) Total investment contemplated in projects and peripheral activities, such as development of infrastructure;

(xiv) Projected and recommended sources of financial resources (estimated);

(xv) Estimated foreign exchange requirements and earnings (including savings);

(xvi) Commercial profitability: pay-off period, approximate rate of return;

Enlargement of product-mix, increased profitability and other advantages of diversification (if applicable);

(xvii) An analysis of overall economic benefits and especially those related to national economic objectives, such as balanced dispersal of economic activity, estimated saving of foreign exchange, estimated generation of employment opportunities, diversification.

It may be noted that items (x) to (xix) under area studies are practically the same as items (viii) to (xvii) under sector studies. Once opportunities have been identified, the structural requirements of the studies are the same.

The outline of resource-based opportunity studies would follow the same pattern. This may be delineated as follows:

(i) The characteristic of the resource, the prospected and proven reserves, the past rate of growth and the potential for future growth;

(ii) The role of the resource in the national economy; its utilisation: demand in the country and exports;

(iii) The industries presently based on the resource, their structure and growth; capital employed and manpower engaged; productivity and performance criteria, future plans and prospects of growth;

(iv) Major constraints and conditions in the growth of industries based on the resource;

(v) Estimated growth in demand and prospects of exports of identified items which may be based on the subject resource;

(vi) Based on (iii) to (v) identification of opportunities for development;

(vii) To (xv) same as (viii) to (xvii) under sector opportunity studies.

In the case of individual commodity or specific project-based opportunity studies, the pattern follows that of a pre-feasibility study. The difference between an opportunity and a pre-feasibility study of a specific project lies in the depth and the methods of securing identical information rather than in the pattern of its contents. When an opportunity study for a specific project is conducted, the pre-feasibility study is sometimes even dispensed with. The reverse is also true. A pre-feasibility study is by-passed even when an area or sector opportunity study has unfolded, among others, the opportunity of investment in the manufacture of a specific product. A pre-feasibility is, however, mounted even in the latter case if it is apprehended that the economics of the project are doubtful unless a certain aspect of the study has been investigated in depth, such as a detailed field market survey, a pilot plant test study, an analysis of the economics of raw material production (for example, the viability of growing sugar beets for a sugar mill).

It needs to be recognized that the basic purpose for which opportunity or pre-feasibility studies are undertaken is merely to economize on cost before launching an expensive, time-consuming exercise of a full techno-economic feasibility study. It, therefore, follows logically that the duplication between opportunity and pre-feasibility studies as between the latter and full feasibility studies must be avoided.

An outline and case of an opportunity study is given in Annex... (still to be completed).

## Nature and Scope of Pre-feasibility Studies

To avoid confusion and to sharpen the comprehension of the nature and scope of the three basic types of pre-investment studies, it would be fruitful to recapitulate their objectives. The basic object of an opportunity study is to identify the potential of an investment programme composed of one or more investment projects. In doing so, an opportunity study sets out indicative dimensions of the programme and the magnitudes of investments and a tentative time-schedule. A pre-feasibility study seeks to establish with the use of data indicators and estimates whether an investment programme - generally limited to an integrated project with one or more manufacturing units - and conceived by an opportunity study or otherwise, is a technically, commercially and economically viable programme. An investment idea generated by an opportunity study and considered viable is analyzed and evaluated in depth by means of a feasibility study on the basis of definitive and dependable estimates to determine if it is technically, commercially, financially and economically feasible and preferable (in relation to other marginal programmes).

A pre-feasibility study is a substitute for an opportunity study but it may be undertaken despite an opportunity study. A feasibility study is a must irrespective of either or both, an opportunity and a pre-feasibility study.

An opportunity study does not seek to establish technical or economic viability of the project; a pre-feasibility study does analyse the viability but on a tentative basis. The basic and the primary task, however, of a full techno-economic feasibility study is to determine, on a definitive and dependable basis the techno-economic feasibility of the project idea by employing the necessary techniques of analysis and measurement as may be relevant.

The distinction between a pre-feasibility study and a feasibility study is not one of coverage, it is one of depth and "the firm" character of the estimates.

The positive results of a pre-feasibility study expose the prospective investor to the cost of a feasibility study; the positive results of the latter expose him to a much larger stake, the entire cost of the project. Since the cost of a full techno-economic feasibility study never exceeds 2 per cent of the aggregate project cost, and is invariably only a small fraction of the total, a pre-feasibility study need not be as meticulous and elaborate as a feasibility study. Incidentally, the normal ratio of costs between pre-feasibility and feasibility studies - exclusive of the field surveys and pilot plant tests which may form a part of either - varies between 1:6 and 1:3.

As an extension of what has been stated in the preceding paragraphs, the basic objectives of a pre-feasibility study may be considered to be to determine:

(a) How far does the project conform to and fit into the scheme of the national plans, programmes (targets), priorities and policy preferences;

(b) Whether the project idea is promising enough to deserve detailed analysis and evaluation (by means of a full techno-economic feasibility study);

(c) What aspects of the project are critical to its techno-economic feasibility and deserve in-depth investigation (by means of partial and support studios, such as market research, laboratory tests, pilot plant tests, technological research) before launching a full techno-economic feasibility study.

Several concrete examples would make the point clearer. In a Southeast Asian country, several reports on health programmes and local demand generated by the medical profession indicated an opportunity for the establishment of a project for manufacture of disposable syringes for injections under medical, preventive and immunization programmes. Because of the absence of any production indigenously and foreign exchange constraint, the use of disposable syringes in the country had been negligible, not merely limited. With the market not absorbing presently any demand and the cost of disposalbe syringes being a critical factor, a pre-feasibility study was considered essential. The demand was a critical factor for the project; the minimum economic size of the plant was considered 200 million syringes a year by an American firm with long experience and established reputation.

The pre-feasibility study found that the critical factor for examination was the sterilization of the product. In the absence of an existing market, it was found that more precise data on the market size may be difficult to obtain. A technological search was made for the sterilization programme. It was discovered that gamma radiation was unavoidable. For gamma radiation, there were a number of problems involved, including economics of size, if the sterilization facility was to be an integral part of the project. A search was, therefore, extended to locate a facility. It was found that the official Atomic Energy Commission of the country had established such a facility for other purposes and was willing to sterilize the products of the candidate project. In the absence of this facility, the project would have been shelved without going through the exercise of a full feasibility study. The way was now paved for a feasibility study. The new economic capacity identified was as low as 10 million disposable syringes a year which was only about one-third of the current expected estimated demand. The small economic size itself was a direct consequence of the proposed use of the external facility for sterilization of the product.

An import substitution study - in the nature of an opportunity study - demonstrated the need for establishing a sugar refining project in a Middle East country. A pre-feasibility study came to the conclusion that the feasibility of the plant would depend on the viability and economics of cane or beet cultivation. Before, therefore, undertaking a full feasibility study, experimental cultivation of sugar beet followed by pilot testing of the grown beet was undertaken. It was later found that the feasibility of a refining capacity based on imported raw sugar could be examined with the project permitting backward integration later.

A pre-feasibility study is expected to cover, among other special features of a given project or investment programme, the following characteristics:

(i) The estimated existing size and capacities of the industry (specifying the market leaders), its past growth, the estimated future growth (specifying major programmes of development), the locational dispersal of industry, its major problems and prospects; general quality of goods; past imports and their expected future trend, volume and prices;

(ii) The role of the industry in the national economy and the national policies, priorities and targets related or assigned to the industry;

(iii) The approximate present size of demand, its past growth, major demand determinants - such as growth in income levels - and demand indicators - such as increase in vehicular population for determining the demand for petrol, projections of the growth in future;

(iv) Major market characteristics and especially those relating to price movements;

(v) The nature of anticipated competition to the candidate project from existing and potential local and foreign producers or suppliers;

(vi) Possible technologies and processes which may be adopted and their relative economics in the context of capacity size, determinable with reference to (iii) to (v) and their sources, local or foreign; approximate production programme;

(vii) Approximate input requirements and their present and potential supply positions:

(a) Main raw materials;

(b) Other critical raw materials;

(c) Utilities, especially power;

(d) Manpower with skill requirements;

(viii) In the context of (vi) and (vii), localization of markets and transport costs, pre-selection of the location;

(ix) Project sponsor(s) - organizational and management aspects: proposed enterprise, legal status, general management potentialities; financial situation;

(x) Capital cost estimate (foreign-local currency) subdivided into:

(a) Land and site development;

(b) Buildings and civil works;

(c) Plant and machinery;

(d) Miscellaneous fixed assets;

(e) Utility installations;

(f) Preliminary and pre-production costs,

(g) Contingencies;

(h) Working capital requirements;

(xi) Capital structure and proposed financing (foreign and local currency);

(xii) Costs of production estimate:

(a) Fixed costs (detailed);

(b) Variable costs (detailed);

(xiii) Commercial profitability:

(a) Pay-off period;

(b) Average rate of return;

(c) Estimated break-even point;

(xiv) National economic costs and benefits:

(a) Rough evaluation tests:

(1) Calculation of project exchange rate;

(2) Effective protection;

(b) Approximative cost-benefit analysis: using estimated weights and shadow prices (foreign exchange, labour and capital);

(c) Economic-industrial diversification;

(d) Estimation of employment creation effect;

(e) Estimation of foreign exchange savings.

It was noted earlier that the content patterns between pre-feasibility and feasibility studies are not perceptibly divergent; the deviations arise mainly in the form of the depth and details. Accordingly, it is necessary even at the pre-feasibility stage to examine, perhaps broadly, the relative economics of:

(i) A series of capacity sizes;

(ii) Alternative locations;

(iii) Substitute feedstocks or raw materials;

(iv) Alternate technologies;

(v) Variable product-mix; and

(vi) Divergent degrees of integration.

For purposes of pre-feasibility studies, short-cut methods may be used to determine a number of components of capital outlay and operational costs. For working capital, for example, one of the methods would be to assume operational cash-outflows (for raw materials, manpower, fuel and power, administrative cost, sales promotion and packaging cost, maintenance and repairs, spare parts inventory) for a certain period. This period should correspond to the operational cycle in which working capital recirculates. It is customary to use a two to four month period for this purpose. In other words, if the total annual cash outflows aggregate to $12 million, the working capital requirements may be at $3 million. Similarly, cost of overseas shipping, insurance, clearing, handling and inland transportation may be estimated by applying a percentage figure (say 8 per cent - overseas shipping 5 per cent, insurance 0.75 per cent, clearing and handling 1 per cent and inland transportation 1.25 per cent) to the F.O.B. value. Cost of installation of plant and equipment may likewise be estimated by applying a similar percentage to the delivered value of plant and machinery. These percentages would vary from project to project depending on the nature of plant and machinery. The percentages range widely. For a cotton spinning mill, the appropriate rate would be approximately 3 per cent, for an asbestos pressure pipes plant 7 per cent, for a ceramics plant 10 per cent.

The process may be extended further. For electrical installations and cabling, the percentage would be two per cent of the installed cost of plant and equipment. Preliminary and capital issue expenses may be considered on a lump sum basis such as 5 per cent of the capital. Interest during construction may be estimated on an average without working out detailed cash flow during the construction period. Thus for a project having a gestation period of 2 years and involving term loan financing of the order of $5 million and attracting 8 per cent interest, the rule-of-the-thumb would yield an interest charge of $0.4 million, 8 per cent interest for one year on $5 million.

Even building costs may be computed on an estimated basis without getting detailed estimates made by architects or construction engineers. Depending on the general specifications of factory building with special reference to the height, a per-square-meter cost may be computed. These costs, however, would vary from country to country, and in fact, from area to area.

The technique of estimating project outlays and operational costs should not be applied to major, significant or critical cost components. These must be estimated for the project as a part of the pre-feasibility study. Nonetheless, it is not necessary for a pre-feasibility study to depend solely on firm quotations. In most cases, at the pre-feasibility stage of the project, it would not be possible to obtain firm quotations.

Unlike a final techno-economic feasibility study, a pre-feasibility study need not involve itself in a detailed market survey unless a certain minimum size of the plant is identified as a critical factor in the economics of the project.

An outline and case of a pre-feasibility study is given in Annex ... (still to be completed).

# LEADING ECONOMIC-FINANCIAL RATIOS OF SELECTED INDUSTRIAL PROJECTS

| CHARACTERISTIC/RATIO | PULP & PAPER | SULPHURIC ACID | PETROLEUM COMPLEX | FERTILIZER COMPLEX | WALL TILES & SANITARY WARE | CEMENT | ALLOY STEEL | COPPER WIRE RODS |
|---|---|---|---|---|---|---|---|---|
| CAPACITY (TONS/YEAR) | 60,000 | 380,000 | 379,400 | 345,000 | 10,000 | 36,000 | 30,000 | 32,760 |
| INVESTMENT ('000 $) | 34,000 | 14,900 | 85,400 | 21,000 | 4,781 | 5,196 | 51,880 | 4,645 |
| TURNOVER ('000 $) | 10,600 | 6,888 | 38,706 | 83,750 | 1,573 | 1,456 | 39,100 | 48,758 |
| AS PERCENTAGE OF TOTAL INVESTMENT | | | | | | | | |
| 1. Preliminary Expenses | 1.6 | 1.4 | | | NA | | 0.1 | 0.1 |
| 2. Planning Cost | 3.0 | - | | | 2.4 | NA | 3.4 | 2.2 |
| 3. Engineering Cost | - | 7.4 | 0.8 | 2.8 | | | | |
| 4. Start-up Expenses | - | 4.7 | | | 4.9 | | 3.1 | NA |
| 5. Consultants Fees | - | 0.3 | | | 2.8 | | 3.1 | NA |
| 6. Costs for Test Runs | - | 0.3 | | | NA | | NA | NA |
| 7. Fixed Assets | 84.5 | 76.4 | 99.2* | 97.4* | 83.4 | 94.6 | 78.1 | 57.6 |
| 8. Land | 2.8 | 0.7 | | | 1.1 | 0.5 | 1.1 | 1.4 |
| 9. All Buildings | 15.3 | 22.3 | 29.2 | 40.5 | 32.0 | 32.8 | 24.8 | 5.7 |
| 10. Factory Buildings | 9.9 | 5.2 | 15.3 | 26.2 | 29.8 | 24.1 | NA | 5.1 |
| 11. Machinery | 66.5 | 53.5 | 70.2 | 56.6 | 51.4 | 61.4 | 52.1 | 50.5 |
| 12. Utilities | - | - | 9.5 | 5.4 | 3.5 | - | 2.4 | 2.7 |
| 13. Working Capital | 6.0 | 4.6 | NA | NA | 8.4 | 4.3 | 8.2 | 34.5 |

* These percentages are on total investment less working capital.

Contd.

Table 3

**LEADING ECONOMIC-TECHNICAL RATIOS OF SELECTED INDUSTRIAL PROJECTS**

| CHARACTERISTIC/RATIO | PULP & PAPER | SULPHURIC ACID | PETROLEUM COMPLEX | FERTILISER COMPLEX | WALL TILES & SANITARY WARE | CEMENT | ALLOY STEEL | COPPER WIRE RODS |
|---|---|---|---|---|---|---|---|---|
| CAPACITY (TONS/YEAR) | 60,000 | 300,000 | 379,400 | 345,000 | 10,000 | 56,000 | 30,000 | 32,760 |
| INVESTMENT ('000 $) | 34,000 | 14,900 | 85,400 | 21,000 | 4,701 | 5,196 | 31,200 | 4,645 |
| TURNOVER ('000 $) | 29,600 | 6,000 | 32,706 | 23,750 | 1,575 | 1,496 | 29,100 | 42,752 |
| | | | IN | PERCENTAGES | | | | |
| 14. Factory Building/ Total Buildings. | 68.0 | 22.6 | 52.4 | 64.7 | 96.0 | 71.0 | NA | 88.0 |
| 15. Repair & Maintenance/Value of Machinery | 2.0 | NA | NA | NA | 0.3 | NA | 6.3 | 1.1 |
| | | | PER 1000 TON | OF PRODUCT | | | | |
| 16. Total Investment ('000 $) | 567 | 497 | 225 | 467 | 470 | 92.8 | 1,035 | 142 |
| 17. Labour (Persons) | 9.0 | 0.3 | NA | NA | 33.0 | 1.7 | 20.0 | 1.0 |
| 18. Total Workforce(Persons) | 10.0 | 0.4 | 2.0 | 0.5 | 35.0 | 2.2 | 30.0 | 1.3 |
| 19. Wage Cost ($) | 27,950 | 670 | 7,900 | 1,300 | 40,200 | 3,360 | 47,150 | 4,600 |
| 20. Fuel ($) | 2,400 | ½ | 6,250 | 90 | 20 | NA | | 800 |
| 21. Power ($) | NA | NA | 7,400 | 1,000 | 13 | NA | 24,750 | 3,000 |
| 22. Water ($) | 1,400 | NA | 4,040 | 1,000 | 4 | NA | | 30 |

Source of basic data on which the ratio are based: UNITED NATIONS PUBLICATION; RESEARCH OF INDUSTRIAL FEASIBILITY STUDIES, Vol.1; No. ID/SER.E/7.

## Chapter 5. Support and Functional Pre-investment Studies

### Need for Support or Functional Studies

It was demonstrated earlier that a pre-feasibility study (and sometimes an opportunity study) may demonstrate the need for support and functional studies before a complete techno-economic feasibility study, an expensive exercise, is launched. The nature of studies would depend on the characteristics of feedstocks available and of the end-products, the conditions in the market, the technologies and processes to be used and the locational factors governing the industry. It may, for example, be necessary to determine whether the material could be processed under the contemplated or available processes. In a number of cases, the cardinal feature may be the market feasibility. It would be fruitless to launch a full feasibility or even a pre-feasibility study if it can be established by a market survey that the size of the market cannot sustain an economic-sized plant.

Support and functional pre-investment studies may be defined as studies or exercises in industrial programming which cover one or more but not all aspects of an investment programme and are required to be undertaken as pre-requisites of, or in support of, basic pre-investment studies. These studies cover specific areas, such as the nature and adaptability of raw materials, economics of location, evaluation of alternate technologies.

### Timing of Support or Functional Studies

A support or functional pre-investment study is undertaken before the commissioning of full-scale pre-investment studies (a feasibility study) when it is felt that a basic characteristic, an input, for example, may be a decisive factor in determining the viability of a project and the support study may show negative results. The raw material available in the area may not be amenable to processing under the available processes. Similarly, it may be necessary to undertake an extensive field survey to determine if there would be enough demand to support a minimum economic sized plant.

Support and functional studies are commissioned separately but simultaneously with the basic pre-investment studies when it is found that detailed work required for a specific function is too involved to be undertaken as a part of the feasibility study. A project for a copper smelter may need, for example, a detailed study of the possibilities and costs of mining the ore. Similarly, for undertaking a pulp project, detailed prospecting of the bamboo forests may be warranted.

A support study is undertaken after the completion of a feasibility study when it is discovered in the course of a feasibility study that it would be safer to identify a particular aspect of the project in much greater detail although the preliminary evaluation as a part of the decision-making process may commence earlier. It has been found in developing countries that the financial institutions require certain specific studies to be carried out to enable them to make a full and thorough evaluation of the investment programme in identified areas. Relevant examples of such support studies are a thorough mineral survey or locational studies.

A frequent reason why support or functional studies are separately conducted is that the agency carrying out the feasibility or project report does not have the requisite manpower or expertise to conduct studies in the areas concerned in project formulation. It may be necessary to commission the services of specialized agencies such as technological institutes or specialized consultants.

In most cases, the abridged contents of a support or functional pre-investment study form an integral part of the feasibility studies when the former are undertaken before or in a synchronised manner with them. A considerable deal of discretion, therefore, has to be used in deciding whether a separate study is warranted. When such studies are conducted, these provide the base for the relevant section in the feasibility study. To that extent, these lessen the burden of the feasibility study. The extracts borrowed should define the scope, the methodology, the technique, the limitations or qualifications and the conclusions. It should also state the agency or agencies which carried out the same.

Support and functional pre-investment studies, as pointed out in Chapter 7, include location and site selection studies, market surveys and demand projections, raw material selection studies, technology and process selection studies, studies on economics of size, cost analysis and capital costs.

Contents of Studies

The contents of support and functional studies differ from study to study and project to project. The studies are expected to define the objectives in the context of the project outline, to describe the methodology and techniques used, to name the sources for and the kind of support received and to give detailed analysis of the findings and results. These studies must state the results unambiguously but with all the qualifications needed. On the misreading of the report or misinterpretation of its findings, a wrong investment decision is most likely to be taken. A small error may end up in a big loss.

Location Study

At the outset, the distinction between location and site selection studies may be reiterated. A site selection study is seldom a part of a pre-investment programme and it normally forms a part of the investment phase. As a consequence, it is an integral part of the investment or project implementation phase.

A site selection study may be organized separately or it may be integrated with what is called the "detailed project report" (DPR), which also incorporates the project implementation schedule. A location study, on the other hand, is a part and parcel of the pre-investment phase whether undertaken separately or as a component of a full techno-economic feasibility study.

A location study seeks to select an area and not a particular site of a project. The pin-pointing and delimination of the project area is accomplished under a site selection study. A location study may select a district for the location of the project. In doing so, however, it spells out certain ingredient characteristics. One such study, for example, concluded that the programmed glass bottles project may be located in the Alwar District of the State of Rajasthan (India) but prescribed the condition that the site to be selected should be served by a railroad station.

It is often found that location studies name a city or a town. There are over-riding considerations for such a selection. The subject city may have been best served by power transmission lines, avoiding the additional costs of laying such lines, or it may possess much better railroad facilities. When the project is labour-intensive, the close proximity to the city may obviate the costs of housing and other civic facilities for its labour force. There might be other considerations as well. A particular location may attract cash subsidies from the government if it is situated in a backward area earmarked for special and accelerated development.

When a city or town or such other area is selected as a location, the object still is not to specify the exact site. Any site within a radius of 5 to 25 kilometers, for example, would be considered within the parameters of the selected location.

A special location study was commissioned for a glass bottle plant in India. A location proposed 20 kilometers from Delhi offered a number of advantages. Its main attraction was the proximity to the market, one-third of which was captive market for the management, the management owing a brewery. But it presented a real problem. The state in which it was proposed to be located near Delhi had been facing acute and chronic power shortage. The electric arc furnace was supposed to use a large quantity of power, which could not be ensured at the subject location.

An alternative to the electric arc furnace was an oil-fired furnace. In the context of abnormal rises in prices of petroleum products, it was not only the cost of furnace oil which was found to be high for the economics of the project but its future supplies were considered problematic. The third alternative was the producer gas plant based on coal. The capital cost in this last case showed a 20 per cent rise on the value of plant and machinery. The price of coal was low but the transportation cost was prohibitive.

Accordingly, an alternative location, the town of Alwar was considered. It brought the project location closer to the source of raw materials but pulled it away from the market. The location attracted certain incentives offered by the Government while plentiful supply of electric power was assured. But the rates of electric power were higher at the new site than at the original location. The substitute uses of power were also to be reckoned with. While the first location could not offer power presently, it was programmed that in five years time there would be adequate supplies available there as well. Out of the five-year period, two years were covered by the gestation period of the project. Another factor for consideration was that the wage levels were substantially higher at the first location. On the other hand, transportation of the furnished product involved at the new location shifting from road to railroad.

With this kind of complexity of conditions, a separate location study was an essential factor, almost indispensable. The results of this study might have led to the shelving of the project for a considerable time.

It would be evident from the foregoing case that each location study has to chart out its own pattern. Broadly speaking, however, the following elements constitute location studies for industrial projects:

1. Description of the investment proposal, its capacity, the nature of the product-mix, projected quantities of the outputs;

2. Climate and weather:

2.1 Air temperature:
Diagrams of max - min temperatures for
- one day (extremes and average)
- one year
- ten years

2.2 Humidity:
Diagrams of max - min humidity for
- one day (extremes and average)
- one year
- ten years

2.3 Sunshine:
Daily duration of sunshine over
- one year
- ten years

2.4 Wind:
- Direction and number of days (wind-rose)
- Direction and max velocity
- Destruction winds (hurricanes, etc.) frequency

2.5 Rain (snow):
Duration and height of precipitation
- over 1 hour
- over 1 day
- over 1 month
- over 1 year
- extremes (hailstorms, etc.)

2.6 Dust and fumes:
- Duration of dust winds
- Content of matter in $/m^3$ of air
- Direction of dust-winds
- Drifting sand
- Fumes from neighbouring plants

2.7 Flooding: (from surface sources)
- Height of flood
- Season
- Duration of flood

2.8 Earthquakes:
- Magnitude according to international scales (e.g. Richter-Scale)
- Frequency

Controls:

- Heating
- Refrigeration
- Dehumidification
- Air conditioning
- Filtration of air (dust)
- Windbreaks and similar protection
- Drainage
- Other controls due to local conditions

3 Water:

Quantity available. Quality can usually be achieved technically - though sometimes at excessive cost - but only when quantitative criteria have been met

3.1 Uses: qualitative classification to determine quantity requirements:

3.1.1 Potable quality:
- for drinking and sanitation
- for food preparation
- as ingredient to a high quality product

3.1.2 Special quality needs:
- low solids content (soft or demineralised)
- with special dissolved constituents (brines)

3.1.3 Coolant quality:
- for process heat exchange
- for air-conditioning and refrigeration
- for condensing (turbines, etc.)

3.1.4 Steam generation quality:
Softened or demineralized as used
- for heating only
- to drive turbines
- into product

3.1.5 Quality when used as an inert product ingredient:
- for transport
- for flotation
- for washing

3.1.6 Fire protection:
- quantity
- pressure requirements

3.1.7 Hydroelectric power generation

3.2 Characteristics (without reference to specific uses)

3.2.1 Dissolved content:
- hardness
- corrosiveness
- gases

3.2.2 Suspended matter

3.2.3 Temperature:
max-min over 1 day
over 1 year

3.2.4 Pressure:
- max
- min.

3.3 Sources:

3.3.1 From public utilities:
- quantity max min
- place of possible connection
- diameter and material of existing network
- pressure
- price

3.3.2 By private development of:
- surface supplies (river)
- sub-surface supplies (groundwater)
- reclaimed effluents

This involves:
- water table studies including pumping tests
- riparian rights and easements
- allotments (in conservation areas)
- impounding (for levelling of availability)
- treatment (of effluents for recovery)

3.4 Methods of treatment:

3.4.1 Removal of suspended matter:
- screening
- filtration
- coagulation and settling

3.4.2 Removal of dissolved matter:
- coagulation and settling
- filtration
- chemical or physical softening

3.4.3 Biological treatment of effluents

4. Site and terrain

4.1 Location of site:
- address (country, district, town, street, No.)
- neighbours (name, addresses, types of industries)

4.2 Site:

4.2.1 Description:
- dimensions (length, width)
- height above sea level
- geographical orientation
- topography
- existing rights of way:
tater, powerline, wads,etc.
- price of real estate

4.2.2 <u>Accessibility of site</u>:
- for construction
- for operation

4.2.2.1 <u>Next harbour</u>:
- depth of harbour basin
- loading and unloading facilities
- bearing capacity of cranes
- warehouses and storage

4.2.2.2 <u>Roads (existing)</u>:
- width of roads and bridges
- free height under bridges
- bearing capacity of bridges
- type of road (all-weather road macadam-wad, dust-piste)
- maintenance obligations which the user may be required to assume

4.2.2.3 <u>Roads (to be constructed)</u>.
- next connection to public road
- topography
- sub-soil conditions
- purchase of rights of way
- local jurisdiction and other legal aspects with special reference to maintenance obligations, posting and marking, public access, etc.

4.2.2.4 <u>Railway (existing)</u>:
- gauge, profile
- capacity of rolling stock
- loading and unloading facilities
- bearing capacity of cranes
- traffic restrictions due to seasonal conditions
- warehouses and storage
- tariffs

4.2.2.5 <u>Railway (to be constructed)</u>:
- next connection to public railway
- topography of track
- sub-soil conditions
- purchase of rights of way
- local jurisdiction

4.2.2.6 <u>Air-transport</u>:
- Type of next landing-place
  Airport
  Air-strip (all weather or not)
- Width and length of start-way
- Warehouse and storage
- Tariffs

4.2.2.7 <u>Water-transport</u> (rivers, channels):
- Width and depth of channels and harbours
- Loading and unloading facilities
- Warehouse and storage
- Tariffs

4.2.2.8 <u>Others</u> (ropeways)

4.2.3 Preliminary preparation of site:
- Clearing
  Wrecking and removing of existing structures and other obstructions
  Removing of timber and other growth
  Relocation of power lines, roads or other service facilities
- Draining
  Removal of standing surface water
  Reclamation of swamps
  Diversion of streams
- Levelling
  Cutting and filling to establish general job levels, but not special grading

4.2.4 Soil conditions:
- Bearing qualities (need for tests and borings)
- Ground water
  Level (max-min)
  Chemical composition (agressivity, etc.)
- Dewatering problems likely to arise during excavation and construction
- Other excavation problems due to soil conditions which will affect drilling, blasting, shoring, etc.

4.2.5 Existing communication systems for construction and operation:
- Telephone
  System (hand-operated - automatic)
  Capacity
  Point of tie-in
  Tariff
- Telex
- Wireless

4.2.6 Local transport systems for public use:
- Train
- Bus
- Airplane
- Ship
- Rope-ways

5. Power:

5.1 Electricity from public of private utilities:
- Quantity available (KVA)
- Tension (V) (high, low)
- Point of tie-in (distance to site)
- Price (tariff)

5.2 Fuel oil, gas oil:
- Quantity available
- Quality (kcal/kg)
- Source (filling station, refinery, etc.)
  Distance to site transportation utilities
- Price

5.3 Coal, coke, gas:
- Quantity
- Quality (kcal/kg)
- Source (distance to site transportation)
- Price

5.4 Steam:
- Quantity
- Pressure
- Point of tie-in, connection to site
- Price

6. Waste disposal:

6.1 Character of plant wastes:
- Liquid
- Solid
- "Problem types" (noxious, virulent, radioactive)

6.2 Methods of disposal:
- Discharge into sewers
- Settling in tanks, etc.
- Incineration
- Removal
- Interment
- Special treatment
  Decontamination for radioactive wastes
  Chemical or biological treatment of living organisms before disposal
  Temporary sequestration before disposal
  Others

6.3 Collateral problems which will probably be subject to abatement ordinances:
- Smoke - Fumes - Odors - Pollution

6.4 Local situation:
- Public and private dumps (location, type)
- Sewage system
  Type (rain water-sewage or mixed)
  Point of tie-in
  Diameter of pipes
  Material
  Treatment plant
- Dues

7. Local market situation and administration (for construction and maintenance of buildings):

7.1 Contractors:
- State: firms, address, capacity (manpower), mechanical equipment
- Types of contractors:
  civil contractors, carpenters; painters;
  electricians, tin-smiths; structural steel, etc.

7.2 Building materials:
- State: quality, quantity, price, availability of cement; sand, gravel, timber; reinforcing steel, bricks; constructional steel; tiles; asphalt, bitumen, glass, paint.

7.3 Authorities: (local - regional - national)

7.4 Location of market for final product(s): (local - abroad)

8. Manpower: i.e. the labour pool for construction, operation and maintenance

8.1 Requirements:

8.1.1 Off-site overhead workers
8.1.2 On-site overhead workers
8.1.3 Professional employees
8.1.4 Supervision (direct)
8.1.5 Hourly labour (or equivalent)
8.1.6 Special purposes (training, etc.)

Construction note: requirements will vary greatly with the type of construction. On jobs which are primarly structural, such as warehouse, the emphasis is on iron-workers, masons, carpenters, cement finishers and common laborers For processing plants this emphasis shifts to pipe fitters, electricians and other specialized trades and the overhead for staff assistance is materially increased.

8.2 Local availability:

8.2.1 of professional assistance (see 7.1)
8.2.2 of skilled labour
8.2.3 of unskilled labour

Note: The availability of workers, especially in skilled fields will vary greatly with location. It will be affected by many factors. If there is another industrial activity in the same general area which is offering premium or other advantages to workers, floating labour will be drained. As the fulfilment of the construction schedule will depend primarily on availability of albour, this becomes a matter of vital concern.

8.3 Wage scales and other labour costs:

8.3.1 Wages (raw-wages): employees; skilled labour; unskilled labour.

8.3.2 Allowances for: holidays; subsistence; others.

8.3.3 "Hidden" costs for: payroll-taxes; recruitment; travel-pay; welfare items; others.

Note: Where there is low labour efficiency in remote districts a lower hourly rate may be more than offset by the need for additional employees.

8.4 Living conditions:

8.4.1 Housing
8.4.2 Feeding
8.4.3 Recreation
8.4.4 Schools
8.4.5 Churches
8.4.6 Shopping facilities
8.4.7 Medical welfare

8.5 Special local conditions:

8.5.1 Labour history: to be investigated to determine whether community attitudes on labour-management affairs are compatible with company policies.

8.5.2 Labour jurisdiction: some policies based on local customs may exist which are at variance with general agreements or with generally accepted practices.

9. Fiscal and legal considerations

9.1 Taxes: real property taxes state levies personal property taxes corporate income taxes excise taxes gross receipt taxes sales taxes use taxes.

Note: sales and use taxes will apply during both construction and operation, others mainly during the post-construction period.

Of great importance are also the exemptions allowed by various states as well as the possibility of "fast write-off" for depreciation.

9.2 Building legislation: licenses and permits code restrictions safety regulations compensation laws.

9.3 Special legislation: in some localities special legislation has been enacted (or should be enacted) for the encouragement of new industry.

When owners plan to take advantage of such legislation, they should become fully aware of all that participation will involve.

9.4 Insurance

9.4.1 Normal insurances: fire; accident employers liability.

9.4.2 Special insurances: flood / storm damage earthquake damage.

9.5 The liability to maintain on-site medical facilities: during construction during operation.

## Raw Material Selection Study

The separately commissioned raw material studies have several aspects: (a) the selection of the material (b) the form and quality of material (c) the source of the material. When the problems are limited to (b) and (c), no separate study is normally undertaken. The problem of raw material in such cases becomes an integral part of the techno-economic feasibility study. Nevertheless, in some cases the source of the material may become the subject matter of a separate study.

A nitrogenous fertilizer plant, as pointed out earlier, may be based on coal, naphtha, fuel oil, crude, natural gas, or on electrolytic process. In the last case, huge amounts of power are needed and the only two raw materials are electricity and water. For a nitrogenous fertilizer project, the raw material is of critical importance: it determines the technology and process, the magnitudes of capital and the very economics of the project. Normally, naphtha may be preferred since it is amenable to a neat and proven process. But before such a clear and simple conclusion is arrived at, it may be necessary to determine by a comprehensive study if naphtha would be available in the required quantities and at economic prices without involving very high foreign exchange costs. In the event that alternative materials are easily available, the problem transforms itself into one of the economics of the process and technology rather than of the feedstock selection, although the feed material still poses a basic factor.

Not unlike a nitrogenous fertilizer plant, a similar choice may confront a paper plant. The paper industry may be based on several alternative raw materials such as different types of woods and grasses, bamboo, bagasse, waste paper, rags and residues. In view of the variety of sources from which the enumerated materials may be obtained, very extensive investigations may have to be undertaken; or if these have already been made, they have to be scanned, evaluated and observed. This may need, for example, analysis of reports on forest surveys.

When mineral products are the raw materials, the problem may not be one of making a choice from given alternatives, it may be one of identifying the required deposits with proven reserves and the requisite quality, located at a distance not involving uneconomic transportation costs. The identification of deposits may involve an extensive search through a number of reports and agencies engaged, directly and indirectly, in geological surveys. Once the proven reserves are identified, it would be necessary invariably to obtain samples and to get them tested for analysis for their physical, chemical and other properties. The tests may extend to pilot plant tests if the subject quality of the material has not thus far been processed in known plants.

A possible outline for a raw material selection study (if the subject is a mineral product) would take the following form (for details see Chapter 13 on Material inputs):

(a) The possible alternative capacities of the project with specifications and qualities of the product-mix;

(b) The alternative raw materials - by products, quality specifications (with tolerance limits), quantity requirements;

(c) Technological and process conveniences and problems associated with alternative raw materials;

(d) Prices of materials and their costs per unit of product after providing for material yields, rejection and wastage factors and transportation costs;

(e) Based on (d), tentative selection of one or two materials and their alternative sources of supply;

(f) Intensive data on the selected materials:

   (i) Location of the sources, with geological and other maps;

   (ii) Historical output data;

   (iii) Size of the old (currently exploited) deposits;

   (iv) Location and size of the new discoveries;

   (v) The prospected and proven reserves;

   (vi) Techniques of mining used and to be used;

   (vii) Agencies engaged in mining the material and to be engaged in the future;

   (viii) Historical trend of prices;

   (ix) Future projected costs and prices;

   (x) Physical, chemical and other properties of the material based on laboratory tests;

   (xi) Quality of the old and new deposits and beneficiation or pre-processing costs, if any, involved;

   (xii) Historical record of the processing of the material for the production of the subject products (of the candidate project);

   (xiii) Transportation facilities available and costs of transportation for the movement of the material from the deposits to the alternative locations of the project;

   (xiv) Additional investment under the project for surveying, prospecting, leasing, exploitation and transportation of the raw material;

(xv) Dependability of the foregoing information, relative economics of the alternative materials and sources of supply.

Technical/Technology Selection Study

The primary objects of a technical or technology selection study are:

(i) Search for alternative technologies and processes;

(ii) Selection of the most acceptable processes and technologies;

(iii) Detailed analysis of the characteristics of input requirements under the selected technologies and processes;

(iv) Evaluation of the selected technologies and processes.

From a perusal of the objects for which they are undertaken it would be clear that the significance of technical/technology selection studies cannot be over-emphasized. When such studies are called for, they constitute the core of the project. Their results determine the raw material and its qualities, product-mix, location, size, machinery and equipment and manpower structure of the project. It is, as a consequence, obvious that the results will, in the ultimate analysis, also determine the total capital investment and costs. (However, it may be recognized that there is an established circular inter-relationship among the basic project characteristics, such as raw materials, technology, size, one leading to the other.)

The content package of technical/technology selection studies differs from one project to another. So does the cost involved in terms of time, manpower and financial resources. The problems which may have to be covered and the questions which may have to be answered are enumerated in Chapter 11 on Technology and Equipment. The broad pattern, however, may take the following form:

(a) Technical specifications of the product-mix (unit sizes, dimensions, grades, colours) component by component - and not merely by products - describing the exact specifications, and when possible, standard specifications, with tolerance limits, of materials used;

(b) Possible capacity sizes of the plant in the light of the demand projections;

(c) Enumeration and descriptions of technologies and processes which may be adopted in the light of (a) and (b);

(d) Major raw material and other material requirements and their sources, physical, chemical and other properties, facilities for transportation and delivered costs - the depth of this section would depend on the nature of the raw material, its use history and source and nature of the raw material selection study, if one is carried out;

(e) Elimination of some of the technologies and processes in the light of (d);

(f) Other input requirements and their criticality in the processes selected under (e): thus, some processes and technologies require huge blocks of power (which may be in short supply) such as in the case of an aluminium smelter or a steel electric-arc furnace; in other cases it may be the availability of high technical skills and sophisticated maintenance facilities; in cases of labour-intensive projects, the availability of even unskilled labour may lend to become a critical factor;

(g) Exclusion of the remaining technologies and processes which remain for consideration after the application of factors arriving under (f);

(h) Economic evaluation of the technologies and processes, which deserve consideration after the exclusions under (g), in terms of capital costs, costs of production, foreign exchange component (of both capital and production costs) and in terms of national economic criteria; in making economic evaluation, consideration shall have to be given to the relative life spans of the plants;

(i) Detailed description of technologies and processes proposed to be selected indicating their sources, especially if patents and licenses are involved;

(j) Delineation of a detailed process chart, if necessary, divided into sections;

(k) Enumeration with technical specifications and capacities of machinery and equipment including those for packaging, utilities, testing and laboratory facilities, maintenance workshops, handling, internal transportation (i.e. cranes, trolleys), water supply and treatment; tools and spare parts;

(l) Full line diagram of the plant with drawings of critical equipment;

(m) Sources of machinery and equipment;

(n) Utility requirements, total power load, peak demand (kW), and total power consumption (kWh);

(o) Enumeration of manpower requirements, including technical supervisors and workers, their skills and levels and training standards;

(p) Technical efficiency and productivity co-efficients, such as machine efficiency, material yield factors, wastage and rejection factors, down-times, manpower productivity, power load factor;

(q) Description of effluent treatment and disposal (within and outside battery-limits);

(r) Generation, recovery and processing of by-products;

(s) Technical requirements and specifications of buildings and civil works including foundations;

(t) Factory lay-out;

(u) Implications of alternative locations and requirements for site selection.

In many cases, technical/technology selection studies include pilot plant tests especially when new raw materials are to be processed. It is obvious that several pilot plant tests cannot be carried out. A pilot plant test is, therefore, undertaken when fairly reasonable indications are available for the selection of a specific technology. The pilot plant tests are admittedly expensive. But, nonetheless, if the need for such tests is indicated, there is no alternative shorter course to be adopted. Any laxity on this score may either make the exercise on the feasibility study futile or lead the entrepreneur to a project of speculative validity.

Laboratory tests for determining physical, chemical and other relevant properties of the materials are generally a must for technology selection studies unless the raw material has been used in the past for the production of the same finished products and the analysis is dependably known.

When laboratory or pilot plant tests are carried out, full details of the tests, their methods and techniques, the sampling adopted, the results and the agencies conducting the test, must invariably be set out in the report. A compact summary of these tests and their details have to be incorporated in the feasibility study itself.

Other Support and Functional Studies

The most significant, by the criterion of the frequency of use, of all support and functional pre-investment studies, are market surveys and demand projection studies. These represent a link between opportunity and feasibility studies. There is no economic purpose served in producing goods and services which do not have demand.

It has been discovered in numerous cases in the developing countries that although some demand does exist, it is not adequate to support an economic-sized plant. A project can be undertaken only if the country has a definite comparative advantage in producing the commodity for the international markets, which may be based on plentiful supply in the country of a basic raw material. A steel plant in Saudi Arabia illustrates the first case; an oil refinery or a fertilizer plant, the second. An aluminium plant may belong to a third marginal category which may be considered because of the availability of cheap (practically no-cost) source of energy in spite of the absence of bauxite deposits and a domestic market.

The problems, scope and contents of market and demand projection studies have been discussed at length under Chapters 8 and 9 and it would be a duplication to recount them here.

The pilot plant studies have been referred to in the earlier sections of this chapter. These are always conducted by external specialized agencies, such as research and technological institutes, laboratories, process owners, producing companies, machinery and equipment manufacturing establishments. Their presentation would depend on the nature of each problem and the practices followed by the agencies conducting them.

The studies on economics of size are generally conducted as a part of technology selection studies. These are separately commissioned when several technologies and market sizes are involved but the problems are confined to the economics of size and do not extend to the intricacies of technology. The principal task before these studies is to evaluate the most economic sized plant after considering alternative technologies, investment costs, production costs and prices. The studies normally take three or four capacities for analysis and develop the broad characteristics of the project, computing results for each capacity size. It is mainly a problem of presentation of the results for alternative capacities, rather than of the presentation of an elaborate study.

The equipment selection studies are required when very large plants with numerous separable divisions and sections are involved and the sources of supplies and costs are widely divergent. Sizeable projects such as steel plants with a capacity of one or more million tons need equipment selection studies. Equipment indenting including preparation of bids, invitation for bids, their evaluation, indenting and deliveries are normally functions and activities carried out during the implementation or investment phase. But where very large investment are involved, the structure and economics of the project depend heavily on the type of the equipment and its capital and operational costs. Even the operational efficiency of the project is a direct function of the selected equipment. In such cases, where standardized costs cannot be obtained, equipment selection studies become imperative as a support to techno-economic feasibility studies.

The equipment selection studies include the capacity of the project, a detailed description of various technologies involved at each stage of the flow chart, the alternative equipments and their sources and an evaluation of the relative economics of each after taking into consideration the capital costs, including engineering and installation costs, the impact of associated components of the project, such as buildings and civil works, life span of the machinery, maintenance costs, the requirements of spare parts, the residual values and operational costs.

Analysis of capital costs and/or production costs are taken up as separate exercises only as an aid to the team preparing the techno-economic feasibility studies, because of the complexities of the project or when the feasibility studies are conducted by engineers not directly teamed with economists, project cost evaluators or accountants. In some large-sized projects, capital cost and production cost evaluation may tend to become a very elaborate function especially if the industrial project is an integrated one involving several activities such as agricultural or mineral operations, production of a very large number of components or processing of the product by forward integration. Analysis of capital and production costs follow the conventional pattern and have been broadly discussed in later chapters of this manual.

## Chapter 6. Contents of Techno-Economic Feasibility Studies

### Contents

As was pointed out in the earlier sections of this manual, full techno-economic feasibility studies are the core and represent the culmination of pre-investment project planning. The project development work which precedes a feasibility study is provisional in character; a feasibility study reclaims from it all that is important and poses as the fountain-head for future investment activity. Most decisions of the investment phase involving contractual and financial obligations are anchored in this document. On the analysis and findings of the exercise depends the evaluation of the project and the decision to proceed - or not - with the project. It is, therefore, a crucial document for project development in a variety of ways and has to be prepared and interpreted with utmost care and caution.

Although the general pattern and format of feasibility studies should remain similar, there have to be divergencies between studies for different kinds of industries and different sizes of industrial projects. The studies for large industrial programmes (such as an aluminium project of 5,[illegible] tons of annual capacity or a two million ton steel plant) have to be conducted in depth; for small and smallish medium-sized industrial projects (say involving investment in fixed assets of say [illegible]1,[illegible] to [illegible]1 million) many aspects may be delineated only broadly.

An outline - enumeration of the components feasibility studies is made in the following section. This throws up in bold relief some of the problems frequently encountered and provides the base on which a feasibility study may be mounted. A more detailed analysis of the problems and a description of the various tools and techniques to be deployed are given in the remaining chapters of the manual.

### 1. Project history

a) Identification of the project in the context of the historical growth of the industry and conclusions of opportunity and/or pre-feasibility studies, if made.

b) The sponsors of the project and their industrial background; the basis of their interest in the project.

c) The consultants and/or the team conducting the pre-feasibility study and those which have prepared support or functional studies, if any, preceding the feasibility study and being conducted synchronisingly with it.

II. Economic perspectives

a) The national economic scene in the perspective of which the project is being conceived and promoted if directly relevant, analysis of basic national economic characteristics, such as demographic and vital statistics, growth rates, shortages and surpluses of national resources including manpower and foreign exchange.

b) Aspects of national economic and industrial policies which may be relevant to the project and in particular with reference to the promotion of the subject sub-sector, present and potential supply position of the major inputs, the regional development aspects if the project is meant to be developed in a given area, the policies towards foreign capital if foreign collaboration is involved.

c) Aspects of the national economic plan - if there is one - in regard to the subject industry, the national and area priorities - if these are fixed - for the industry, and the relevant plan targets - annual, for the plan period and under perspective planning, if developed.

III. Demand, markets and sales

a) Identification of the product/s and substitutes, the extent and localisation of the market, segmented and whole, the structure of the market (indicating bulk consumers) and distributive channels, market usages and consumer preferences.

b) Determinants and constituents of demand and their growth patterns.

c) Local and regional market trends during a fairly long period for each major product proposed to be manufactured and other closely associated products, showing in particular, domestic production, imports and exports, local consumption and anticipated development of the local market, per capita consumption in the country and comparison with other countries.

d) potential for export especially to the countries in the region, indicating the quantities expected to be exported and costs of transport and customs duties.

e) Local laws, regulations and customs affecting marketing of proposed products including import and export tariffs, quotas, restrictions and subsidies.

f) Competitors with their location, present and future output, production cost and selling prices.

g) Anticipated changes in competition, such as expansion, modernisation and diversification of the existing units and the establishment of other new units.

h) Foreign competition and any anticipated changes in laws or regulations which might affect volume of exports.

i) Elasticities of demand, price, income and substitution elasticities

j) Expected selling prices to be met in domestic and export markets, estimated transportation costs and other expenses, maximum and minimum competitive selling prices, f.o.b. or ex-works, the competitive advantages of the proposed project in respect of the relative availability and cost of labour, efficiency of production equipment and processes, quality of products.

k) Projections of demand in the light of (a) to (j) by market segments (where necessary) and by application of sensitivities

l) Schedules showing forecasts of sales volume for domestic market and export markets and the justification for assuming the quantities and shares

m) Forecast of realisable domestic and export prices.

n) Justification of the proposed capacity of the contemplated plant in terms of market size

o) General and technical description of the product-mix with drawings and designs, standard specifications, if there are any, and product applications and end-uses.

IV. Engineering and technical aspects

a) Description of available alternative processes and technologies.

b) Determinants of technology selection and the justification of the process and technology selected.

c) Proven reliability of plant processes and technology.

d) Analysis of adverse factors in selected technology and their impacts.

e) Patents and licences involved and their sources

f) Process flow chart and detailed description of the process.

g) Types and size of major equipment items and structures and justification of their selection.

h) Auxiliary capital equipment (stand-by spare parts, transport equipment, material handling equipment, testing and laboratory facilities, maintenance and repair workshop equipment)

i) Line diagrams of plant and machinery and of major items of machinery

j) Requirements, sources, availability, cost and reliability of utilities, relevant data on each system and reason for selection of sources in each case

k) Power requirement in peak kW demand and annual kWh consumption at different assumed levels of production, electrical system by line diagrams.

l) Fuel requirements for heating, steam and plant processes.

m) Water balance of the plant where applicable, problems concerning water treatment.

n) Transportation facilities for raw materials and finished products within and outside battery limits.

o) Technical requirements of buildings and civil works including atmospheric controls, and foundations

p) Description of laboratory and testing, requirements and maintenance and repair workshops (tools, etc.).

q) Replacement requirements of equipment and parts thereof and recurrent supply of tools

r) Criteria and justification of selection of proposed location for the project and of the site with its soil and other relevant characteristics.

s) Plant layout including storage for raw materials and finished products and provision for possible expansion.

t) Necessary guarantees covering the process, equipment, engineering designs and specifications.

u) Equipment inspection, tests and trial runs.

v) Input-output criteria, material yields and other technical ratios - structural and operational.

w) Generation of by-products and effluents and recycling thereof.

x) Anticipated use of consultants and collaborators for special phases of the project design, engineering, erection, start-up and commissioning and for operational phase.

y) Disposal of effluents (liquid, gaseous and solids) including any which may be noxious or dangerous.

z) Working shifts, hours/shift, days/week, days/year including down-times for different sections of equipment and the basis thereof.

V. <u>Location</u>

a) Total area required.

b) Topographical data and contours of the site selected.

c) Meteorological conditions

d) Soil conditions of the site.

e) Constructed and flow areas and specifications, such as height, load-bearing capacities and other characteristics by different building sections, such as factory buildings, stores and warehouses, utility facilities, such as power house, laboratory, workshop, water tanks and towers, administrative and auxiliary buildings, such as welfare facilities, canteens, time-office and residential accommodation.

f) Machine and equipment foundation with specifications - not drawings.

g) Conditions of environmental control such as heating, cooling and humidification facilities.

h) Drainage and effluent disposal system.

i) Internal and access roads, landscaping.

VI. <u>Total investment</u>

a) Fixed capital requirements in local and foreign currencies by assets:

i) Land (price, transfer cost)

ii) Site development (levelling, internal and access roads, gates, drainage, and sewage ...)

iii) Buildings and civil works: factory and auxiliary buildings including those for utilities, workshops and laboratories, administrative buildings, stores and warehouses, time office, car parks, recreational and serial facility buildings, canteens, locker rooms, staff and workers housing, architects fees.

iv) Machinery and equipment - local and imported: (f.o.b. or f.o.r. price, freight overseas and internal, insurance, forwarding, clearing, handling, fabrication and installation costs).

v) Utility facilities: power sub-stations, electrical cables, wirings, emergency generating sets, intercommunications, and external communications, lighting, water storage, pumping and treatment, fuel storage and pumping.

vi) Workshop and office equipment, tools

vii) Spare parts.

viii) Transport equipment for persons, raw materials, fuel and finished products

ix) Miscellaneous fixed assets, such as office furniture and equipment, fire fighting equipment, warehouse and factory furniture.

x) Preliminary and capital issue expenses.

xi) Pre-production expenses, such as costs of pre-investment studies, other planning and engineering costs, product promotional expenses including advertising and sales cost, staff salaries, benefits and training costs, travel costs, other administrative expenditures, interest during construction.

xii) Start-up costs.

xiii) Expenditure for raising loans including mortgage expenses and registration fees.

xiv) Escalations.

xv) Contingencies.

b) Working capital required at full capacity operations, to cover inventories of raw materials, spare parts, auxiliary materials, goods-in-process, finished goods, accounts receivable and cash in hand.

VII. <u>Material inputs</u>

a) Quantity, specifications, sources and availability of raw and semi-finished materials and the justification of their selection.

b) Proven reserves in case of minerals; special treatment of products before processing, seasonal character of supplies in case of agricultural products.

c) Results of tests carried out indicating further tests needed.

d) If semi-processed materials or components are to be obtained from outside suppliers, an evaluation of the technical and economic soundness and specifications of the supplies.

e) Material yields, leakages, wastage and rejection factors.

f) Facilities for handling and storage, and special problems thereof.

g) Estimated costs, possible cost variations, customs duties, processing and conversion costs.

VIII. <u>Manpower</u>

a) Institutional and legal framework of the management.

b) Description of manpower and organization along with an organization chart showing lines of communication and control.

c) Numbers and levels of managerial, commercial and technical personnel including supervisors.

d) Numbers, levels and availability of operating and maintenance workers - by skills and shifts

e) Numbers, levels of personnel and workers required during the pre-production period.

f) Plans for recruitment during construction and operational phases.

g) Number of expatriates required, their levels and tenures.

h) Plans of training at different levels for technical, commercial and managerial personnel and workers in the country and abroad by external programmes and on-the-job.

IX. Production cost analysis

A) Capacity utilization over the estimated life-span of the project.

B) Output by items.

C) Projected sales and residual inventories.

D) Work shifts and hours and days of working.

E) Analysis of variable and fixed costs at different levels of output:

1. Variable costs:

Raw material
Fuel oil (masut) and gas oil
Lubricants
Packaging (returnable and non-returnable)
Electricity
Steam
Water
Production wages and salaries:
  Basic wages
  Social security contributions
  Health insurances
Production bonuses
Overtime wages
Temporary labour wages
Freight
Sales taxes
Business taxes
Sales commissions
Purchasing commissions

2. Fixed costs:
   - Spare parts
   - Maintenance supplies
   - Office supplies
   - Service wages and salaries:
     - Basic wages
     - Social security contributions
     - Health insurance
   - Selling and delivery wages:
     - Basic wages
     - Social security contributions
     - Health insurance
   - Maintenance
   - Insurance
   - Depreciation:
     - Buildings
     - Machinery and equipment
     - Transport equipment
   - Amortization of non-physical assets
   - Communication expenses
   - Travel
   - Other administrative expenses
   - Rent
   - Property tax
   - Interest
   - Financial expenses
   - Royalties

## X. Financial planning

A) Acceptable norms of equity-debt, equity-preference, fixed assets, debt ratios.

B) Prevailing and competitive interest rates and conditions governing loan and capital financing.

C) Capital structure

1. Share capital
   a) Equity
   b) Preferential

2 Long and medium-term loans

a) From official financial institutions including those for special programmes such as for workers housing.

b) From non-official financial institutions

c) Banks

d) Foreign institutions

e) International institutions

3. Bonds and debentures

4. Deferred credit arrangements from collaborators, suppliers and contractors.

5. Current bank credit

6. Subsidies and other contributions from government.

D) Contributions to share capital by

1. Promoters

2. Public

3. Foreign collaborators

4. Public financial institutions

E) Funds flow analysis during the construction period on a quarterly - or in case of large projects, on monthly basis.

XI. Sales and revenues

A) Proposed selling prices in domestic and export markets after making adjustments for expected competition and necessary market penetration.

B) Deduction for cost of selling (commission, discounts), distribution and transportation costs.

C) Net selling prices ex-works

D) Sales revenue after providing for inventory adjustments.

XII. Cash flow analysis

On the basis of data developed under VI-XI for both pre-production period and operational life-span setting out separately cash inflows and cash outflows.

XIII. Commercial profitability evaluation

A) Accounting ratios:

1. Rates of return at different levels of output on original investment ($R_{ok}$).

2. Rate of return on average investments ($R_{ak}$) during the life-span of the project.

3. Rate of return on average book value of investments ($R_{bk}$).

4. Rentability : return on equity.

B) Payback period

C) Capital recovery index - an extension of payback period by calculating the payout for each year.

D) Discounted cash flow (DCF) returns:

1. Present networth analysis based on cut-off rate

2. Commercial benefit-cost ratio

3. Internal rate of return (or profitability index)

4. Discounted capital recovery index

E) Structural and economic ratios: at different points of time, preferable in the years of output variations:

1. Capital output ratio

2. Capital fixed assets ratio

3. Equity debt ratio

4. Cost components

Material cost

Wage cost

Overheads

Capital charges

Distribution costs

5. Material yields

6. Productivity ratios

7. Other operational ratios, such as fuel and power per unit.

F) Sensitivity analysis:

1. Break-even analysis

2. Rates of return with projected changes in variable factors such as costs of specific inputs, prices of outputs, levels of output, tax rates, variations in foreign exchange contents.

XIV. Cost benefit analysis (to be expanded later on)

## Chapter 7 Agencies responsible for commissioning and conducting pre-investment studies

### Institutional framework and public policy

The question as to who should undertake pre-investment studies, is best answered while looking at the government's policy towards industrial development the opportunities available within the country for industrial development and the levels of sophistication in technology and management attained by the country.

Depending on the institutional system in the developing countries, industries are normally developed by:

a) Individuals (generally through formation of joint stock companies but also through partnerships)

b) Public enterprise (mostly through public corporations - common or statutory - but sometimes departmentally);

c) The joint sector - a pure or hybrid combination of private and public enterprise

d) Co-operative societies

e) Foreign enterprise - as a wholly owned subsidiary or jointly in collaboration with indigenous capital, public or private, or both

There are many combinations and permutations of partners engaged in the development of industries. Often, governments in developing countries have formed partnerships with foreign companies, some of which are multi-national. There are also instances in which triangular or multi-lateral arrangements have been concluded. Thus in the case of a petroleum complex established in Madras, India, the governments of India and Iran and an international oil company from the USA joined hands. Besides, the joint capital participation, one partner provides the market, another technical know-how and the third the feed-stock.

A great deal depends on public policy. If the industrial policy of the country contemplates industrial development to be accomplished mainly through public enterprise, it is the government which shoulders the responsibility for the preparation of pre-investment studies. This may be done either by the responsible ministry (ministry of industry or ministry of planning) through developmental institutions, public corporations or especially created consultancy and research organizations. In many developing countries, however, while governments do undertake this responsibility and desire the development of industries to be channelled through public enterprise in certain defined directions, they leave open a wide area for development by private enterprise. Thus, if the national plan assigns high priority to industrial development, the government may also undertake studies on its account with the understanding that private enterprise will ultimately implement them.

Responsibility for commissioning pre-investment studies

Although it is dangerous to generalize, one may assume that in countries with an outspoken industrial development policy, the identification of investment opportunities continues to be mainly the responsibility of governments and associated agencies irrespective of the governmental policy towards private enterprise. This objective is achieved generally through official or semi-official agencies established to assist and promote industrial development in the country. Examples of official agencies are the Industrial Studies and Development Centres in Riyadh, Damascus, and Amman and the National Industrial Development Corporation of India. This does not, however, mean that private consulting firms and institutions do not prepare such studies. A large number of pre-feasibility studies which are in the nature of opportunity studies, is in fact, conducted by private companies.

The responsibility to commission or undertake complete techno-economic feasibility studies has largely been that of the investor, be it the government, government agencies or private entrepreneur, single or collective, indigenous or foreign-based. It is only when the investor is convinced that there is at least a prima facie case for the commercial viability of the contemplated project, that he undertakes and finances such a study. In the case of government sponsored projects, the emphasis should, however, be on national economic priorities and not only on commercial profitability.

Agencies to conduct pre-investment studies

The pre-investment studies may be prepared and conducted by agencies with divergent constitutions and promotional motivations. These agencies may be

1) international organizations, such as UNIDO;

2) government departmental agencies in charge of industrial development;

3) official agencies or research organizations set up or sponsored by governments

4) industrial development banks or financial institutions

5) indigenous industrial enterprises

6) production companies as potential collaborators

7) engineering firms

8) equipment manufacturers;

9) consulting organizations in developing countries or those operating internationally

The modus operandi of the agencies conducting pre-investment studies is dependent on their respective promotional motivations -

a) whether the studies are undertaken as an activity in public, private or corporate sectors to promote industrial development

b) whether the studies are conducted for new investments by the same enterprise

c) whether the studies are undertaken for a compensation, direct or indirect, that is, for a fee such as by a consulting firm or an equipment supplier.

The institutions 1) to 4) in the para preceding the last fall in category a) 5) and 6) under category b), and 7) to 9) under category c).

Investors in developing countries normally commission pre-investmnet studies when

a) there are persistent shortages of the candidate commodity in the domestic market

b) other firms have established units in the industry and these have attained fair, if not, phenomenal success

c) national planning or industrial promotion authorities declare that the industry has been assigned high priority

d) the prospective investors' own trading activity suggests that demand has presumably approximated or crossed the capacity of a viable project

e) ideas for new industries are mooted by exporting firms from other countries

f) new industrial opportunities are identified by opportunity studies;

g) opportunities are identified by the trade as a part of import substitution programme

h) newly discovered or exploited mineral or other products show potential for new industries

i) the growth of certain large industries throw up opportunities for ancillary industries

j) existing industries show potential for backward or forward integration

k) international deals lead to inter-industry linkages

l) growth in international markets show potential for export promotion

Promotional agencies may sponsor feasibility studies for industries, which have been assigned high priority under national planning or under programmes of industrialization. The high priority may be the result of

a) strategic desiderata

b) need for import substitution

c) the discovery of an important national resource

d) foreign exchange earning capacity of the industry;

e) high added value of manufacture.

f) signigicant potential for generation of employment;

g) reduction of dependence on foreign supplies.

Experience of two countries

The experience of two developing countries based on different systems and moored in different economic contexts may illustrate the dispersal of responsibility for pre-investment studies. The selected countries are India and Saudi Arabia.

With a very large population, Indian industry has attained size and sophistication which distinguish it from many other developing economies. India has followed a policy of mixed economy with an extensive private sector and the predilection of public policy manifest for public enterprise. The size of both private and public investments in industry has grown substantially - in absolute if not relative terms.

In the Ministry of Industrial Development, a large organization functions in the name of Directorate General of Technical Development (DGTD). The DGTD processes applications for industrial licences and recommends grant of licences on the basis of its own studies which are in nature of opportunity studies. These studies are prepared in co-operati[illegible] with leading industrial establishments, trade or industry associations (such as Engineering Association of India), and special teams (sometimes called task forces) of the (national) Planning Commission (PC). The PC conducts opportunity studies on sectoral and sub-sectoral bases and industry by industry, indeed, by leading commodities. The PC does not undertake feasibility studies but the reviews made by them are fairly comprehensive and their projections are based on historical and prognostic data derived from special units and agencies, such as leading producers and consumers, trade and industry associations and Chamber of Commerce, specialized agencies and institutions.

Area opportunity studies are commissioned by State Governments and developmental institutions, such as the Industrial Development Bank of India. In very special cases, these have also been undertaken by other institution, such as the Industrial Finance Corporation of India.

The feasibility studies, based on opportunity studies and targets fixed, are commissioned by government corporations operating industries, concerned Ministries of Government, State Governments principally through State industrial development corporations, operating private industries and new industrial entrepreneurs.

The opportunity studies have been carried by teams of developmental institutions, such as state industrial development corporations or Industrial Development Bank of India (IDBI), National Industrial Development Corporation (NIDC), research institutions, such as the National Research Development Corporation and National Council of Applied Economic Research (NCAER) and public and private consultants. Several studies have been commissioned and conducted and financed by international organization, such as the World Bank.

The feasibility studies are conducted mainly by public and private consultancy organizations; some of the latter are foreign controlled or have foreign associations.

The industrial promotional work emanating from the national plans and from specific industry studies has been dispersed over a wide area. This is partly due to the federal character of the political institutions and partly to the dimensions of the task involved. There are official, quasi-official, private and collective organizations involved in industrial promotional programmes. Special promotional institutions, apart from leading development banks - IDBI, Industrial Finance Corporation of India (IFC), Industrial Credit and Investment Corporation of India (ICICI), and a whole lot of State (provincial) finance corporations - have been established. These include functioning on an international scale, institutions like the India Investment Centre with branches in selected international cities and at the State or provincial level, organizations such as the state industrial development corporations. The latter directly participate in new industrial ventures and seek co-operation in many cases from private industry in what are termed as joint sector projects.

Saudi Arabia, geographically a large country, is very thinly populated. It is the largest oil exporting country in the world with estimated annual oil revenues topping $2[illegible] billion. The process of industrialization in the country has started only recently. The Kingdom has some real constraints on industrial development - such as manpower shortages, but, on the other hand, the financial resources including those of foreign exchange are bountiful. The Government is very keen to diversify the mono-commodity-based economy. It intends to lean heavily - or solely - on private enterprise. It realizes, nevertheless, that the capacity of the private local entrepreneur - among other things, due to his lack of industrial experience - is extremely limited and the State has, however reluctantly, to supplement the effort in critical areas where large capital resources or high level technology are essential.

The development of industry is channelled through two organizations, the Petroleum and Mineral Organization (PETROMIN) sponsored by the Ministry of Petroleum and Mineral Resources and the Industrial Studies and Development Centre (ISDC) attached to the Ministry of Commerce and Industry. Both organizations are by and large autonomous.

Pre-investment studies of petroleum- and mineral-based industries are the responsibility of PETROMIN, which is also largely the agency responsible for industrial programmes in the public sector. The ISDC is responsible for industrialization in the private sector. This institution has undertaken a number of opportunity and feasibility studies, some of which have been conducted with the assistance from international consulting organizations. Earlier, the Ministry of Commerce and Industry directly commissioned American consulting firms to undertake a large number of opportunity and feasibility studies.

Opportunity and feasibility studies commissioned by PETROMIN are meant for the organization itself while those undertaken by the ISDC are made available to private enterprise. The opportunity studies are announced by bulletin and are available for use free of cost. The copies of the feasibility studies are, however, sold at a nominal price (which is one-tenth of the final price of the study). The final price is a subsidised price. The subsidised price is linked with the investments on a graduated scale. The entrepreneurs ultimately establishing the industry have to pay the balance 9 per cent of the price.

Cost of studies

There are no set or established norms governing costs of pre-investment studies. They differ from project to project and from one type of study to another. The costs are a function of several factors: size and nature of the project, type of pre-investment study, its scope and depth, agencies commissioning and undertaking the study and the availability of the information material.

Opportunity studies

For opportunity studies, the costs vary widely and may be correlated with the scope of the studies. The costs also depend a great deal on the depth required. There is no definite relationship between the amount of investments and cost of studies. The latter does also not depend on opportunities the study may unfold for consideration.

The costs of opportunity studies are determined mainly by the man-months estimated to be put into the exercise. The period required for carrying out the studies may differ from one month to two years. The man-months cost would depend on the resourcefulness of the agency commissioning the study and the kind of agency which is deployed to conduct the study. The man-month cost may vary from $1 to 5 or more. A well-developed opportunity study should involve anywhere between 3 man-months to 5 man-months.

Opportunity studies throw up many possibilities. The ultimate cost, therefore, may not be very large when linked with or loaded on effective investments.

Related to magnitudes of project investments, as a general rule-of-the-thumb, the following order of costs may be indicative:

i) For one specific item of industry, such as newsprint paper, rayon grade pulp, aluminium — .1 to .5 .
(The cost would be 25, to 1 , more if raw material analysis or tests by pilot plants are involved).

ii) For group of opportunities for associated industries, such as industries based on date palm cultivation, or on lime-stone, or metal working industries — [illegible].1 to [illegible].3 [illegible]

iii) For sub-sector opportunities, such as building materials industries, machine building industries, agricultural implements industries. — [illegible].1 to [illegible].2 [illegible]

## Pre-feasibility studies

The costs of pre-feasibility studies (which are confined mostly to one specific industry) are approximately 2 to 5 per cent higher than for similar opportunity studies.

The costs of pre-feasibility studies are also variable with the nature of industry and the kind of agency involved. In some developing countries, pre-feasibility studies have been undertaken by government organisations for small and medium-sized industries, with very low cost involvement. Based on information collated from both international and national sources, the results are fairly dependable. These studies may cost anywhere from [illegible]1[illegible] to [illegible]1,[illegible] or more.

## Feasibility studies

The spread of costs in the case of feasibility studies is limited and may be related to total project outlays. The sophistication of the industry technology and the agency which conducts the study, however, have a great bearing on the total costs. By and large, the following standards may be indicative.

| | |
|---|---|
| a) Small industries: | [illegible]5,[illegible] to 1[illegible],[illegible] |
| b) Medium-sized conventional industries: | 8,[illegible] to 15,[illegible] |
| c) Medium-sized industries with sophisticated technology (such as a base petrochemicals project): | 1[illegible],[illegible] to 3[illegible],[illegible] |
| d) Large conventional industries: | 1[illegible],[illegible] to 2[illegible],[illegible] |
| e) Large industries with sophisticated technology: | 15,[illegible] to 5[illegible],[illegible] |

The cost of a feasibility study of a nitrogenous fertilizer plant with an annual capacity of 2[illegible] tons of N was $1[illegible]. A composite study of 5 similar fertilizer plants carried out on a crash basis was $1,[illegible]. The former was conducted jointly by an Indian firm, a process supplier from the Netherlands and two Engineering-contracting and producer companies from the USA. The latter was carried out by a group of American sponsors, investors, fertilizer producing companies and engineering firms.

Related to magnitudes of project investments, the following cost ratios are indicative for feasibility studies:

| | |
|---|---|
| a) Small industries | 1.0 to 3.0 % |
| b) Medium-sized conventional industries | 0.3 to 1.0 % |
| c) Medium-sized industries with sophisticated technology | 0.5 to 1.5 % |
| d) Large conventional industries | 0.1 to 0.7 % |
| e) Large industries with sophisticated technology | 0.2 to 1.0 % |

Support and functional studies

In several cases, in-depth partial studies are a prerequisite of pre-feasibility or feasibility studies. Examples of these are an extensive mineral survey, a pilot plant test on the use of a specific raw material or application of specific technology, a location study involving field surveys, soil tests, transport surveys, a market-survey based on field work covering an extensive random sample. It is necessary for such studies to commission the services of outside agencies or to organize a full team working for several months. The costs of such studies may sometimes be as high as the total of all costs for a full feasibility study. Each case has, therefore, to be evaluated on its own merits. It involves the assessment of the man-months required and their levels, background and specialization, the use of equipment and associated and incidental costs, such as travel and subsistence allowances, cost of drawings and mapping.

An extensive market survey (in India) for nitrogenous fertilizers - covering a large number of farms - and a widely used consumer product each costs around $41,[illegible]. A similar study for domestic refrigerators was estimated to cost $8,[illegible].

Dependability of studies

In view of the problems of access to technological information, engineering firms and consulting organizations are best suited to undertake detailed feasibility studies. The costs, however, of these agencies are relatively high, especially if they are operating internationally. There is no hard and fast rule about dependability of studies conducted by different organizations. By and large, it has been found that the adequacy of studies is positively correlated to the amount of costs involved.

There is always the need for minimising costs. Nonetheless, any false saving at the cost of reliable data and adequacy of studies is likely to jeopardize the promotional endeavour not only for the candidate project but also for those which might be sponsored by others. The projects which fail, create an adverse investment climate. It is, therefore, imperative that the studies be conducted by organizations which have the necessary expertise and access to dependable up to date information on candidate industries.

Teams of experts for conducting studies

It is admittedly desirable and prudent, as pointed out earlier, that pre-investment studies are conducted by teams of experts; nevertheless, it is often imperative that the studies have to be carried out by single experts, an economist or an engineer/technologist. This may be due to certain constraints such as paucity of funds and non-availability of expertise at necessary levels. It is seldom advisable that pre-investment studies be conducted by economists unaided by engineers. They would not have easy access to technical literature; when such literature is available, there would be problems of assimilation. In a feasibility study, for a ceramics plant, gross errors were committed on two rather insignificant peripheral problems (i) high sulphur content in the fuel - which needed more expensive muffle kilns, and (ii) high content of dissolved solids in water - which required water treatment to reduce the content from 3   to less than 3  ppm. Problems of this kind can be identified only by a technologist having direct experience of the industry, A pre-investment study would need a thorough knowledge of the intricacies not only of given (selected) but also of alternative technologies with variations in capacity-sizes of plants, automation, product-mix, inputs. An economist, for example, fully conversant with a certain industry would not be able to appraise the problems if the inputs were changed. He may be familiar with a naphtha-based N-fertilizer plant, he would feel completely lost if the plant with the same capacity - say, 2[illegible] t/year of N - and the same product mix - say, granulated urea - was to be an electrolytic plant. The entire project would be different in almost all its significant contents.

A problem often encountered by non-technical personnel in mounting pre-investment studies is the non-familiarity with the use of phraseology.

An engineer left alone is better placed. He, too, however, will be faced with a series of time consuming, if not intractable, problems. He would have to familiarize himself with market usages and conditions, tax laws, and techniques of financial and economic analysis. Many engineers do initiate themselves into the intricacies of commercial usage and economic analysis. Such engineers need not be classified as unadulterated technicians and would be able to conduct pre-investment studies.

There has emerged in the recent years a tribe which may be termed project planners, who are either engineers, economists or management experts. They specialize in conducting specific types of pre-investment studies or pre-investment studies of specific industries.

The present manual has been prepared with a view also to serve the needs of experts carrying out pre-investment studies without the help of specialists in other disciplines. It should be recognized, however, that no manual can supplant the technical information which ought to support every pre-investment study. No amount of reference or simulated material or access to technical literature can dispense with the need for technical consultations with competent and knowledgeable technologists whatever their source, a single expert, a consultancy organization, an engineering firm, a producing company, an equipment manufacturer.

The most desirable combination of a team for the preparation of feasibility studies is the following:

i) one or more technologists/engineers specializing in the candidate industry and/or special branches (thus, a feasibility study for a large aluminium smelter will need not merely a metallurgist specialising in aluminium but it will also require electrical, mechanical and civil engineers, whereas for a small aluminium extrusion mill a metallurgist would usually do);

ii) an industrial economist familiar with project preparation and evaluation techniques;

iii) a market research expert;

iv) a management expert.

It is rarely to be found in developing countries, except for very large investment programmes, that such welcome amalgam of expertise is forged for conducting studies although a team so constituted is known to be able to deliver the best results.

# PART III. TECHNO-ECONOMIC FEASIBILITY STUDY

## Chapter 8. Demand Studies and Market Surveys

### Demand Size, the Prime Indicator

No industrial project deserves a feasibility study unless the subject product has adequate demand at a marketable price. Accordingly, the size of the present and potential market - more precisely, the demand - is among the prime indicators of project viability. The first step in project formulation and analysis, in most cases, is the estimation of size and the analysis of structure and basic characteristics of demand.

Notwithstanding the prime importance of demand and prospects of sale of the output of a project, the number of projects established in developing countries without any or proper market studies is indeed very large. The high infant mortality and frequent teething troubles of innumerable industrial projects in those countries may be directly attributed to a lack of knowledge about the size, growth and structure of markets. The most common factor responsible for low utilization of industrial capacities and the consequent waste of scarce resources is the absence of demand commensurate with established capacities. Many industries operate below the break-even point and others are closed down.

The principles of market and demand analysis are basically the same when applied to conditions in developing and industrialized countries. Nevertheless, a few special problems are encountered in the former. The difficulties revolve mainly around data availability.

Consumption and demand data are not easily available and accessible on most consumer products. Statistical infrastructure for conducting market surveys is also conspicuous by its absence. In almost all cases a certain amount of primary data has to be generated, developed and processed, since secondary data in requisite detail and manifestations, are not generated; when generated, these are not published or accessible.

There is greater reluctance on the part of producers to reveal information on operational aspects of industry and of consumers on family budgets, personal incomes, consumers habits, preferences and responses. The fact and frequent changes in socio-economic life patterns render available historical data irrelevant to the purposes of industrial programming.

The problem gets accentuated when a relatively new product, not being produced locally or imported from abroad, is to be introduced. As a result, it not only takes a great deal of effort to design and conduct market surveys in developing countries, it also calls for considerable discretion in selecting the analytical tools.

Minimum Economic Size

Dictated by technological factors (such as the minimum size of a critical machine or process equipment) or commercial considerations (such as the marginal cost of other competitors), there is in most industries a minimum economic size. It is, for example, not economic except under extraordinary conditions, to set up a cement plant of less than 300 tons per day capacity since the smaller plants require vertical shaft kilns which cannot compete with rotary kilns. With a car population of less than 35,000 and the total vehicular population of less than 70,000 (equivalent to not more than one month's production of an economic-sized plant and less than one week's production of large plants), Syria cannot plan to establish a car manufacturing facility. The examples can be multiplied: an aluminium smelter in Kuwait, a steel mill in Lebanon, a white printing paper mill in Saudi Arabia.

When a given market is divided by long distances involving high transportation costs, the constraint of minimum economic size gets further accentuated since movement of the product from one geographical sector to another renders the price of the commodity uneconomic.

A project, the capacity of which is less than the minimum economic size of plants in the subject industry, may be eliminated without detailed analysis.1/ In rejecting summarily the viability of projects, the

1/ This, however, does not mean, as indicated later, that a project has to be based only on domestic demand. Should other over-riding considerations so require, a larger plant may be based only on international markets. A 150,000 tons N/year fertilizer plant in Saudi Arabia was based almost on freely available natural gas with a domestic demand of only 5,000 tons/N year.

potential of the build-up of the market (with reasonable market promotion) should not be overlooked.

There are numerous factors which may account for the inadequacy - from the point of view of a minimum economic sized project - of demand. Some of these are:

(i) Small population, such as in Kuwait;

(ii) Low per capita incomes (in the majority of developing countries), leading to low purchasing power;

(iii) Unequal distribution of incomes leading to small number of consumers who can afford to buy (such as cars in Bangladesh);

(iv) Socio-cultural background or restraints, such as against alcoholic drinks in Saudi Arabia;

(v) Climatic factors, such as consistemly hot climate for use of heaters;

(vi) An absence of a production sector in the case of intermediate goods, such as steel in Jordan;

(vii) Segmentation of markets by long distances involving heavy transportation costs;

(viii) Existence of production capacity leaving only a small uncovered gap;

(ix) Free or inadequately restrained flow of cheap imports.

The low per capita income represents a conglomeration of numerous elements. A few of these are low nutritional standards, inadequacy of clothing and housing, a high rate of illiteracy (resulting, for example, in low consumption of paper), a low level of sophistication (such as represented by use of air conditioners, refrigerators, cosmetics).

In attributing the low demand in a market justifying an economic-sized plant, the dynamics of the conditions must be reckoned with. The low demand may soon transform itself into a size of demand which would justify a manufacturing facility. In other cases, small domestic demand may be supplemented by potential for exports.

Demand Size, a Secondary Indicator

There are exceptions to the general convention of initiating industrial project studies with estimation and analysis of demand. There may exist a huge demand in a country which does not warrant a study to establish the justification of a large-sized, let alone a minimum economic-sized, plant.

India has over a dozen nitrogenous fertiliser plants operating and more under construction and yet it does not need a market study to select the most appropriate size. It has an unsatisfied demand which may exceed a million tons of nitrogen per year, as against a minimum economic size of nitrogenous fertilizer capacity of 80,000, a fairly competitive capacity of 200,000 tons and a giant capacity of 500,000 tons of N per year.

A demand study may not likewise be the initial step (for project planning and formulation) if the project is to be based on an abundantly available natural resource and it is too obvious that international markets do exist. It is not necessary, for example, to identify the size of demand for steel in India or for oil refinery products in Libya. India possesses some of the finest reserves of iron ore and manganese and good supplies of coal. Similarly, Libya has plentiful supplies of oil. Libya would not establish an oil refinory geared to its domestic market. The primary motivations in these cases are to be located in other areas, such as relative priorities for the use of the scarce resources, such as foreign exchange, skilled manpower, infrastructure. In yet other cases, it may be the availability of the right type of raw materials which may determine the most appropriate capacity. The case of newsprint in India illustrates the point. The critical factor is not the size of demand to justify an economic-sized plant; it is the availability of raw materials which may lead to a size involving only economic, i.e. competitive, costs of production.

## Basic Requirements of Demand and Market Studies

In view of their significance, distinctive connotations and repetitive use, a few basic terms of demand and market analysis may be broadly defined.

A product includes a whole range of its variants, such as large and small cars or different kinds of cables which can be produced in a single manufacturing unit meant for single or multiple uses. Steel may be used for construction, for manufacturing machines of sugar plants or for building ships; however, it is the same product. A product may, however, be distinguished from its variants by qualities such as mild steel and special alloy steels. The delimitation of the product does not depend on the uses but on the integration of the proposed manufacturing programme.

The demand of a product is the quantity of the product, which the consumers (direct or producers in the case of intermediate and capital or investment goods) are willing to buy at a given price in a given market over a given period. The people willing to buy cars in Syria may be 200,000 but the number of people who will be willing to pay the prevailing prices may be 20,000 only. The demand for cars is, therefore, 20,000 and not 200,000.

In conducting demand studies in developing countries which are infested with production and import controls or regulated distribution systems, a clear-cut distinction should be made between demand and consumption. The demand for cars may be four times the number now being sold if the cars were allowed to be imported without foreign exchange or tariff restrictions. The sale of cars in India is so regulated that one has to register months and years in advance. The demand for cars in India would be the number of cars the people are willing to buy and not what they in fact do buy.

A market of a product is the set of consumers, existing and potential, willing to buy the product. The market, therefore, of an enterprise - existing, contemplated or planned - is the set of consumers to which the enterprise can sell its product. A collapsible tubes manufacturing project can sell its products only to manufacturers of certain liquids, ointments and pastes, i.e. toothpastes, medicated pastes, cosmetics, creams and eatable pastes such as those of cheese cream and tomatoes. The manufacturers of these products then constitute the market of collapsible tubes. Car spark plugs can be sold to automobile manufacturers, repair shops and the actual car owners. These constitute the market. In case, however, of intermediate and capital goods markets, it may often be necessary to investigate the size of the market of the final product and not of the subject product only. For appraising the demand, for example, of glass bottles, it may be necessary to estimate the demand by the growth in the size of the market for beer, milk and drugs.

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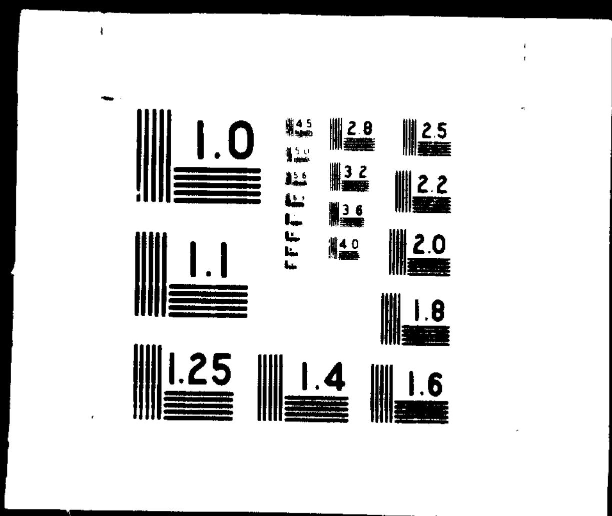

The intermediaries, such as wholesalers and retailers, are included in the broad sense of the term since they buy and sell the product but they do not have their own demand; they are components of the market who may be dispensed with although invariably they perform a useful function. A market of a product, may be divided into territorial, occupational, income-wise or end-use segments; each, nonetheless, is a segment only and is not the whole market.

In some cases, the market is essentially limited by geographical considerations. It is too expensive, for example, to transport bricks beyond certain distances, say beyond a radius of 40 kilometers, which may depend on the means and cost of transportation and the availability of alternative building medium in adjoining areas. In this case, there will be no point in conducting a market research for the whole country for a project in a given area, even though all parts of the country may require bricks for building purposes.

The key issue of market analysis for a feasibility study is to estimate the demand for the subject product of the candidate project during the life span of the project.

The size of demand is a function of several variable factors of market structure and behaviour: the composition of the market, the degrees and extent of competition from other sources of supplies of the same product and substitutes, elasticities of demand, market responses to socio-economic patterns, price variations, distributive channels, the growth rate of the consumption levels and their distributive composition. The problem of appraisal of demand, as a result, is invariably a more intricate exercise than is commonly assumed. A high degree of skill of the analyst is required to develop a statistical model most appropriate to the product under study and the objective conditions in the market to ensure a high probability that the actual demand would equal (or reasonably exceed) the forecast demand. The problem gets accentuated since while the primary task of analysis is to estimate the size of demand, it is also necessary to identify its components (by product mix) and segments (consumer groups), its characteristics, social, legal and institutional constraints and restrictions, its growth dynamics and their sensitivities.

A demand and market study should aim at providing the following guidelines of information:

(i) The precise nature of the product (product mix, if necessary) with technical specifications (standard specifications, if available), distinguishing qualities, colours, dimensions, designs, forms;

(ii) "The present" - when the study is being conducted or preferably when the project is likely to go into operation - size of the market;

(iii) The composition of the market by segments - geographical (regional, domestic and export), by end-uses or economic (such as by income levels of consumers);

(iv) The growth rates of the overall market and of the segments as indicated under (iii) preferably for the life span of the project based on probable prices and projected conditions of the market including legal and technical constraints and developing socio-economic framework; it is significant generally to cover the first ten years of the operational life of the project and then to approximate for the future period by a mere extension of the identified later trend since predictions in the economic world of today beyond ten years enter the realm of "astrological" speculation;

(v) The market penetration ratio which the candidate project is expected to achieve over the projection period in the context of developing domestic and international competition including that from substitutes, costs of production and prices, changing consumer preferences and responses;

(vi) The prices - gross and net - which are most "probable" to prevail and on the basis of which (iv) and (v) are projected;

(vii) The conditions of market promotion including where necessary "after" sales service and packaging standards contemplated to achieve (v);

(viii) The sales organization, organic (within the enterprise) and external (distributive channels and outlets).

In short, under market and demand study aspects, an industrial techno-economic feasibility study seeks to:

(a) Identify the product;
(b) Estimate the present demand;
(c) Project the future demand;
(d) Project the sales for the candidate project;
(e) Project future prices;
(f) Recommend sales promotion programme;
(g) Propose a sales organization including distributive channels.

The starting point for most market and demand studies in developing countries is a thorough analysis of the relevant institutional and government policies, practices, legislation and procedures. These are an overwhelming constraint on the structure and development of markets. These include licensing, dominance of public sector, distributive policies, controlled distribution, price controls, credit controls, foreign exchange regulation.

The degree of precision required in market analysis - which is positively correlated with time, effort and cost involved - should be determined by a reference to the basic industry criteria, such as size, sensitivity of industry to variations in factors such as price vulnerability to substitutes. The criteria may include operational economics of the industry itself. The forecast of sales, for example, may indicate that between 900,000 and 1,000,000 units of a product would be demanded in a given year. With greater precision, the forecast sales may be estimated at 970,000 units. If the project's break-even point is located at 600,000 units and the installed capacity for technological considerations has to be a minimum of 800,000 units, the time and money spent on refining the first estimate may be superfluous.

Too much concern for precision and predilection for advanced econometric models and techniques may not be justified also when the source of data is of doubtful validity. The statistics on international trade, assumed to be one area of detailed and reliable statistics, are often visibly erroneous since these are manipulated to evade payment of duties. To apply statistical measures of confidence (or probable errors) in analyzing such data would be sheer waste of time. The margin of error is far too great at the base for a precise statistical appraisal.

Statistical Data for Demand Studies

The statistical and qualitative information required for market research is obtainable from an infinite number of sources which have to be searched and located in each individual case. These may be classified as follows:

(i) Official regularly published statistical annuals, returns, statements, such as statistical yearbooks, annual or monthly statistics on agricultural production, industrial production, foreign trade, vital statistics;

(ii) Census reports - population census, census of manufacturers;

(iii) Annual reports of government organs, such as Ministries of Petroleum and Chemicals, of Food and Agriculture, of Steel and Heavy Industry, the Departments of Mining and Geology;

(iv) National and sectoral plans;

(v) "Task force" or team reports on the operations or development of specific industries and sub-sectors, such as those engaged by the government with or without association of industry associations, consultants and experts;

(vi) Industry development reports by regional and international organizations, such as the Economic Commission for West Asia, UNIDO;

(vii) Opportunity studies undertaken or commissioned by industry, government or development organizations;

(viii) Annual and special reports and returns published by industry associations and Chambers of Commerce and large or multinational companies and corporations;

(ix) Industry research reports and statistical compendiums produced by professional institutions, research organizations, universities, consultants, data banks, development financial institutions;

(x) Family budget surveys;

(xi) Reports of market surveys conducted earlier in the same area of research for other projects and commissioned by development institutions or potential investors.

Industry surveys - often styled as industry census or census of manufacturers - are rich sources of informational material for market research. Industry surveys are conducted at different points in time or regularly. They are sometimes national in coverage and sometimes regional. Some surveys cover the entire industrial sector, others specific sub-sectors or size-ranges of industrial establishments. They cover data on institutional framework, age-composition, product-mix, manpower structure, inputs and costs of production, utility requirements, sources of inputs, distributive channels, inventory levels, capital and credit structure. However significant the industrial surveys or censuses may be for market estimation and forecasting, it should be realized that they are not, by their nature, market surveys. Neither are they intended for market research.

Like industrial censuses, family budget surveys are extensively or even more useful for market research. They throw light on actual family expenditures on specific items, such as food articles, fuel, electricity, clothing, consumer durables. The data are available by locations, occupational patterns and income levels of the household sector. These data are important indicators of consumption and demand levels. Their significance notwithstanding, family budget surveys as such are not meant for specific industry pre-investment studies. They are too elaborate, expensive and time-consuming for industrial project feasibility studies. The demand studies require only fragmentary information from family budget surveys. When the need for information from family expenditures on specific items is required, limited product consumer surveys have to be conducted.

The data obtained from published and unpublished material from official, quasi-official and other institutions are seldom complete for market and demand studies and have, of necessity, to be supplemented, supported and re-inforced by specific market surveys.

The market surveys are principally of three types:

(i) Industry surveys covering production and development plans of industry and respondents are development agencies and organizations, industrial establishments and investors and development financial institutions;

(ii) Consumer surveys based on random sample when the number of respondents is very large or by universal coverage;

(iii) Trade surveys the respondents of which are various trade outlets.

The guidelines on the methodology for these surveys are outlined in a later section of this Chapter.

It is a common experience of most developing countries that data on production are most readily available. When production data on specific industrial items are not available, it may be possible to obtain statistics from large producers controlling a dominant share of the output and these, when added together, may give a fairly dependable indication of the total output in the country. There are usually a number of statistical publications to which recourse may be made for production statistics. These include those published by central statistical organizations, research institutions, professional organizations and especially Chambers of Commerce and trade associations. When possible, data banks may be contacted.

Import and export figures are regularly published by practically all governments, in many cases via customs statistics. Problems arise in two areas: most data are out-of-date by two or sometimes three years; data for import for similar commodities are lumped together. Import data on oxygen cylinders are mixed with all types of gas cylinders including low pressure cylinders. Similarly data on car tyres are mixed with tractor, truck, motorbike, scooter and bicycle tyres.

Data on inventories are difficult to obtain. For some selected commodities, governments do publish data but such commodities are few. Most trade associations, where they exist, such as Indian Sugar Mills Associations, Indian Jute Manufacturers' Association, publish inventory statistics. In most demand and market studies, inventory data are ignored under the escape of the qualification, "apparent" pre-fixed to the term "consumption".

A major problem of statistical data for market surveys is the adaptation of the available data consistently with the scope of the study without tampering with the original data. For a white cement plant project, it is no use, for example, to base projections on a series of total demand for all qualities of cement. In fact, the latter has no relevance to the demand for white cement. It is of no advantage, similarly, to use the data on demand for all glass products if the study is for a sheet glass plant.

Distortions in data may occur due to other factors. The demand of a product may have been suppressed by the levy of a high customs duty. When the candidate project goes into production, its product will not attract any import duty. The past demand based on high import duty has, therefore, to be modified by the application of the price elasticity of demand.

The range and depth of statistical information and the period for which the data are required for market research depend on each study and no guidelines can be designed. In one case, past production figures may assume a position of decisive significance, in another the production data may be patently misleading. The case in India of aluminium production may illustrate the first and that of gold the second. The same norm holds true for statistical information on imports, exports, consumption or demand levels, prices, the existing structure of the market. In several areas, the past consumption are demand levels have no relevance to the real current or future demand, since the supplies may have been severely restricted or controlled.

The problem of period defies standard pattern. In one case, ten-year data may be inadequate because of abnormal fluctuations during the period; in another case, it may not be possible to cover a period of more than three to five years. It is sometimes argued that homogeneity or regularity of data should guide the length of period for which they are collected. The test of homogeneity may make redundant some of the available sources of statistical information in developing countries.

Territorial, end-use and consumer group segmentation of markets differ from product to product. It is, therefore, not possible to design guidelines on their nature and structure. In one case, such as milk products, the market is regionally divided; in other cases, such as steel, paper, the market limits may extend beyond the national frontiers. The paper industry in India does not consider exports as an object to be strived towards; the paper industry in Sweden is highly export-oriented.

The demand indicators also differ from product to product and from one market to another. In one case, the cattle population, in another case the age group of children up to 5 years, and in yet another case the number of vehicles or the number of workshops may be the prime indicators of demand. In one study the literate population may be the main index of the market and in another, the illiterate.

It is difficult to classify products for purposes of fixing time periods for collection of data. By and large, the demand for mass consumption products such as food, clothing, bicycles, radios, should be based on long-term series; for intermediate and capital goods, a relatively short-term series should be acceptable.

For most industrial feasibility studies, it is superfluous to estimate world demand and supplies although it is frequently necessary to estimate the current export market and to project its future potential.

Some industrial ventures in developing countries are intended especially to serve international markets. There are others which are intended to serve both domestic and foreign markets. Even in the case of projects meant primarily for domestic supplies, international interactions are unavoidable. The industries which are not eligible for full tariff or prohibitive quantitative protection, have to face international competition. An analysis, in those cases, of the international market is essential and of regional markets indispensable.

The more frequently required statistical bases relating to international trade are:

(i) Total world supplies, leading exporting and importing countries;
(ii) Quantum of imports into the country and the share of imports to total consumption;
(iii) Regional exports and imports and direction thereof;
(iv) Growth rate in international and regional trade;
(v) Prices and fluctuations in the past;
(vi) Impacts of major technological developments in the industry;
(vii) Leading changes in the structure of the product market;
(viii) Significant quality trends;
(ix) Major characteristics of the international trade in the commodity including tariff patterns;
(x) Trade preferences, regional or otherwise.

Analysis by Segments

An analysis of demand (whether present or potential and by volume or by characteristics) can be made either for the market as a whole or for each market segment separately. Depending on the market structure and availability of data, an analyst starts with one and ends up with the other. Not infrequently it is imperative to make estimates for the component sectors in order to be able to arrive at the whole. When it is possible to estimate the current demand for the entire market to be served, it becomes necessary to dissect the market to make future projections and to determine the acceptable product-mix.

For a ceramics plant, for example, the market segments may be:

(i) Tiles: (a) coloured, (b) white and (c) designed; or
(a) individuals, (b) bulk consumers; or
(a) first-quality, (b) second quality, (c) commercial quality;

(ii) Sanitaryware: (a) coloured, (b) white; or
(a) full sets, (b) washbasins, (c) W.C.'s and (d) bathtubs; or
(a) individuals, (b) bulk consumers; or
(a) first quality, (b) second quality; (c) commercial quality.

For a paper project, the market segments may be:

(i) Newsprint: (a) for dailies, (b) for magazines, (c) other uses;

(ii) Bond paper: (a) for printing, (b) for writing;

(iii) Printing paper: (a) white, (b) coloured; or
(a) for printing books, magazines, (b) for educational books, (c) for school exercise books; (d) for government stationary, (e) other general uses;

(iv) Tissue paper: (a) toilet paper, (b) special printing paper, (c) packaging paper;

(v) Kraft paper: (a) light-weight packaging paper, (b) corrugated medium, (c) board;

(vi) Art paper: (a) ordinary light weight, (b) special cream laid; (c) art board;

(vii) Laminated paper: (a) white, (b) coloured, designed.

For a rexin or leather cloth project, the likely market segments may be:

(i) Domestic market: (a) automobile manufacturers, (b) furniture manufacturers, (c) other domestic uses;

(ii) Export market: (a) South Asia, (b) Far East, (c) Middle East, (d) Europe.

The foregoing examples would show that market segments may be identified by nature of the product, its qualities and end-uses, by consumers groups, or by geographical division of the market.

The rationale for dissection of market into segments by consumer characteristics is based on the fact that the development of demand invariably varies from one segment to another. Variations occur as a result of a number of conditions. The consumer habits in one may change more rapidly than in another (a high income segmant may, for instance, show greater response in accepting a higher priced product). Secondly, some segments may even structurally grow at a faster rate than others (for example, urban households in a certain income bracket grow at a higher rate than do rural households, a consequence of urbanization). Segmentation of the market helps also in planning marketing effort for the project as considerable gains are possible by gearing promotional strategies to the characteristics of different market segments. One over-riding consideration, however, is that most often the appraisal and projection of market size can be made only by analyzing separately each market segment by broad or more detailed classification. To estimate the demand for daily newspaper, one has to refer only to the literate population and for scientific journals to the graduates in science. The demand for cosmetics is likewise limited not merely to the female population, but to a certain age bracket mainly. Similarly, to determine the size of demand for cattle feed, th analysis has to be restricted to cattle population in cattle-inhabited areas.

## Characteristics of Product-mix and Market

The market and demand study must very clearly identify the important specifications of the product in the market and the likely changes which could be made to suit the local or international market to be served. Wherever possible and necessary, the designs and drawings of the commodity should be given in the report to demonstrate clearly what is being considered. In giving the specifications, sizes, designs and models should be clearly shown. A reference to the standard specifications, when available are equally essential.

The sizo structure of pipes of a steel pipes project with an annual capacity of 90,000 tons is reproduced in the following statement.

Statement **Product Mix of a Steel Pipes Project**

| Diameter | Share in Production (%) | Production (Tons) |
|---|---|---|
| 15 MM (½") | 5 | 4,500 |
| 20 MM (3/4") | 5 | 4,500 |
| 25 MM (1") | 15 | 13,500 |
| 32 MM (1.1/4") | 15 | 13,500 |
| 40 MM (1.1/2") | 15 | 13,500 |
| 50 MM (2") | 10 | 9,000 |
| 65 MM (2.1/2") | 10 | 9,000 |
| 80 MM (3") | 10 | 9,000 |
| 100 MM (3") | 5 | 4,500 |
| 125 MM (5") | 5 | 4,500 |
| Total | 100 | 90,000 |

## Estimation of Current and Past Demand

The first target of market and demand analysis for feasibility studies, noted earlier, is the estimation of current or present demand.

The current refers to, by convention, the year preceding the one in which the study is made. Due to lack of adequate data availability, this year may be a year before the preceding one.

Some studies try to take the base or the present or current year in which the project is expected to commence commercial production. This may be avoided. Most of the data are available for past years. The base year itself would then need projection. Moreover, the commencement of a feasibility study is too early a point in time when it can be projected with any precision about the time of consummation of the project.

Whether the year selected is a fiscal year, a plan year, a calendar year or a commercial financial year, depends on the basis of the period for which most of the data to be used by the analysis is available. Thus, if the analysis is to be geared to the available data on industrial production and international trade and if the country published these data on a fiscal year basis, such as April to March, the fiscal year should be the basis. This will greatly help in data processing and will obviate the need for approximations for period adjustments. If the data on demand and production are available on plan year basis, perhaps commencing in July, that year should then be the basis. When the financial year of the candidate establishment is pre-determinable, that may be the preferable choice since all economic data on sales and realization during the whole life span of the project shall have to follow the financial year.

The base point for estimation of current and past demand is the actual consumption in the relevant period. If it is possible to identify the size of actual consumption, it will not be too complicated to estimate the suppressed part of the demand and to arrive at the aggregate demand. Actual consumption figures of most products are not easily available. A shortcut, or at any rate, a beginning has to be made with "apparent consumption".

The consumption of a product in a domestic market in a given period is arrived at by aggregating the production, the adverse balance of trade and decrease in inventories. Thus consumption ($C_o$) is

$$P + (I - E) + (S_o - S_c)$$

where

$P$ = production during the period
$I$ = imports
$E$ = exports
$S_o$ = stocks at the commencement of the period
$S_c$ = stocks at the close of the period.

Adjustments should be made for captive consumption of the product by the producers (such as of LPG gas by the refiners).

Abnormal factors (such as long-term strikes in a dominant factory belonging to the producing or consuming industry) have to be identified and provided for by escalating or deflating the final figures. It may sometimes not be possible to identify the abnormal factors. It would, therefore, be necessary to resort to an average of the previous two to three years with appropriate adjustments.

Like the consumption of the current year ($C_o$), the consumption of the past years (C-n ...C-1) may also be estimated. If there are gaps in the series, these have to be filled in by interpolation. The technique of interpolation is referred to in the following chapter.

The factors governing export markets are completely divergent from those affecting the domestic markets. The techniques of their estimation and forecasting are also distinctively different. It is advisable, therefore, to make analysis of domestic and export markets separately.

In a free market, current consumption may be equated with current demand. But as pointed out earlier, current consumption is not the same as current demand or requirements.1/ In most developing countries, restrictions on production and imports of commodities are frequent. One overbearing constraint is the non-availability of foreign exchange resources. In estimating the demand of a commodity, it is necessary to provide for

1/ It is often erroneously assumed that demand analysis and forecasting become easy if the entire quantities of the subject product were imported, and not domestically produced. Imports, however, are a very illusive indicator of aggregate demand. As a consequence of the common constraint in developing countries of chronic foreign exchange shortages, imports are subject to severe restrictions, by quotas, exchange allocations or tariffs.

various factors which might have remained suppressed through rationing or exchange restrictions. In many cases, the only way to deal with these factors is to make intelligent estimates. What premia or discounts are assigned to base data in order to provide for the suppressed factors, depend on each individual commodity, the nature of the market, the size and the structure of the industry. A factor of prime importance is the existence of monopolistic or oligopolistic (and monopsonic) imperfections. The production itself may have remained restricted because of plan targets and licensing policy of the government. Production may be restricted as a result of non-availability of inputs, domestic or imported.

Apparent consumption is after all apparent only. If actual consumption is not, it is not the effective demand during the current year. It is necessary, therefore, to check apparent consumption of the base year and the trend with other subsidiary or secondary data. In a study on ceramic products, the alternative data base was provided by the housing activity in the country. In a similar study on gas stoves, the consumption of LPG provided the base for estimating the current demand.

In demand studies, the factors not quantifiable should be provided for on the basis of assumed discounts and escalators. When such factors are not of significant magnitudes, there is no need for inflating or deflating the estimates, but nonetheless, these must be clearly stated in the report.

Market Surveys

While the indirect way of assessing the current demand and projecting it into the future on the basis of secondary data is a sound one, the more scientific approach is to conduct a full market survey. Moreover, secondary data might not be available; when available, these may not be adequate. The only alternative then is to launch a consumer survey. To economize on cost, effort and time, surveys are almost always organized on a random sample basis; the sample being representative of the "population" or the aggregate for which the studies are being made. The "sampling frame" must be designed with a high degree of skill, so that results are not biased. The assistance of a statistician should be sought while designing the frame. Once the frame is designed, it will be possible to get estimates of the required information while precise limits of the sampling errors may also be determined.

When a market survey is undertaken, the object is not merely to ascertain the total demand or its growth rate, but it is also to identify many other characteristics and facets of the market, such as localization of demand, growth of demand in different sectors, consumer preferences, changes in consumer tastes of different component classes, income elasticities, price elasticities, consumer motivations, distributive trade practices and preferences. The consumer surveys, thus, seek both quantitative and qualitative information. They are not restricted to the direct manifestations of demand but extend to those of the market.

In conducting a market survey, several steps have to be taken. These broadly are:

(i) Selection of the product - qualities, sizes, colours;
(ii) Identification of the field-horizon - the categories of consumers, trade outlets or producers;
(iii) Selection of specific market segments;
(iv) Determination of the size and the design of the random sample;
(v) Recruitment of field enumerators;
(vi) Training of field enumerators;
(vii) Organization of field work;
(viii) Scrutiny of collected data;
(ix) Analysis of data;
(x) Interpretation of data.

The precision and dependability of the international yield of market surveys depend on a number of factors: the representative character of the sample, the background of the field investigators/ enumerators/interviewers, the involvement and the willingness of the respondents (consumers, individual or industrial), the quality of the questionnaire, accuracy of data interpretation and processing. Many consumer surveys in developing countries produce data of doubtful validity because of the untrained character of investigators and the unresponsiveness of respondents. The investigators should be properly trained and be given a detailed explanatory memorandum defining the terminology used in the questionnaire. They have also to be trained in the methods of motivating the respondents in divulging the correct and precise answers.

Industry and trade market surveys - as distinct from consumer surveys - generally involve more intricate, technical and specialized questions.

Investigators in these cases ought to be fully qualified. In cases of engineering products, qualified technical people are needed. A great deal of skill is required in framing the questionnaire itself. The questions, answers to which are susceptible to personal sensitivities, should be avoided.

Market surveys require both specialized skills and a trained field force. There are specialized agencies for market surveys and these should be used as far as possible.

A recourse to specialized market research consultants may prove expensive. But for projects in which market size and characteristics are a critical factor, this would be the more prudent course to adopt.

Data processing is by all counts a statistician's specialized job. An economist with a statistical background or a statistician with an economic background is required to interpret and lay down the basic rules for the analysis of the data. The pool of statistical information has, first of all, to be pruned of inconsistent data and those with doubtful validity. If a very high income bracket respondent with a large family says that he owns a mini-sized refrigorator, it is a question which needs to be questioned. Similarly, if a respondent has shown that he paid a price for the refrigerator which does not conform to the size of the refrigerator owned, the information deserves to be deleted. Sometimes, data inconsistencies are discovered when data are tabulated and abnormal correlations are obtained.

Errors in market surveys occur because of (i) imprecise questions; (ii) misunderstanding of the respondent (the investigator may not have been able to communicate adequately or correctly); (iii) deliberately distorted answers by respondents, which may be due to the reservation in divulging personal information such as on incomes because of the fear that the data may be misused by revenue authorities; and (iv) incorrect interpretation or association.

A few examples of errors are: (i) a respondent in giving his income level gave only a fixed monthly basic salary and overlooked pre-requisites, allowances, interest and divided incomes; (ii) a respondent in replying to a question on what he would be willing to pay for a refrigerator, gave a figure which he would have paid when he bought his existing refrigerator four years ago; (iii) a respondent thinking that his answer would lead to more frequent and free after sales service, gave his preference for a visit of the company's mechanic every week although he realized that it was a tall order.

The scope of the market survey depends on a number of factors:

(a) The nature of the commodity;

(b) The size of the investment proposed;

(c) The structure and size of the market;

(d) Cost of conducting the survey;

(e) The significance of the size of the market to the viability of the project;

(f) The extent and dependability to secondary data.

The data obtained on the sample basis, the sample being only a component - although a representative component - of the total "universe", has to be magnified.1/ When the sample is taken from the universe as a whole, the magnification can be achieved only for the total universe. The magnification can be achieved by consumer classes if the sample selected is on a stratified basis. Thus a random sample of 600 from a total universe of 30,000 car owners in Syria may be selected on a stratified basis: 400 from large cities each with a population of over 100,000, 150 from smaller towns each with a population of over 10,000 to 100,000 and 50 from the rural areas. In this case, the magnification of the characteristics can be achieved by three groups of urban-rural population separately.

The magnification is accomplished by multiplying the sample result by the respective inflatory factors. The inflatory factors are the ratios between the sample size and the total size of the universe. Thus if the number of car owners in the large cities is 20,000, the inflatory figure shall be 50 (20,000 divided by 400, being the size of the sample in the subject strata). If now it is found that the number of two-year old cars in the large city sample was 25, the number of two-year old cars in the large cities would be 1,250.

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1/ Universe in statistical language means the entire coverage or population. Thus if a random sample of 600 car owners is taken from 30,000 car owners in Syria, the 30,000 car owners constitute the universe and the 600 owners selected on a rational but random sample basis, the sample.

A sample of a consumer survey questionnaire is given in the following statement. The questionnaire needs to be designed, as mentioned earlier, with a considerable degree of skill. It should be compact and concise and yet comprehensive. If it is too involved, the respondents would not answer. The questions should be clear and not confusing. They should not be provocative, arousing the suspicions of the respondents. Each question should be purposeful, leading to desired information on demand structure and behaviour, which needs to be investigated.

It is customary to test the questionnaire with a selected small number of respondents before it is finally launched for the field operations. The test is to be conducted to determine if (i) the questionnaire is not too long; (ii) any question is misunderstood and does not evoke precise answers; (iii) any question arouses suspicions of the respondants.

Statement — **Sample Questionnaire for Consumer Demand Survey of Refrigerators**

Questionnaire No. ______ Area Code ______

1. Name of Respondent ____________________
2. Location of Respondent (city, town, village) ____________________
3. Income level: Below $100☐ $101-250☐ $251-500☐ over $500☐ per mo.
4. Occupation: Business☐ Service☐ Professional☐
5. Size of family: 1☐ 2 or 3☐ 4 to 6☐ more than 6☐

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6. Age of refrigerator: Does not own☐ less than one☐ over 1 to 3☐ over 3 to 5☐ over 5☐
7. Income level when refrigerator was bought: Below $100☐ $101-250☐ $251-500☐ over $500☐
8. From whom the refrigerator was bought: Distributor☐ Agent☐ Retailer☐
9. Size of refrigerator owned (liters): Below 100☐ 101 to 160☐ 161 to 250☐ over 250☐
10. Size of refrigerator desired (liters): Below 100☐ 101 to 160☐ 161 to 250☐ over 250☐
11. Price paid for the refrigerator: Below $250☐ $251 to 400☐ $401 to 500☐ over $500☐
12. Price willing to pay: Up to 250☐ $251 to 400☐ $401 to $500☐ over $500☐
13. Willing to buy if price higher by: up to 5%☐ up to 10%☐ up to 20%☐
14. Willingness to buy new refrigerator: yes☐ No☐
15. Colour of preference: white☐ beige☐
16. Preference for double doors: yes☐ no☐ indifferent☐
17. Frequency of after sales service desired: once a month☐ once a quarter☐ once in 6 months☐
18. Motivations for buying the refrigerator: Status symbol☐ basic necessity☐ economical to preserve food☐ domestic gadget for convenience justified by income☐

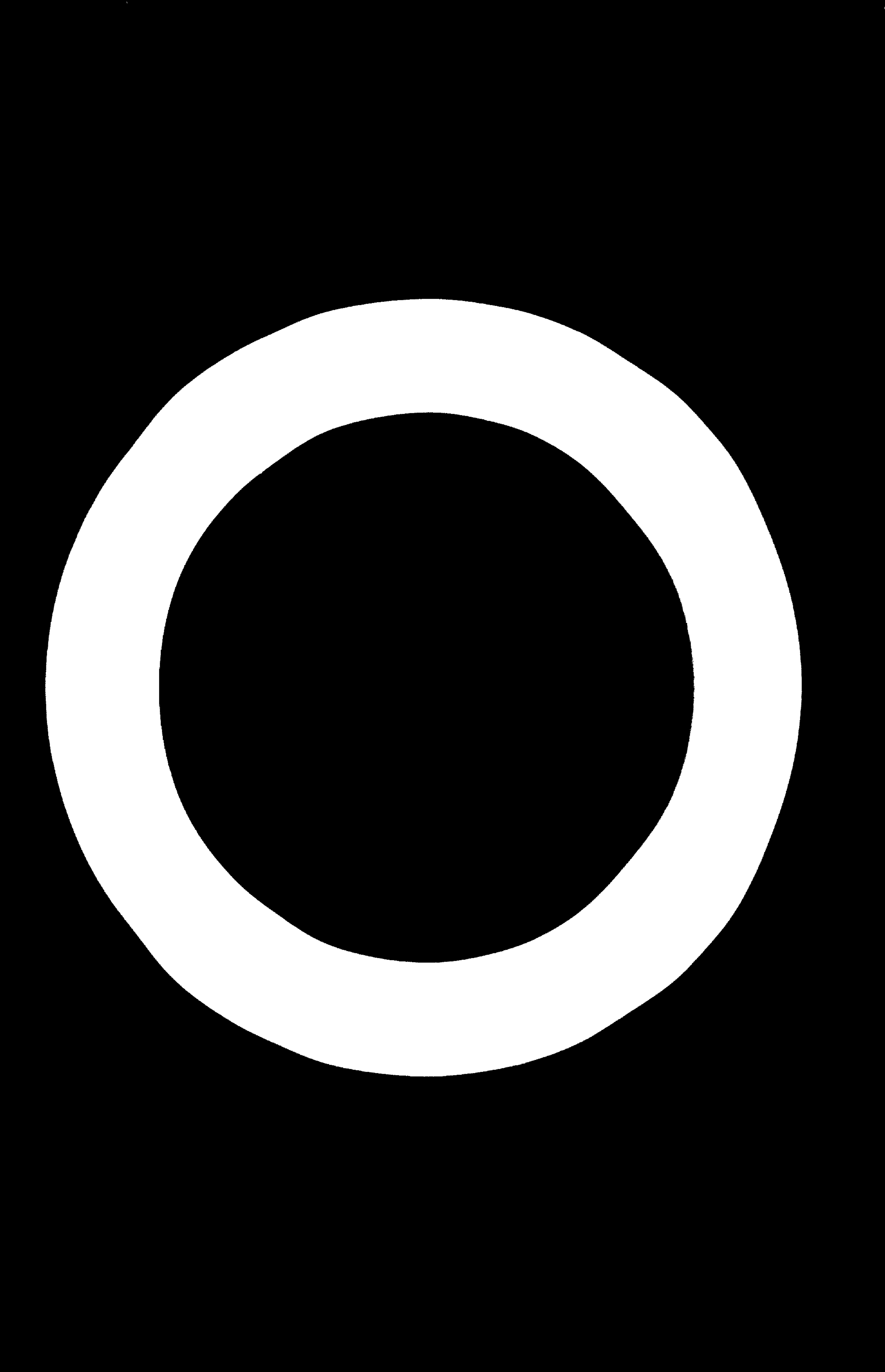
19. Preference in which the listed consumer durables acquired or willing to acquire (Indicate preferency by numbers)

TV ☐ Car ☐ Motor-bike ☐
Cooking range ☐ Camera ☐
Projector ☐ Sewing Machine ☐
Dishwasher ☐

Date ____________________ Respondent ____________________

Interviewer ____________________

It may be noted that answers are specified. The respondents/interviewers are required only to put the crosses or numbers.



## Chapter 7 Forecasting techniques for demand projections

### Basic steps for forecasting

Projection of market demand is, perhaps, the most significant and certainly the most intricate element of market and demand analysis. The production capacity of the project is based primarily on and should, in any event, conform to the projected size of the demand.

There are various methods of forecasting demand ranging from simple estimates or guess work to sophisticated mathematical techniques some of which have to use computer facilities. It is often necessary to apply a combination of these. Unless the demand is too large and the contemplated capacity too small, it is seldom sufficient to rely on the mere extension of time series of total availability (imports plus domestic production). It is necessary also to assess the potential growth of competition from other units and substitutes, impacts of prices on demand, changing structure of consumption expenditures.

Before launching the forecast and selecting the techniques, the objectives of forecasting should be clearly spelt out. An exercise on demand for project feasibility studies is aimed at (i) the forecast of the potential demand for the subject product, (ii) estimates of potential supplies, (iii) the forecast of the potential share the candidate project is likely to secure in the market, and (iv) the characteristics and conditions on which (i) and (iii) are based. It is the task of the study to provide precise quantitative answers to these objective guide-posts, churned out of masses of data, collected, analyzed and processed with utmost discretion.

The basic steps for demand forecasting are:

a) Locate the historical data showing the size and rates of change of past and present demand

b) classify the historical demand data by market segments

c) identify the factors (determinants) or indicators of factors that best explain past demand

d) identify the relationships that existed between the factors and the demand in the past

e) forecast future development of the factors and of relationships between the factors and demand

f) forecast demand by extrapolation of the factors and the relationships

The analyst should carefully examine the data collected to find out whether the consumption corresponds to demand or whether there is latent unsatisfied demand. The unsatisfied demand will be indicated by either disproportionately large profit margins or by some measures of control like price control, import control, rationing. The level of unsatisfied demand can be determined by a market survey of the importers, local manufacturers, wholesalers, retailers and consumers.

In practice, one or several shortcuts are usually resorted to because of lack of data or when precision requirements are not too rigid. Some common shortcuts are the following:

a) assume certain factors as constant (for example, the level of marketing effort for competing products)

b) assume constant relationships between certain factors and demand

c) assume linear relationship between given factors and demand

d) concentrate on factors (or a factor) that explains a major share of the variations in past demand

e) assume future development of the factors and the relationships as an extension of trend in the past periods

f) analyze past demand in one market while making the forecast for another

g) assume one or more relationships implicitly or intuitively

Common determinants of demand

Determinants of future demand depend a great deal on the nature of the product and its end-uses or applications. For identifying the determinants, the product may be classified into one of the following groups:

i) consumer non-durable products consumed in one-time use, such as paper, processed food like butter

ii) consumer durables such as clothing, pens, bicycles, refrigerators, cars, sanitaryware

iii) industrial intermediates being the component inputs of other products, such as steel ingots, caustic soda

iv) capital or investment goods products used repetitively for production of other goods and services, such as industrial machinery, tractors.

v) multi-use products such as sugar which has direct consumer and industrial demand (the latter for manufacture of cakes, candies, biscuits, jellies) and sewing machines and air conditioning equipment which are both consumer durables and capital goods.

The consumer goods have by and large broad-based markets – in most cases, mass markets – and industrial and capital goods have relatively smaller number of users.

The demand for consumer goods is subservient basically to multiple dimensions of demographic data and calculations of purchasing power, that for capital goods is primarily a function of the expansion, rehabilitation and modernization plans of the subject industries. The demand for intermediate goods (such as chemicals, components, base metals) is derived from the size of output of the finished products.

Some of the leading determinants indicators of demand are:

i) Size of the population and its structure. In some cases, it is the total population, in others, it is certain segments of the population which determine the size of demand. The demand for cosmetics, for example, depends on the size of a certain age of the female population. Similarly, the demand for spectacles depends on the size of a certain age group of both female and male population. The demand for educational material, such as exercise books, is correlated to the number of the school going children in specified age groups. The proportions between male and female population of the same age group will differ, and therefore, the numbers of each have to be separately projected.

ii) Growth of incomes and distributional structure. The demand of certain commodities is correlated to the total incomes of the community. In other cases, it is related to income levels. The demand for bicycles grows with the overall income level in the country, but for cars to the expansion in the incomes of a certain minimum level of income brackets.

iii) Urbanization coefficient. Certain products are a peculiar feature of urban life. Their demand is not linked to the general increase in population but to the growth in urban population. The use of LPG for domestic cooking, for example, grows with an increase in urban population.

iv) Growth in end-uses or complementary demand. The number of electric lamps can be linked to the growth in the generation of electric power and allocation thereof to the domestic sector. The demand variable for gas stoves is dependent, likewise, on the availability of LPG. For forecasting demand for consumer goods, therefore, a recourse may be made to the sources of complementary demand. If one is known, the other can be predicted more easily. In case of industrial intermediates, the demand depends directly on the production of the end-products and of capital goods in the expansion of the consuming production sectors.

v) Growth in substitute demand. The demand - or at least a segment of it - for a number of products depends on the growth of the demand of substitutes. The latter is a negative factor and may be identified as a negative indicator. Thus the demand of jute bags will decline, other things remaining the same, if the substitute demand for polythene coated paper packaging is rising.

vi) Replacement demand. In the case of consumer durables and capital goods, one of the components of demand is the replacement requirements. The age structure of the growing population of the candidate item will be a factor in the growth of the demand. The demand, for example, of transistor radios, grows not only with the expansion in incomes and a rise in the population with certain income brackets, the old radios are discarded and the existing owners will re-enter the radio market. The size of the replacement demand depends on the age structure and life span of radios.

vii) Distinctive indicators of subject demand. The demand for certain products may be linked to certain distinctive phenomena reflecting a relationship with its end uses. The demand for newsprint paper, for example, grows with the circulation of newspapers and magazines, which in turn is dependent on literacy programmes. Similarly, the use of asbestos pressure pipes is indirectly dependent on the investments in community health engineering and water supply programmes. The demand for petrol pumps at service stations is linked not merely to the number of service stations and the size of the vehicular population to be served, but it is also dependent on new road building programmes.

Basic reconnaissance for demand forecasting

The information required for market and demand analysis are both types, quantitative and qualitative. The collection, analysis, processing, interpretation and application of quantitative data require statistical acumen that of qualitative information calls for experience and discretion of the analyst.

The informational requirements for demand studies may be classified into the following broad categories:

i) demographic, physical quantitative (such as number of television sets, tons of aluminium) and economic (such as prices, incomes, values of production) data;

ii) production, consumption and trade (both internal and external) statistics;

iii) statistics on transportation system - by movement of goods and fiscal data (especially direct and indirect taxes);

iv) institutional data such as on distributive channels, structure of markets by consumer categories;

v) behavioural data such as on consumer habits and responses - individual and collective, trade practices

vi) legal information including that on executive or administrative regulations.

Informational material for market and demand analysis common to most studies cover:

i) of the product, near substitutes, major or critical inputs and complementary products:

a. licensed, installed and planned and most likely capacities of the existing and potential producers;

b. production targets under national plans;

c. actual production both by volume and value for the past years of the product, substitutes and inputs;

d. imports, exports, re-exports;

e. captive consumption - consumption of the producers of the same product and the quantities not available for marketing;

f. internal trade - by trade flow or through transportation system (needed for assessment of market segments);

g. inventories;

h. prices * (by monetary values and index numbers), C and F, c.i.f. or f.a.s. (free alongside ship) for imports f.o.r. for exports;

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* In referring to import or export prices, a factor of immense significance is the exchange rate at which those are converted into common currencies.

ex-factory, F.O.R. (free on rail) or F.O.R. Destination (free on rail destination), delivered for domestically produced products, and wholesale and retail for all

ii) GDP or NP, per capita incomes, per capita disposable incomes, occupational, regional and size distribution of incomes, family budgets of the consuming population

iii) demographic data of the consuming population

iv) fiscal information, incomes, production, purchase or sales taxes and customs duties, applicable to the relevant products, government subsidies or incentives, such as on use of fertilizers, insecticides.

How far the data be extended to international horizon or can be dissected into market segments, would depend on each case and the analyst has to make his own choice.

The period of data depends on the nature and likely size of the project, and of course, on data availability. For reasons of statistical consistency, it is sometimes considered prudent that the data may be limited to the period for which the relevant homogeneous data are available. In the developing countries, homogeneous data - data having consistently the same product definition, geographical coverage and coverage of respondents or reporting units - are available in very limited number of areas. It is, therefore, often necessary to dovetail heterogeneous data by processing and treatment. In Saudi Arabia, for example, international trade statistics have witnessed a change in the reporting year, from Hijri year to Gregorian calendar year. It is not merely a problem of the divergence in the date of commencement of the year, but the Hijri year is shorter by 11 days or about 3%. It becomes necessary in such cases to convert the first or the later part of the series by approximation. Thus if the Gregorian calendar year is accepted as the basis, the earlier part of the data related to the Hijri year would have to be converted into the corresponding Gregorian calendar year

$$Q_{cn} = \left( \frac{D_p}{355} \times Q_p \right) + \left( \frac{D_c}{355} \times Q_c \right)$$

where $Q_{cn}$ is the quantity of current Gregorian year

$D_p$ is the number of days of the previous Hijri year in the current Gregorian year

$Q_p$ is the quantity of the previous Hijri year

D is the number of days of the current Hijri year

is the quantity of the current Hijri year

355 are the days of the Hijri year

Now if the number of cars imported in the previous Hijri year is 18,[illegible] and the number of cars imported in the current Hijri year is 24,85[illegible], and if the Hijri year starts on March 13, the number of cars imported in the current Gregorian year will be

$$\frac{71 \times 18,[illegible]}{355} + \frac{284 \times 24,85[illegible]}{355}$$

or 23,43[illegible]

In some cases, gaps may be found either historically, geographically or by product coverage. These gaps have to be filled in by statistical approximation in the same way as abnormal data have to be substituted by interpolation. Thus it is often found that import data are not available in respect of certain countries during some years. In India, several significant data are collected by states and it is a common experience that some states have not reported for certain years. Similarly, data covering factories are inconsistent since the definition for purposes of coverage was altered.

While data available on different bases should be processed and detailed, a long series of data should be split into acceptable and non-acceptable parts if there is a perceptible change in the trend because of overwhelming factors. It would be no purpose in attempting to process a long term series of cement consumption if it is found that the consumption was restricted because of import restrictions upto a period and then the demand witnessed a steep upward trend as a result of commencement of cement production within the country. On the contrary, it is likely that the consumption may have declined because of import restrictions and controls.

It should, however, be realized that long term data, notwithstanding substantial changes, may be extremely useful in making a factorial analysis. The gasoline consumption, for example, in many countries has declined by 2[illegible] to 4[illegible]% as a result of the oil price increase since October 1973. These changes help identification of the impacts the change in prices produce on the demand (price elasticity), a cardinal factor in demand estimation.

Forecasting techniques

Depending on the nature of the product, the nature and structure of the market, data availability and precision requirements, any one or more of the following techniques may be used to forecast demand of a product for a given period of time in a specified market:

A) Trend (extrapolation) method
B) Consumption level method
C) End-use or consumption coefficient method
D) Leading indicator method
E) Regression models
F) Simultaneous equation models
G) Simulation models
H) Market survey method

Apart from the above-mentioned methods, there are adaptable forecasting models such as exponential smoothing model which are useful for short run forecasting. The parameters of these models adapt themselves with the latest data and hence lead to very accurate short-term forecasting. However, these methods are not discussed here since project analyst is interested only in medium and long term forecasting. Market survey method has been covered in the preceding chapter.

A) Trend (extrapolation) method

It is, perhaps, the most popular and often the extremely useful method of forecasting. The use of this technique requires the extrapolation of historical data on the assumption that the pattern of past movement of the time series will continue to hold good in the forecast period. The assumption is based on the hypothesis of mutually compensating trends. If the consumption of cement in Syria has grown by 1 % in the sixties, the demand for seventies is extended at the same rate.

The method involves two stages: (a) determination of a trend (through graphical plotting or mathematical appraisal of growth patterns), and (b) identification of its parameters. Some of the more suitable alternative trend curves for forecasting are the following:

i) Arithmetic (liner) trend: This is given by $Y = a + bT$, where Y is the variable under forecasting, T is the trend variable. The intercept (a) and the slope (b) are to be estimated.

ii) Exponential (semi log) trend: $Y = ae^{bT}$ or $\log Y = \log a + bT$. The semi log assumes a constant growth rate (=b) each period.

iii) Second and higher degree polynomial trend $Y = a + bT + cT^2$. If the second or higher order differences are approximately constant, a second or higher order polynomial will best explain the desired trend curve.

iv) Cobb-Douglas (Double-log) function.

$Y = aT^b$ or $\log Y = \log a + b \log T$. The double log trend assumes a constant elasticity (=b) every period.

v) Auto-regression method:

The variable under forecast is regressed on its past value.

$Y_t = a + bY_{t-1} + cY_{t-2}$

Since the past values are known, the value in the next period can be forecasted using the auto-regression model.

The arithmetic linear trend is more frequently used. For considerations mentioned later in this section of the manual exponential trend should be preferable.

Annual demand figures are bound to be fluctuating. It is invariably necessary, therefore, to identify a long term trend. In order to obtain the trend, it is necessary to go backwards over a period of at least 10 to 15 years. In many developing countries, the production and import figures for a period of 15 years may not be available. It would, therefore, be necessary to limit the analysis to a period of less than 15 years or even less than 10 years. No short-term trend should normally be used for future projections unless it is very clearly defined. Six to eight year period not witnessing abnormal oscillations should be considered the minimum.

The first step to discover the trend would be to take a moving average of two or three years if there are too many fluctuations. This will syphon off many angularities.

A moving average may be taken for two, three or four years by identifying a possible cycle in the data. Where the moving average gives a distinct smooth curve, the problem of identification of the trend is automatically resolved. The following example shows the application of the moving average method:

| Year | Apparent Demand for Passenger Cars* ([illegible]) | Three-year Moving Average |
|---|---|---|
| 1951 | 21[illegible] | |
| 1952 | 263 | 241 |
| 1953 | 221 | 259 |
| 1954 | 294 | 272 |
| 1955 | 3[illegible]2 | 285 |
| 1956 | 26[illegible] | 29[illegible] |
| 1967 | 3[illegible]3 | 3[illegible]3 |
| 1958 | 34[illegible] | 319 |
| 1959 | 31[illegible] | 339 |
| 1960 | 363 | 349 |
| 1961 | 368 | 375 |
| 1962 | 39[illegible] | 373 |
| 1963 | 36[illegible] | 387 |
| 1964 | 41[illegible] | 398 |
| 1965 | 423 | 414 |
| 1966 | 41[illegible] | 434 |
| 1967 | 468 | 458 |
| 1968 | 495 | 478 |
| 1969 | 47[illegible] | 495 |
| 1970 | 52[illegible] | 523 |
| 1971 | 58[illegible] | 55[illegible] |
| 1972 | 55[illegible] | 577 |
| 1973 | 6[illegible] | |

* Domestic production plus import plus opening inventory minus exports minus closing inventories minus cars thrown out of use.

In attempting to find the trend of production and imports (or apparent consumption), one might find abnormal aberrations in some years Sometimes, figures for certain years are missing. These have to be statistically interpolated before determining the trend or the growth rate. The Lagrange's formula may be used for interpolation.

The Lagrange's formula is of the following form:

$$Y_x = Y_0 \frac{(x - x_1)\ (x - x_2)\ \ldots\ (x - x_n)}{(x_0 - x_1)\ (x_0 - x_2)\ \ldots\ (x_0 - x_n)}$$

$$+ Y_1 \frac{(x - x_0)\ (x - x_2)\ \ldots\ (x_1 - x_n)}{(x_1 - x_0)\ (x_1 - x_2)\ \ldots\ (x_1 - x_n)}$$

$$+ \text{-----------------------------}$$

$$+ \text{-----------------------------}$$

$$\frac{(x - x_0)\ (x - x_1)\ \ldots\ (x - x_{n-1})}{(x_n - x_0)\ (x_n - x_1)\ \ldots\ (x_n - x_{n-1})}$$

Where $x_0\ x_1\ \ldots\ x_n$ is the time series,

$Y_0\ Y_1\ \ldots\ Y_n$ is the corresponding demand series,

x is the year for which the demand is to be interpolated,

and $Y_x$ is the demand of the year for which the interpolation is desired.

The method of least squares may be used for obtaining an objective fit of a straight trend line. The formula for obtaining the magnitude of periodic change is

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$$

Where $x_1\ x_2\ \ldots\ x_n$ are the deviations of the time series from x the assumed mid-point.

The periodic change is then applied to the periods preceding and following the mid-point starting from the average at mid-point

The following example will make the application clear:

| Year | Demand for AC Pressure Pipes ( tons) |
|---|---|
| 1969 | 532 |
| 197 | 564 |
| 1971 | 635 |
| 1972 | 649 |
| 1973 | 629 |
| 1974 | 627 |

The straight line trend may be calculated as shown in the following statement

| Year x | Demand tons y | Deviation of x from mid-point | xy | $x^2$ |
|---|---|---|---|---|
| 1969 | 532 | - 2.5 | - 133 | 6.25 |
| 197 | 564 | - 1.5 | - 846 | 2.25 |
| 1971 | 635 | - .5 | - 317.5 | .25 |
| 1972 | 649 | + .5 | + 324.5 | .25 |
| 1973 | 629 | + 1.5 | + 943.5 | 2.25 |
| 1974 | 627 | + 2.5 | +1567.5 | 6.25 |
| | 3636 | | 339 | 17.5 |

Applying $$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$$

we get $$b = \frac{6(339) - ( \times 3636)}{6(17.5) - ( )^2}$$

or $b = + 19.4$ ( tons)

Once the trend line has been located, its projection mathematically or graphically is merely an extension operation.

A trend line (of the observed past years) might lead to a point in the current year which is either too high or too low - when compared to the actuals. In such cases, one must revert back to the average of the last two or three years as the point from where to start for future projection of the trend line.

A past trend line is based on the growth rate at mid-point after taking into account the secular growth trend and neutralizing the deviations, positive and negative, from the trend. The projection of the trend line, *ipso facto*, extends the absolute quantum and not the rate of growth to the future period. If the past observed period on which the trend line has been developed is long - 15 years, and the projection period is also fairly long, 15 years, the assumption of the same quantum of change - not the rate of growth - will lead to erroneous results. The results will be more distorted if the rate of change is substantial - when linked to total demand. If the change in demand for sugar shown by the trend line in the decade commencing from 1965 was 5 , tons with a demand in 1965 being of 3 , , the demand in 1974 would be 8 , tons rising to 1,1 , tons in 198 . Now to assume that the growth was 5 , tons over both 3 , and 1,1 , tons is obviously incorrect. At the first point, the rate of growth identified is 16.6 and at the latter point 4.5 . It may be understandable that the rate of growth may decline as the base expands but the amount of divergence may be much lower. This demonstrates the need for use of exponential trend line.

One simple method to combine the use of the linear trend line and exponential methods would be to compute the growth rate at mid-point of the observed time series and to apply this rate to the estimated present demand - as distinguished from the identified point by the trend line. In the above-mentioned case of the demand for sugar, the rate of growth to be projected will be

$$\frac{5 ,}{575,} \times 1$$

or 8.7

since the demand at mid-point between 1969 and 197 is

$\frac{55 , + 6 ,}{2}$ tons and the identified rate of change is 5 , tons.

The main limitation of this method is that it is a mere extrapolation of the past and is not based on any cause and effect relationship. It is for obvious reasons not suitable for new products and those with relatively brief existence or for which fairly long-term data are not available.

Trend line methods are based, as pointed out earlier, on the hypothesis of mutually compensating effects. In real life, this hypothesis has very limited validity. The trend line methods, therefore, should be used, as far as possible, only for preliminary pre-investment studies, such as opportunity and pre-feasibility studies. For full techno-economic feasibility studies, whenever trend line methods are adopted, a cross-check with other methods becomes imperative.

The trend line technique, however, can be very usefully deployed in combination with other methods. Under the consumption level method, for example, the trend line technique may be used for market segments which are expected to project the past trends.

In cases in which precision requirements are limited and demand is not a critical factor for determining plant size or economic viability, the trend line method based on the projection of past trends can be considered to be adequate.

The trend line method may be found to be the only practical tool for demand studies of export markets. It is not possible for most studies of the size of plants meant for developing countries to make an elaborate analysis of international markets and their future trends.

(B) Consumption level method

A variant of end-use method is the consumption level method. This may be employed where the product is of direct consumption. The demand under this method may be projected either on a global (total market) or segmented market basis.

The demand for cars may be estimated by computing the ratio of cars to per 1 population or the coefficients for car-ownership among identified income levels, industrial units and government (per 1 of employees), and taxis (per 1 of population by population levels of identified towns and cities). Once the total requirements are known, the existing car population may be deducted to arrive at the new demand. To this demand shall be added the replacement requirements.

A major factor in determining consumption levels is the incomes of consumers, which determine, among other things, the family budget allocations that they are willing to make for the subject product. The income level is a major indicator of consumption levels of several products. But for a few exceptions, consumption of most consumer products and income levels of consumers demonstrate a high degree of positive correlation. The degrees, however, of the correlation differ from product to product. The examples of products having negative correlation with income levels are to be found in the family budgets of poorer sections of the community, such as coarser variaties of food, cloth, paper, pens, shoes, soaps, or items such as hurricane lanterns, bicycles.

A centre for utmost caution, which is often ignored in many demand studies, is that income elasticity of products changes from level to level. Products, which are supposed commonly to have negative correlation with incomes, show positive correlations up to certain levels of income. The high income elasticity evident at lower levels declines with the crossing of higher income barriers. This is true of most products. In developing countries these barriers over the life span of industrial projects are not crossed quite often but nonetheless, the tendencies of lower income elasticities with increased incomes are in recurrent evidence within income brackets. The aggregate result would, therefore, depend on the income structure. Refrigerators are not demanded up to a fairly high level - relatively - of incomes. Over these levels the income elasticity rises and then reaches a plateau. The demand for radios shows a similar pattern.

It is often recommended that the demand for some products may be determined by international comparisons. It is assumed that the new developing countries will tend to approximate the levels achieved by industrially developed countries. The divergences, however, are so substantial - most often ratios vary by 5 to 50 times - that international comparisons as a guide are almost bound to lead to misleading results. That, perhaps, could be done is to locate, if possible, similarly placed countries - by economic standards, such as per capita income - which possess consumption level data for the subject product. Thus if data are available for per capita consumption of paper in Kuwait, these may be applied to Saudi Arabia; and if available for Pakistan, these may be applied to India. Similarly, the data may be exchanged for similarly placed industrially advanced countries.

International comparisons may be used for purposes of cross-checking but as primary indicators for determining the size of demand, these ought to be scrupulously avoided no matter whatever be the source of information, international organizations or governments.

When it is discovered that the demand is primarily a function of per capita income or GNP, the gross demand - to be adjusted by other relevant factors such as price or cross elasticity - may be determined by the application of income elasticity of demand. It is obvious that even in cases in which the demand is a function of incomes, the demand varies differently for different commodities. The extent to which the demand changes in response to variations in incomes, is measured by income elasticity. The income elasticities differ not only between products but also between different income groups and different regions for the same product. Thus, the demand for paper may increase by 2% with an increase of 5% in per capita income in rural areas up to 41 [illegible], it may increase by 1% with the same increase in the per capita income in urban areas with incomes higher than [illegible]5. Whenever it is possible, therefore, to determine variations in per capita income by income brackets and by regions, the analysis should not be limited to the average per capita income in the whole national economy, but it should be extended to occupational, socio-economic and geographical sectors.

When relatively small changes are involved, a coefficient may be developed and applied to changes in per capita incomes. Thus, if it may be found that in a country an increase in per capital income by 1% leads to an increase in consumption for paper by 2%, the demand of paper for future years may be estimated by the application of the income elasticity coefficient. It is illustrated by the following example: (see next page)

| Year | Per capita income | Increase in per capita* income | Increase in demand for paper* | Per capita demand for paper | Population | Demand for paper |
|---|---|---|---|---|---|---|
| | [illegible] | [illegible] | [illegible] | kg | million | [illegible] t |
| Base Year | | | | | | |
| 197[illegible] | 9[illegible] | - | - | 2.[illegible] | 54[illegible] | 1[illegible]8[illegible] |
| Projection Years | | | | | | |
| 1971 | 91.8 | 2 | 4 | 2.[illegible]8 | 557 | 1158 |
| 1972 | 94.5 | 5 | 1[illegible] | 2.2[illegible] | 571 | 1256 |
| 1973 | 94.5 | 5 | 1[illegible] | 2.2[illegible] | 585 | 128[illegible] |
| 1974 | 99.1 | 1 | 2 | 2.4[illegible] | 6[illegible]1 | 1442 |
| 1975 | 1[illegible]4.4 | 16 | 32 | 2.64 | 616 | 1636 |

* on base year

A more precise formula for obtaining the income elasticity coefficient, based on logarithms is:

$$E_1 = \frac{\text{Log } Q_2 - \log Q_1}{\text{Log } I_{P2} - \log I_{P1}}$$

where $E_1$ is the income elasticity coefficient of the product,

$Q_1$ is the quantity demanded in the base year,

$Q_2$ is the quantity demanded in subsequent observation year,

$I_{P1}$ is the per capita income in the base year, and

$I_{P2}$ is the per capita income in the observation year.

If the data on per capita incomes and per capita demand for paper in 197[illegible] and 1973 as given in the preceding table were available, the income elasticity of paper in the given country would be

$$E_{[illegible]} = \frac{\log (2.2[illegible]) - \log (2.[illegible])}{\log (94.5) - \log (9[illegible].[illegible])}$$

$$= 2.[illegible]$$

Once the coefficient of income elasticity has been identified, it may be applied to any future year to obtain the per capita consumption (unadjusted) of paper in that year. Thus if the per capita income in 198[illegible] is higher by [illegible] than the base year 197[illegible], the per capita consumption of paper in 198[illegible] would be 12[illegible] higher over the per capita consumption in 197[illegible]. The per capita consumption may then be applied to the consuming population to arrive at the absolute size of demand.

(c) End-use or consumption coefficient method

This method is particularly suitable for intermediate products. The demand is obtained by summing up the demand of all the users of the product. The following are the relevant steps.

1. Identify all the possible uses, for example, input of other industries, direct consumption demand, exports and imports.

2. Obtain or estimate the input-output coefficient (for the consumption norm) with respect to the product in question and the industries using the product.

3. Find the targetted levels of output of all the consuming industries;

4. Find the demand for its direct consumption and exports - net of imports of the product.

If the problem is, for example, the forecasting of demand for methanol, the first step will be to identify the industries using methanol. Formaldehyde, fertilizers, pharmaceuticals, and DDT together consume about 8[illegible] of the methanol production. By knowing the planned manufacturing programmes for these four industries, a major part of the methanol demand can be easily projected. All other industries, if their demand is fractional, may be clubbed together and aggregate growth rate may be computed.

The end-use method can be applied to consumer products too. To estimate the demand for gasoline, it may be more convenient to link the demand to the vehicular population and then to forecast its growth.

The method, in fact, can be applied to mixed types of products as well. The consumption of cement can be based on new construction activity for private and public housing, factories, dams, public works and other constructional activities.

The end-use method has to employ consumption coefficients and therefore, it may also be styled as the consumption coefficient method. The identified constant factor or coefficient relevant to the consumption goal is applied to the size of the activity to arrive at the forecast consumption level. The following example of gasoline demand will demonstrate the application of the method.

Identified consumption coefficients

| | Gasoline consumption per annum per vehicle in (000) litres |
|---|---|
| Private cars | 3.20 |
| Taxis | 8.60 |
| Commercial vehicles using gasoline | 11.20 |
| Scooters, motorbikes. Three wheelers | 0.12 |
| Other uses | 10% of cars |

Projections of demand for gasoline (based on foregoing consumption coefficients)

| Type of vehicles | 1975 Vehicles (000) | 1975 Gasoline Consump. $10^6$ l | 1980 Vehicles (000) | 1980 Gasoline Consump. $10^6$ l | 1985 Vehicles (000) | 1985 Gasoline Consump. $10^6$ l |
|---|---|---|---|---|---|---|
| Private cars | 110 | 352 | 150 | 480 | 21 | 672 |
| Taxis | 40 | 344 | 6 | 546 | 90 | 774 |
| Commercial v. | 80 | 996 | 110 | 1232 | 140 | 1563 |
| Scooters, etc. | 280 | 37 | 410 | 49 | 700 | 84 |
| Other uses | - | 35 | - | 48 | - | 67 |
| Total | 510 | 1764 | 730 | 2355 | 1140 | 3165 |

Consumption coefficients vary from one market to another, historically, by size of producing units and as a function of technological progress.

As shown in the foregoing case of gasoline consumption, the consumption coefficients were different for each type of vehicle. Each one of these coefficients may vary from one period to another. It is necessary, therefore, to be extremely cautious in determining past and in projecting future coefficients.

In case of intermediate products, coefficients may vary with the size of the consuming unit. A larger sized industrial unit is able to maximize material yields reducing its consumption. The material ratio also changes with advances in technology. It is possible, for example, to reduce consumption of steel by reducing the thickness of the plates while still conforming to prescribed standards. In the case of an asbestos pressure pipes project, it was found that the coefficient of asbestos fibre consumption depended on the quality of the fibre.

As a result of the divergences in consumption coefficients, a considerable amount of skill of the analyst is required in projecting the coefficients and consequently the size of demand, although the data may enjoy a high degree of precision and dependability.

The end-use method, with or without the application of consumption coefficients, requires data on consumer industries as much as the coefficients. A recourse has to be made to the existing plans and projections of industries. Almost all developing countries have adopted the system of national planning. Targets are fixed for industries and sometimes for consumption levels. These targets adjusted by annual or mid-term progress reports lay the basis for estimating outputs of consumer industries. There may also be special planning or task force reports on the development of the subject industries. Where such dependable data are not available, the application of the end-use method calls for projections of output of the consumer-industries.

The advantages of the method are that

i) consumption norms are not too difficult to identify;

ii) by a simple technical identification of the consuming industries, one may be left with manageable number of consuming industries for which levels of output have to be projected, and

iii) it takes into consideration the anticipated technological and other structural changes.

Its limitations are that

i) the targetted or desired levels of outputs of different consuming industries very often differ from their actual production in the prediction period;

ii) it may tend to be a tedious and time-consuming technique.

D) Regression models

Under the regression models technique, forecasts are made on the basis of estimated relationship between the forecast variable (dependent variable) and explanatory variables (independent variables).

The regression method not only provides the forecast but it also explains the variation of the forecasted variable in the past. It is easy to apply since computer packages are readily available. All that is needed to be done is to try different combinations, to carry out the statistical tests as prescribed and to arrive at the desired forecast equation.

On the other hand, the method suffers from certain limitations. The independent variables themselves are to be forecasted. Although the forecast equation is true in the past, it need not continue to be so in future especially if there are major structural changes in the economy. To the extent forecast of independent variables are wrong, the forecast itself will go wrong.

E) Leading indicator method

A variable of the consumption coefficient and regression methods is the leading indicator method. The leading indicators are the variables which move up or down, ahead of some other variables. Thus it has been found in Ahmedabad (India) that demand for electric fans lags behind investments on housing by various agencies by about 2 years. The use of these indicators for forecasting purpose involves two stages:

a) Identification of the appropriate leading indicators;
b) Determination of the relationship between the leading indicator and the variable under forecasting.

This method obviates the need for forecasting the explanatory variable but it is not always possible to find out the leading indicator, the lead time may not be stable and the relationship itself may change with time. The method is not much used.

F) Simultaneous equation model

The simultaneous equation method specifies a complete model which can be solved into or reduced from an equation. A reduced form equation is one which expresses the endogenous variables in terms of pre-determined variables and parameters.

The method possesses all the advantages of the regression method. The simultaneous equations can always be reduced into a form in which right hand variables are easy to predict. Although the model looks very complicated, one should not be unduly alarmed since it is the computer which will solve it once the form is specified and data is fed into it.

However, simultaneous equation model also assumes that past relationship will hold in the future. If the analyst has reason to believe that there will be structural shifts in the economy in the near future, he cannot use this method.

G) Simulation methods

Simulation is a method which seeks to approximate a real world situation via mathematical and computer methods and in that way "test-out" in advance what would happen in the real world if certain variables undergo changes.

The method assumes that it would be possible to identify the critical variables and their interrelationship arrived through market surveys. Simulation programme should reflect the real situations inasmuch detail as possible. The various assumptions will be tried out in the model to see its effect on the forecast. This is a relatively new technique. Its use in market forecasting is confined mainly to developed nations and that too for consumer items catering to very large markets, dependent on a mass of variables.

The detailed analysis and application of the three foregoing techniques, E, F and G involve modalities which are beyond the scope of this manual. It is necessary to engage the services of statisticians when these are to be pressed into service. With the limitations of data availability in developing countries, their use may be dispensed with.

## Price elasticity of demand

The quantum of demand is a direct function of the price elasticity of demand. The two, the price and demand being negatively correlated. The price of a commodity is a major factor in determining the total quantum of demand. One has, therefore, to estimate first the demand at current prices. This has then to be escalated or deflated by assuming possible changes in the price level of the commodity.

The price elasticity of demand, the ratio of the relative variations in the volume of demand to the relative variation in price may be expressed as a coefficient (E)

$$E = \frac{Q_1 - Q}{Q_1 + Q} : \frac{P - P_1}{P + P_1}$$

where E is the price elasticity coefficient

$Q_1$ is the new demand at the new price,

$Q$ is the existing demand at the present price,

$P_1$ is the new price,

$P$ is the present price.

The application of the formula may be demonstrated by a simple example. If the numbers of refrigerators demanded at $500 and $600 are 500,000 and 400,000 respectively, the price elasticity of demand is:

$$\frac{500,000 - 400,000}{500,000 + 400,000} : \frac{600 - 500}{600 + 500}$$

or $\frac{100,000}{900,000} \times \frac{1100}{100}$

or 1.22.

Now if it is known that the price will decrease by 10% only, it can be predicted that the demand will increase by 10 x 1.22 or by 12.2%.

It is often assumed that the price of the end-product of a candidate project shall remain constant. In real life, it is seldom true. In other words, the volume of demand estimated for the future years is unrealistic unless it is tempered by the factor of price via the price elasticity coefficient.

The price elasticity coefficient of demand is a highly useful tool for studying sensitivities in the economics of a project by applying variable prices which might prevail in future. The variation in prices change not only the revenue directly, it effects the size of the market, and therefore, the production levels. The change in the production level will have regressive effects on costs of production.

As a significant tool for measuring sensitivities in demand, levels of output and costs of production, the price elasticity coefficient of demand can be employed for designing marketing strategy.

There are some limitations of this tool and it should be applied cautiously. It assumes that other conditions of the market structure and behaviour remain constant. The coefficient is applicable to relatively small variations in prices since the coefficient does not remain constant over a wide range of price variations.

Cross elasticity

The demand of a product is determined not only by its own price, the price of complementary or substitute products also have a significant bearing on its demand. As a result of the substantial increase, since October 1973, in the price of oil and consequently of gasoline, the demand for cars has gone down appreciably in many countries of the world.

It is often necessary to identify the products the price variations of which may affect the demand of the subject product. This is determined by cross elasticity.

The cross elasticity of product A to product B is determined by the following formula:

$$C_{AB} = \frac{Q2A - Q1A}{Q2A + Q1A} \div \frac{P2B - P1B}{P2B + P1B}$$

$C_{AB}$ (the cross elasticity of product A to product B) is thus the ratio of proportionate change in the demand of product A to the appropriate change in the price of product B.

If $C_{AB} > 0$, the product B is a substitute of A;
If $C_{AB} < 0$, the product is complementary to A; and
If $C_{AB} = 0$, there is no cross elasticity between A and B.

We may take three examples to demonstrate the application.

| | | $t_1$ | $t_2$ | % Change |
|---|---|---|---|---|
| (x) | Price of petrol (per litre) | 0.4 | 0.5 | + 25 |
| | demand for cars ( ) | 200 | 160 | - 20 |

| | | | | |
|---|---|---|---|---|
| (y) | Price of electric shavers (average) | 25 | 33 | +2 |
| | Demand for safety razors (million) | 6 | 9 | +5 |
| (z) | Price of milk (per litre) | 2 | 25 | +25 |
| | Quantity of cloth (million metres) | 1 | 1 | |

... AB in

Case x = $\frac{-2}{22} \times \frac{225}{25}$ = − .8

Case y = $\frac{5}{15} \times \frac{22}{2}$ = + 3.3

Case z = $\frac{}{2} \times \frac{225}{25}$ =

Since AB is less than in case x, it establishes that demand for car is complementary or positively dependent on the price of gasoline.

Since AB is more than (in fact, as high as 3.3 ) in case y, it establishes that safety razors are a sensitive substitute of electric shavers.

Since AB is in the case of z, there is no cross elasticity between milk and cloth.

When complementarity or substitutability of products are established, the demand forecasts should be suitably amended to provide for the impact of the expected price changes in complementary or substitute product.

Forecasting for exports

International markets are governed by a complete set of different factors. It is therefore essential to forecast separately the demand for export markets.

It is seldom possible to make detailed demand forecasts for international markets for individual industrial projects. Recourse, therefore, has to be made to production and demand forecasts made by specialized consulting houses in leading consumer countries, national trade organizations and regional and international agencies. Once the aggregate demand and trend have been identified these are to be related to world production, its growth rate, major development plans and conditions in the international market for the subject product.

It was necessary, for example, for an aluminium plant in Bahrain or a nitrogenous fertilizer plant in Dammam (Saudi Arabia) that an international market study was organized, since the two projects had to rely for a major part of their turnover on export markets.

Many projects do not depend on exports to such extent but their success is linked to a substantial degree on the export markets.

When data can be mobilized, the techniques of demand forecasting are the same for international markets as for domestic markets.

A factor of prime significance is the cost of transportation including freight, insurance, clearing and forwarding costs.

The price factor is equally important in estimating demand for exports. In considering the price factor, a significant consideration is tariff policies of the country and of other exporting countries. The tariff policy for this purpose should include trade relations between the country and others within regional or ethnic groups, and especially those governing bilateral and multilateral trade agreements.

In estimating the export potential, a reference to multilateral and bilateral trade agreements by the country is indispensable. Many international trade agreements, such as of sugar, provide quota allocations for and impose restrictions on the exploitation of certain markets. Most agreements, and especially bilateral agreements, promote and foster exports. Some of these lay down the quantities to be exported.

A reference to technical know-how or process agreements which the project may have to enter into is equally warranted. Some agreements and especially those with multi-national corporations sometimes impose restrictions on exports by the licensee or patentee enterprises. If such restrictions are envisaged, the exports to the scheduled areas for the scheduled period shall have to be omitted.

Sensitivity analysis

In estimating a characteristic such as demand which is dependent on a full set of variables, the estimates and projections do involve a certain amount of subjective analysis, and may be an element of guess-work. The estimates have to be based on a wide range of assumptions. In other cases, probabilistic estimates have to be made. Predicting for the future, these involve a considerable degree of uncertainty. Who could, for example, predict, until recently the discovery of vast reserves of oil in the U.K., which is bound to have far-reaching impacts. The reopening of the Suez Canal, uncertain for a long time, shall have overwhelming impacts on the viability of industrial projects in the whole Middle East and perhaps in South East Asia. Not long ago, the devaluation of the dollar could not be considered a probability. Apart from these unpredictable developments, a number of factors contributing to demand remain supressed and it is impossible to account for all of them in making estimation.

The problem of uncertainty extends to that of errors of estimation. In statistical analysis, especially when prediction for future is involved, the distinction between uncertainty and errors becomes extremely thin. Despite best care, the random sample may not be wholly representative of the universe. Every random sample involves a certain amount of statistical error since the result is not the observed characteristic, it is only an estimated one. Statistical errors are impregnated even in observed data.

The data available are often erroneous. If an analyst were to use only 100% accurate statistical data, he will make no market and demand studies.

In brief, the estimates and forecast may go wrong because of (i) errors in base data, (ii) inadequacy of data, (iii) unforeseen economic and socio-political developments, (iv) limitations of statistical methods, (v) unknown or suppressed factors and relationships, (vi) qualitative unquantifiable factors and relationships, (vii) unrealistic or imprecise assumptions, (viii) technical technological changes, and (ix) changes in institutional and economic relationships and structure.

Some of the uncertainties to be reckoned with are:

i) Slower or accelerated increase in national and per capita incomes.

ii) Technological developments within or outside the subject industry or in the production of inputs

iii) Emergence or disappearance of a dominant competitor

iv) Perceptible changes in structure of family budgets

v) Emergence of a substitute

vi) Changes in infra-structural facilities altering cross-elasticity

vii) Signing of bilateral or multilateral trade agreements or the formation of regional customs groups such as EEC

viii) Discovery of new sources of raw materials for the subject industry or for substitutes

ix) Changes in transportation costs

x) Changes in tariff barriers

xi) Inflationary price rises (or declines) distributed unevenly over differnet commodities and increase in input costs

xii) Emergence of export markets

xiii) Discovery of new applications of the subject product.

It is only by a systematic approach to the problem that the element of uncertainty is reduced to the minimum. The statistical sensitivity analysis, making probabilistic calculations on the degrees of uncertainty, provide the approach.

The object of sensitivity analysis is to determine the impacts on the size of demand - aggregate or by segments - if the factors and coefficients leading to the demand turn out to be more or less favourable than the assumptions. It is possible, for example, that while applying price elasticity to the demand for canned products, the average inflationary price increase was assumed at 5%, the actual increase might be 15%. The forecast demand then would not be realized. Similarly, the demand might have been estimated by applying the leading indicator method with an indicator being the urbanization rate of 10% per annum but the urbanization coefficient might turn out to be 7% only. By applying the possible sensitivities - that is, assuming higher or lower values of factors of analysis, the more optimistic and pessimistic estimates of future demand are made. The range provides the safety margin for the determination of the project size.

When the subject product is meant for export market, sensitivity analysis assumes added significance. The forecast for exports should be subjected to sensitivities - rise and fall - of effective prices inclusive of likely changes in tariff rates and foreign exchange value of domestic and competitive currencies. Devaluation of local currency may boost the export demand substantially as the devaluation of a competitor's currency may result in a precipitate fall in the export potential for the candidate project.

Nevertheless, it may be realized at the outset that the deployment of sophisticated tools and techniques of demand analysis and forecasting - including and especially the sensitivity analysis - cannot guarantee that the demand for the subject product and realizable sales of the candidate project would exceed the forecast levels. Abnormal factors may upset the prognosis and computations. No amount of statistical analysis could predict, for example, the so-called energy crisis which emerged in October 1973 and its overwhelming impacts on prices and demand for energy and petrochemical products. The prices quadrupled not only of crude but also increased substantially for down-stream products. The predicted growth rate in demand for petroleum products of 8 , in fact, transformed itself into a decline of approximately the same magnitude. Phenomenal increases were witnessed in prices of wide ranging products, including those of the most important input, fertilizers. The price increases resulted in fall in demand of cars, among other products, resulting in a chain reaction.

In limited domestic markets of developing countries, relatively limited abnormal factors may upset best market predictions. It must be realized that it should not be expected of demand analysis that the predictions may not go wrong. The deviations do not invalidate the value of the market analysis; in fact, these reinforce the need for such analysis and especially that for sensitivity analysis for demand forecasting. The latter process reduces the uncertainty to abnormal factors and prepare the project planners and promoters for the risks involved.

As aforesaid, the sensitivity analysis is applied by assuming less or more favourable factors and coefficients. If the growth rate of demand in the past has been identified at 6.5 over a period, with rates of annual growth ranging from 2.5 to 1 , alternative projections may be made on the basis of growth rates at mid-points between lowest and highest rates on the one hand and average growth rate of 6.5. Similarly, if the income elasticity coefficient on the basis of past data has been identified at 1.2, it will be prudent to assess the impact on demand with income elasticities at 1. and 1.5. The process of alternatives estimation may be applied to price elasticity and to the variations in the price itself. It is likely that the introduction of the domestic producer may help to reduce the retail prices by 25 (since the product supplies were obtained wholly by imports). In fact, the existing producers may be provoked or obliged to reduce the prices by that level and increase supplies. It will be necessary for the investor then to know what will be the impact of these changes on his sales.

In making the sensitivity analysis, it is not sufficient to measure the effect by a single change (in a fact or in a coefficient). It is frequently necessary to attempt to assess the change on the basis of various combinations and permutations of changes. This may involve a good deal of arithmetical manipulations, which are time-consuming. A resort to computer facilities is the answer.

It is conventional to provide at least three demand estimates with epithets such as "pessimistic", "optimistic" and "realistic". A feasibility study on asbestos pressure pipes made first four projections of production demanding apparent demand since no imports were permitted by the government and the requirements were ostensibly fully met. Two periods of growth rate were taken since the longer period showed a more rapid growth rate. In other words, the growth rate in the later period had declined. To take care of the more recent trend, a larger period was not taken although it should normally be preferred. The two period trend was projected by both the extrapolation of the trend line and the extrapolation exponentially. Other adjustments were then made and two final estimates were given. These were styled "projection one" and "projection two". The divergences were substantial. These can be seen from the following statement.

Projections of demand of asbestos pressure pipe in India

| Year | Projection one ('000 tons) | Projection two ('000 tons) |
|---|---|---|
| 1975 | 14[illegible].1 | 117.[illegible] |
| 1976 | 173.7 | 135.7 |
| 1977 | 215.4 | 156.3 |
| 1978 | 267.1 | 178.8 |
| 1979 | 331.2 | 2[illegible]2.[illegible] |
| 198[illegible] | 41[illegible].1 | 226.2 |

Against 1978 figure of projection one at 267000 tons and of projection two figure of 179000 tons, the projection of the trend line gave an estimate of 141000 tons. A task force report estimated it at 331000 tons.

Precautions for statistical analysis

The compilation, analysis and application of demand require utmost caution in the absence of which very definitive data can lead to highly misleading results. Some of the points for caution are:

i) The definitions of characteristics should be precise and scrupulously adhered to. While analyzing the demand for industrial gases, distinctions among different gases - oxygen, acetylene, nitrogen, argon - should be strictly maintained. Each has a different process of production and the ratios of demand among them vary.

ii) In identifying averages, norms, standards, trends, coefficients, fairly large number of observations amenable to statistical tests of significance, should be taken into account. Trend established over a four year period in whatsoever market should not be assumed to be valid for a long time projection.

iii) Data and coefficients associated with one market or market segment should not be transplanted for others. The income elasticity of demand for low income groups is not the same as of high income groups.

iv) The assumptions made in the analysis and application of data and formulation of coefficients and correlations should be distinctly expressed without reservations.

v) The selection of statistical techniques for estimation, analysis and forecasting should be appropriate to the nature of the product, market and data-pattern.

vi) The conditions governing a curve or viable should remain constant. If these change, necessary adjustments must be made. Data, for example, related to Hijri years cannot be used for Gregorian years.

vii) Application of reference data should be used with necessary adjustments. The salary wage levels of a small sugar factory cannot, for example be transplanted for a steel plant. Similarly the rate of construction of a factory building for a paper plant cannot be used without modification for a textile mill project.

viii) The dynamics of data and coefficients should be recognized. The price elasticity coefficient at £1 per unit cannot be used if the price rises to £2 per piece. The price elasticity may be 1.2 for demand for printing paper in Syria in 1960, it may be only 0.8 in 1975.

ix) In identifying trends, coefficients and relationships, abnormal or extraordinary cases should be eliminated. In estimating demand for cement, for example, in Egypt, the data relating to 1967-68 being war year, should be substituted by statistical interpolation.

x) Simple averages should be avoided in preference to weighted averages.

xi) It is sometimes advocated that when data are not available, the analyst may be content with a few rough estimates. Such rough estimates not supported by dependable data should be scrupulously avoided. When broad and associated quantitative or qualitative evidence indicates that the capacity proposed is far too short of the expected size of demand, the project may be recommended. But nonetheless, any rough estimate ought to be avoided. This may mislead the investor. In fact, the purpose of market and demand studies is to generate statistical information when it does not exist and to analyze and process what does exist. There is, therefore, no justification for making rough, subjective estimates without statistical support.

## Chapter 10. Market Strategy - Price Policies and Product Costing

### Determination of capacity and output levels

Once the present and future demand estimates have been developed, the market segments identified, the characteristics of the market analyzed, the next step in market and demand analysis for feasibility studies is to determine, in the light of price policies and the contemplated product-mix, the market penetration the candidate project can achieve. On this depends, subject to other techno-economic considerations, the capacity of the proposed plant.

It needs a considerable degree of intricate knowledge of the subject market - the market of the commodity in the given market segments - and professional ingenuity of the project analyst to identify the market share the project will be able to enjoy. When the candidate project is likely to be the sole producer in the market and the probability of market insulation by government policies or through tariff or quota protection is high, the entire market demand may be the limit within which the target of capacity may safely be fixed. The other constraints will be the technological considerations, the availability of inputs and financial resources which may be mobilized by the promoters for the candidate project. The problem arises when it is apprehended that other producers already exist or are likely to enter the market. The existing producers may also expand their capacities or increase output levels. Here again, the problem of capacity is easily resolved if total demand is not likely to be exceeded by the combined capacities of the existing (with their "to be" expanded capacities) and planned new units which are likely to go on stream.

With most developing countries following the technique of planning for economic development, targets of capacities are expectedly set under periodic plans for different industries. An attempt is made by means of legislation or regulations governing industrial development - such as the Industries (Development and Regulation) Act of 1951 in India - and under some form of industrial licensing, to ensure that capacities in excess of targets are not created. Under such systems, the problem becomes easier since all that needs to be ensured is that the aggregate capacities to be created, along with the existing capacity, do not exceed the target capacity at any point of time. Under certain national plans, directly or through development and regulatory machinery, capacity ranges are also contemplated. Small capacities are not permitted since these may be wasteful of resources. Larger capacities are not permitted with a view to prevent monopolistic market structure and avoidable concentration of excessive capacities, the output of which may have to be transported over long distances involving avoidable strain on the limited capacity of the transportation system.

The national plan targets and licensing policy guidelines are important indicators. Nevertheless, the project feasibility studies cannot and ought not depend solely on these indicators. They are meant for general policy guidelines and are seldom based on detailed demand studies. When proper studies have preceded the policy guidelines, these may have to be updated. Moreover, policy oriented studies do not fully reckon with distinct project criteria, such as its specific product-mix.

For some projects, the problem of capacity is resolved by the limited availability of essential inputs, such as the mineral reserves. In most private industrial projects in developing countries, the limits to capacity are set by the financial resources of the promoters. Several potential industrial promoters start with the basic premise of a certain specified amount which they are willing to invest.

The problem has to be faced by the project analyst when none of the constraints, endogenous and exogenous, enumerated above - the demand size, plan target, raw material availability - are operative. The most indicative norm in such cases is the typical size of plants in the subject industry. Most industries develop, in the course of their history, certain typical economic sizes. While these sizes change with passage of time, during a given period, these are fairly established by range of capacities. A few examples are: 1000 to 1500 tons/day for cement plants, 150,000 to 200,000 tons of N for nitrogenous fertilizer plants, 60 to 100 tons/day for paper mills, 200,000 tons a year for petro-chemical naphtha crackers, 1000 to 1500 tons of cane crushing capacity/day for sugar mills. These are neither the minimum economic nor the optimum sizes. These are the typical sizes developed by the process of industrial history. The most desirable capacities are the optimum sizes but the projects in developing countries have to contend with minimum or typical sizes.

Following the fixation of the capacity by a combination of techno-economic project considerations, the targets for production levels have to be programmed. Apart from the technical - technological considerations (including the quality of manpower available), the sales of a new project take time to be built up. It is customary to expect a realization of a production level of 40 to 50 % of the capacity in the first year, 60 to 80 %, in the second year and 95 to 100 % from the third year onwards. There are many constraints a new industrial project faces in developing countries. It is prudent to project production levels on a rather conservative basis even though the project analyst may be confident that higher levels can be achieved. In estimating sales, the discount for the build-up of inventories and work-in-process should be provided for leaving the balance for sales.

With the detailed knowledge of the total size of demand, the prevailing price levels and the structure and responses of the market analyzed, it is not difficult to envisage the market strategy capable of achieving the target sales. The strategy should include:

i) fixation of product prices including promotional prices.
ii) creation of sales organization;
iii) appointment of distributive outlets;
iv) fixation of trade discounts and commissions;
v) sales promotion and advertising programmes;
vi) standards of packaging;
vii) distribution system;
viii) after sales service;
ix) consumer advisory services;
x) export market system, if necessary;
xi) consumer contacts, feed-back and research.

The responsibility of feasibility studies in items (ii) to (x), is limited to recommending broad policies on the basis of information gathered from the market survey. The projection of product prices has to be accomplished by reference to the levels of sales to be achieved in the light of price elasticities of demand and demand size and the competition from domestic and international suppliers and from substitutes.

Marketing system and strategy are designed by reference to and analysis of the market characteristics. Some of the characteristics are statistical in nature, the others are matters of procedures, practices and conventions. They throw revealing light on the behaviour of demand and are helpful tools in the determination of conditions governing future demand and planning for product promotion during the pre-production period.

A factor of significance is transportation cost. There are certain bulky commodities the transportation of which over long distances may be very expensive. In estimating the transportation cost, necessary provision should be made for leakages and breakages in transit and for handling cost. For international marketing, extra provision for packaging may be required.

Another major factor is likely reaction of the competitors in the market. In developing countries, monopolistic or oligopolistic markets present impediments to new entry. With the introduction of a new product into the market, the existing producers react. An obvious result should be the decrease in price. The current prices, therefore, cannot provide the basis of the estimates of demand in future. The oligopolistic producers may be charging higher prices than would be warranted by the free forces of demand and supply. A reduction, therefore, in the prices may become inevitable with the introduction of the new competitor. It has been noticed often that if the existing producers are powerful, they attempt sometimes to oust the new infant entrant. In making demand estimates, due consideration should be given to this contingency. The project should be able to withstand temporary onslaughts which might be inflicted upon it by the existing competitors.

A study, therefore, of the nature of competition is essential for designing the requisite market strategy. The nature of competition depends on the structure of the market. At the apex of the market are the leading suppliers which may be both domestic and foreign. The nature of competition from domestic suppliers may be analyzed by a reference to national, sectoral and industrial planning reports, annual statistics on industrial production and inventories, the progress reports of industrial licensing and industrial censuses. The industrial censuses whenever available, provide revealing data on the structure of the market, its size, growth, component units - their number, sizes and growth, and prices.

The analysis of the future response of the competitors is a matter of qualitative appraisal and there is no substitute for the experience of the analyst governing trade and industry of the subject product. Consultations with the concerned market operators lend insight into the problems. References to the commodity market reports, where organized markets exist, yield rich dividends.

The ultimate product to be sold to the consumer may consist of several parts. Some of the components of the commodity may have to be procured locally by ancillary industries or may have even to be imported. This aspect should be defined and the impact on price of the product should be estimated.

In a ceramics plant study, two items assumed special significance. Sanitaryware is usually sold in sets. The set includes bath tubs. Bath tubs in the market were found to be of enamelled cast-iron. Metallic bath tubs had to be produced separately and it was found that there would not be enough demand to justify an economic sized plant. A similar conclusion was reached in case of metallic fittings. These items in the set, therefore, had to be imported either by the producers or by the trade if the local product was to compete effectively with the imported items.

Marketing organization specifying distributive channels and sales strategy is an important subject for both market and feasibility studies. In many commodities, market penetration has to be programmed during the pre-production period if an economic level of production is to be obtained without much loss of time. Sometimes, when the competition is very keen from either other producers in the same country or imports, special sales promotion programmes have to be outlined.

A feasibility study must also specify the kind of distributive channels to be deployed, the sales organization to be created and the sales strategy to be adopted. Some products need very special distributive channels and machinery. The distribution organization is more elaborate for consumer products of mass consumption and may consist of several tiers of intermediaries, sole and sub-distributors, stockists, sales agents, wholesalers, retailers. Distribution system for capital goods needs less elaborate distributive machinery but capital goods and most consumer durables often require after sales service network.

The sales strategy covers a series of measures, such as packaging standards - sometimes standard specifications - sales promotional programmes (advertising media campaigns, distribution of gifts, bargain sales), transportation system and a discreet pricing policy.

Like "after sales service", special transport arrangements assume phenomenal significance for some commodities. For sale of LPG, special bulk storage and cylinders are indispensable: for oxygen and acetylene industrial gases, high pressure seamless cylinders and liquid oxygen tankage are essential. For some perishable food products, such as ice-cream, special cold storage facilities both at market centres and for transportation have to be provided.

In many feasibility studies, marketing organization, sales promotion strategy and pricing policies are delineated in a separate section and do not form part of market research and demand studies. There are no compelling reasons to follow one or the other course. The advantage in dealing these aspects with the demand studies is the avoidance of some duplication. Where market penetration and effective sales levels depend on the market organization, the integration of the two parts would be found extremely useful. An analysis of the channels of distribution in some cases becomes a useful tool for estimating the size of demand by market segments and helps to fill in gaps in the demand structure.

Product prices and price policy

The element of price is important not only in estimating the current demand, it has a great bearing also for the future estimates. While the project for which the estimates are made is a new entrant, there would be others entering the market at approximately the same time. With the injection of greater competition and the eventual increase in the size of the producing units, there would be a tendency for prices to fall. The prices may be brought down also by substitutes. In projecting future demand over the life-span of the project, it would be sound to assume a certain reduction in prices. If the cross-elasticity of demand of the commodity in question is high, due credit may be taken of the expansion in supply of the substitute.

In many countries, there is a consumer preference of imported products. It would be prudent, therefore, to envisage that the new product might or would in fact, command prices slightly lower than the prices of equivalent imported products. If the size of the project contemplated is large enough to make a dent on the imported quantities, a certain increase in demand could be assumed as a result of this factor. But in estimating the revenue of the industry, the reduced prices invariably ought to be taken unless the product is one which is not of a sophisticated character but is a bulky commodity. Here again, it depends on the nature of the commodity and the qualities in use.

There might not be any particular consumer preference for imported sugar, but there would be one for imported drugs.

The qualities, sizes, colours of products have a significant impact on the total quantum of demand. In estimating demand, therefore, necessary account should be taken of the qualities presently in vogue in the market and those which are proposed to be produced.

In considering the prices of the product, when the unit is the first in the industry, due consideration should be given to the transportation cost and the tariffs borne by the imported commodity, unless the assumption is that Government would impose a countervailing - full or partial - production or turnover tax.

Whenever an enterprise or a country for some time prices its product lower than the cost of production in order to promote the demand with a view to maximising its long-term profit, the policy is called "promotional pricing" and the price charged "promotional price".

In projecting demand for the future, a feasibility study must examine, as pointed out earlier, the possibilities of introducing a promotional price. Given certain elasticities of demand, the promotional price - a price lower than the prevailing price - can make the whole difference between a commercially viable and non-viable project. In a feasibility study on cast-iron gas stoves in a Middle East country, the price was assumed at 40 per cent of the prevailing market price. This was the cardinal point in establishing the viability of the project. The commodity, a consumer durable, was being thrown out of the market by its cheaper substitute, enamelled plate gas stove. To gain the needed deeper penetration in the market, it was necessary to reduce the price which would be competitive with the substitute price. Without the increased demand, the project would be uneconomic and non-viable.

Product prices in a reasonably free market tend to approximate to marginal cost of production. If the project analysis yields a very high rate of profit, the prevailing price on which the analysis is based should be re-appraised and reviewed. It is likely that due to oligopolistic market structure - with only a few producers, a recurrent condition of many industrial products in developing countries - or because of the restricted imports, the prevailing prices may be very high. The project analysis and evaluation should be based on more realistic free market prices which will govern the market in the long run. The relatively high profit prices are bound to give rise to more entrants and expansion of the existing producers, leading to more intense competition and lowering of the prices.

Infant industries attract tariff protection from governments. The prices, therefore, remain high. With expansion of production and the maturity of industries, the tariff support is gradually withdrawn. It is prudent, therefore, to assume this and to base financial and economic analysis on progressively reduced prices until the same are brought at par with import – world market – prices (c.i.f. plus normal import duty).

Ceramic tiles were sold in a country at an average price of $250 per ton. The average import price without the duty was $140 per ton. On ad valorem basis, the prevailing duty was $21 per ton (or 15%). It was assumed that when the project goes into production, tariff protection would be granted in the form of additional import duty bringing it to the level of 40%. The tariff protection was to be extended for at least 3 years but was expected to be extended to 5 years.

Two factors deserve special attention of the analyst. The mark-up for internal trade costs and margin of profit was very high – $89 on a c.i.f. price of $140 and a retail sale price of $250. (The $89 figure is derived by deducting from $250, c.i.f. price plus import duty). Deducting the costs, clearing, internal transportation, storage, breakage, interest and other incidental costs (all aggregating to $45), the balance of $44 was represented by trading profit. It was discovered that the internal profit of $25 was adequate (being 10% of the retail price).

A normal and reasonable price for local production to start with, would be constituted as follows:

| | | Per ton |
|---|---|---|
| Import price | $ | 140 |
| Current duty | | 21 |
| Additional duty | | 35 |
| Internal handling costs | | 45 |
| Trade margin | | 25 |
| | | 266 |
| Less promotional discount | | 26 |
| | | 240 |

It would be seen that in the computation, the benefit of protective tariff duty has been credited and the abnormal rate of profit of the trade has been reduced. A final deduction of 1[illegible] of the potential retail value has been made to permit an initial introduction into the market to provide for the price disadvantage against an imported product.

The final price assumed is thus lower than the present prevailing price of the product. But it takes into account the tariff protection.

This advantage must gradually disappear possibly within 3 years. The product prices to be assumed, therefore, should be as follows:

| Operative years | Price/ton |
|---|---|
| First year | 24[illegible] |
| Second year | 23[illegible] |
| Third year | 22[illegible] |
| Fourth year | 2[illegible]5 |

In the computation of the current reasonable price, abnormal profits of the trade were eliminated (reduction from [illegible]44 to [illegible]25 per ton). But no account was taken of the abnormal price the exporter was charging. There was also the likelihood of the exporters deliberate attempt to undercut the new entrant and of a new entrant coming into the market. Providing for both, it would be prudent for the economic analyst of the project to develop sensitivity on the prices of the product by reducing them by 5%, 10% and 15%. The last figure would eliminate the duty advantage and would make an effective price for internal competition.

In fixing product prices, due provision should be made for freight and handling, insurance, storage, breakage, rejections, trade discounts and commissions and sales promotion costs. Transport costs assume special significance if there are domestic competitors who will have cost advantage in areas in closer proximity to their own location. In estimating transport costs, the mode of transportation sometimes assumes added weight. A cheaper mode of transportation, like internal waterways or railroad system, may be found to be more easily available to a competing establishment than to the candidate project.

These costs components can be properly taken care of if it is borne in mind by the project analyst that he is aiming at the ex-factory price. Costs, therefore, beyond the factory and including discounts and commissions payable to the trade must be deducted from the realizable sales price.

In the preceding two chapters, direct relationship between demand (or sales) and prices of products was explained. The tools of elasticity of price and cross-elasticity should be used to fix prices in order to attain target sales. This will also link the sales levels to the final sales revenue and profit. The realization of specified sales target may call for reduction in prices as a function of income, price and cross-elasticities.

## Product costing

One of the major deficiencies encountered in pre-investment studies is the inaccuracy of product costing. Although Chapter 15 will be devoted to the structure of production costs, it seems appropriate to look at this question already now from the point of view of pricing since both the attainable prices and the quantities sold determine the amount of sales. Chapter 15 is designed with the objective of preparing the ground for costs flow analysis and the amount of sales is a crucial component in this context. Sensitivity analysis usually provides for changing the values of the components of (a) the cash flow table in order to obtain different internal rates of return or present values, or (b) any other profitability criteria (simple rate of return, pay back period, etc.) Whether these assumed changes can always be supported from the cost point of view is the objective of the following elaborations. Experience shows that newly established industrial enterprises frequently operate with heavy losses in developing countries. Not only were project proposals badly prepared at the pre-investment stage but even more frequently was product costing lacking or insufficient. Profitability calculations are prepared as if the project was to produce one single product, whereas in the majority of cases a mixture of products is to be manufactured. In five examples different product combinations and the appropriate ways of product costing are presented further below. (Note: Those cases are based on historical data; a modification using standard costs will have to be done during the review of this draft of the Manual).

Basis of any pricing policy should be the manufacturing (production) costs of the enterprise, the supply and demand structure of the market as well as the economic policy of the Government which strongly influences the price structure through subsidies, customs duties and price fixing. The price, at which sales actually take place, is not often equivalent to the "calculated" price. It is the task of management to gradually find the price that may be carried by the market. This price should at least cover all costs accruing (cost-covering price) since only this guarantees that depletion is avoided. Only in the case of monopoly, an enterprise may freely calculate the prices of the individual products or services, i.e., sell such products or services at prices which include a desired markup. For enterprises which do not enjoy a monopolitic position, pricing policy is more than calculation: they have to try to realise the highest possible profit by continuously weighing the obtainable prices against the accruing costs, their pricing policy has thus to rely on the necessary information from the market as well as from cost accounting. This is certainly true for already operating establishments which envisage an expansion of their operations. In the case of new investments this approach has to be modified since historical cost data do not exist. Expected costs or standard cost have to be applied instead. The determination of standard costs for direct cost items such as material and labour is still comparatively easy. The planning of overheads becomes problematic since with changes in the degrees of capacity utilization overheads are effected differently. Despite these difficulties it is nevertheless recommendable already at the feasibility stage to attempt product costing since it forces the team of experts preparing the project to get fully acquainted with its operational details (departments as cost centres) which is needed for a better planning of the process chart.

<u>Absorption costing and partial costing</u>

In regard to pricing, two different costing procedures should be noted: absorption costing and partial costing. Either actual (historical) costs or standard costs can be applied to both procedures.

The combination of <u>absorption costing and historical cost data</u> is the most common practice in already operating establishments. This is based on the principle that all the costs that have accrued during a given accounting period should be charged to the products manufactured or services rendered within the same period.

All cost data will be collected by types of costs (or categories of cost). Costs may then be charged either directly or indirectly to the respective products. Whereas the determination of direct costs (mainly direct labour, direct materials, turnover tax) does not create any difficulty, the share of each particular product in the total factory overheads (indirect costs) cannot be determined exactly, but it can only be estimated by way of approximation. The attribution of the factory overheads to various specific products is thus performed in the form of rates of surcharge.

In this context, it is convenient to use <u>cost centre accounting</u>. For cost controlling purposes, indirect costs are first collected at those cost centres (departments) where they have accrued and have been so recorded. The factory overheads thus identified at an individual cost centre is then absorbed by specific products handled by that centre according to certain criteria, such as relative machine hours or process tim . This last phase actually is product costing. The sum of direct and indirect costs, as well as of extaordinary costs and profit mark-up, which must be carried by each product in one way or another, is the basis for product pricing policy.

The increasing share of fixed assets in the mix of production factors especially in some branches of industry (mechanization, automation) causes the share of factory overheads (indirect costs) to grow, and the share of direct costs (especially the share of direct labour) to decrease. This adversely affects the reliability of product costing.

Direct or partial costing circumvent this problem. This approach consists in adjusting cost recovery or pricing policy to the effective market price structure. An elaborate product costing would lose its significance if the product could not be sold at its calculated price. The objective is not to get the highest possible price for every individual product, but to obtain effective prices of all products in such a way that they can yield a total revenue covering all costs and containing whatever profit may be possible . In the short-run or under special circumstances, it can be permitted to sell at a price that covers all variable costs of the product but not all the fixed costs. Within a given plan capacity the sum of fixed costs is considered to be invariable. It does not necessarily have to be shared by every individual product. The obtainable prices which yield more than the sum of variable costs, can only contribute to the recovery of fixed costs (marginal contribution). Therefore, the acceptable minimum price would be equal to the sum of variable costs. The difference between absorption costs and direct (partial) costs, which could not be covered in a given period, ought to be covered eventually in subsequent periods.

In the long-run, it is absolutely necessary that both fixed and variable costs be covered in order to maintain the viability of the enterprise. With partial costing, however, the pricing policy of an enterprise becomes more elastic and is much more adjustable to short-term market fluctuations. Partial costing is theoretically justified by the behaviour of costs at varying levels of capacity utilization.

## EXAMPLES OF COST CENTRE ACCOUNTING AND PRODUCT COSTING

Five examples are presented below with a view to demonstrating the typical procedures for establishing costs accruing in various processing departments (cost centres), allocating the administrative overheads to these departments, costing different products produced in a given department, and calculating the selling prices of final products as well as those of intermediate products where applicable.

These examples have been derived from a sample held in a consulting firm in Europe. Although the figures are not totally fictitious, they are rather hypothetical in nature, and no reference value ought to be attached to the magnitude of cost parameters involved in these figures.1/

The five examples refer to five enterprises in different branches of industry:

A: Wool-combing, spinning and weaving

B: Vegetable oil refinery

C: Curd soap

D: Organic chemicals

E: Superphosphate

The last example (E) deals with the simplest case, in which the plant produces a single product and its various processing units are completely vertically integrated.

Example A deals with a case where different process departments are not well balanced in their relative capacities; as a result, some of their intermediate products are partly sold on the market and some are supplemented by products purchased from other enterprises.

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1/ The unit of currency involved in the value data is not specifically indicated in these examples. However, for those who seek a degree of realism in the figures, it might be helpful to note that the value data has been prepared in a currency unit equivalent to about 4 U.S. cents.

Example B is taken from a case involving different brands of product subject to different unit costs. For the department producing them, job order accounting has to be undertaken, in addition to process costing, in order to allocate the manufacturing overheads of the department to the respective brands of product

In Example C, the enterprise sells part of its intermediate product at a competitive (pre-fixed) market price, which happens to be lower than the price at which the full cost of the product (including administrative overhead and turnover tax, not to speak of normal profit margin) could be recovered. In this example, the cost burden at this intermediate stage is shifted into the pricing of the final products.

Example D is the most sophisticated of the five examples. The enterprise has not only its own electricity and steam generation units, but also its process departments produce a range of different types of product. To permit the costing of different product lines, job order accounting is utilized extensively in this example.

Example A: SPINNING AND WEAVING MILL

The enterprise has three processing departments, each producing one type of output only. Thus, each department can employ process cost accounting. Only material costs are considered as direct costs and turnover taxes as direct sales costs. These are not added to the "total overhead costs" in the schematic cost statement. The general overheads recorded in the "Administration and sales" department are related to the total manufacturing cost in order to establish the rate of surcharge (6.55 per cent) to be applied to the costing of the intermediate and final products sold (tops and fabrics). For the administrative overheads, similar treatment is applied to all the remaining examples.

The wool-combing department processes 10,000 kg of raw wool (price: 20.-) into 9,950 kg of tops. Only 2,500 kg of tops receive further treatment by the enterprise. The remaining quantity is sold to another company.

The spinning department manufactures 2,000 kg of yarn from 2,500 kg of tops as produced in the wool-combing department. The output is used by the weaving department, together with additional 4,000 kg of yarn purchased from outside.

Relative to the weaving department, the capacity of the wool-combing department is too large and the one of the spinning department too small. However, it so happens that the available purchase price of yarn is equal to the cost of yarn internally manufactured and there is a market for the surplus tops. Therefore, the enterprise has no strong incentives for correcting the existing imbalance between the three processing departments.

Ten per cent profit margin and five per cent turnover tax are assumed in obtaining the "calculated selling prices".

(A: Spinning and Weaving Mill)

## SCHEMATIC COST STATEMENT

| COST TYPES | TOTAL | Wool-combing Dept. | Spinning Dept. | Weaving Dept. | Administration and sales dept. |
|---|---|---|---|---|---|
| | | COST CENTRES | | | |
| **Material Costs** | | | | | |
| Raw wool | (200,000) | (200,000) | | | |
| Yarn | (200,000) | | | (200,000) | |
| **Personnel Costs** | | | | | |
| Wages | 16,000 | 4,000 | 2,000 | 10,000 | |
| Salaries | 23,600 | 4,800 | 1,000 | 5,000 | 12,800 |
| **Capital Expenditures** | | | | | |
| Imputed depreciation | 114,000 | 22,000 | 30,000 | 60,000 | 2,000 |
| Imputed interest | 11,400 | 2,200 | 3,000 | 6,000 | 200 |
| Imputed risks | 17,800 | 1,800 | 2,000 | 14,000 | |
| **Service Charges** | | | | | |
| Consultants | 5,000 | | | | 5,000 |
| Postage | 2,880 | | | | 2,880 |
| Electricity | 11,000 | 4,000 | 2,000 | 5,000 | |
| **Taxes** | 15,000 | | | | 15,000 |
| **Special Sales Costs** | | | | | |
| Turnover tax | (35,000) | | | | (35,000) 2/ |
| TOTAL OVERHEAD COSTS 1/ | 216,680 | 38,800 | 40,000 | 100,000 | 37,880 |

1/ Include overheads only. Direct costs are indicated in parenthesis

2/ This charge is proportional to the value of products actually sold within the accounting period.

**Basis for Computation of Surcharge:**

| | Manufacturing Costs |
|---|---|
| Manufacturing costs of wool combing department | 238,800 |
| + Overheads of spinning department | + 40,000 |
| Purchased yarn for weaving department | 200,000 |
| + Overheads of weaving department | + 100,000 |
| = Manufacturing costs | = 578,800 |

**Rate of Surcharge for Administrative Overheads:**

$$\frac{\text{Overheads of Administration and Sales Dept.} \times 100}{\text{Manufacturing Costs}} = \frac{37{,}880 \times 100}{578{,}880} = 6.55\,\%$$

(A: Spinning and Weaving Mill)

## CALCULATION OF SELLING PRICE

| | Total | | Unit Costs |
|---|---|---|---|
| **Wool-combing Department** | | | |
| Input of raw wool: 10,000 kg à 20.- | 200,000 | | |
| + Total overhead wool-combing dept. | + 30,800 | | |
| = Manufacturing costs of wool-combing dept | = 230,800 | | |
| Tops produced | | 9,950 kg | 24.-/kg |
| **Spinning Department** | | | |
| Input of tops: 2,500 kg à 24.- | 60,000 | | |
| + Total overhead spinning dept. | + 40,000 | | |
| = Manufacturing costs of spinning dept. | = 100,000 | | |
| Yarn produced | | 2,000 kg | 50 -/kg |
| **Weaving Department** | | | |
| Input of yarn: 6,000 kg à 50.- | 300,000 | | |
| + Total overhead weaving dept. | + 100,000 | | |
| Manufacturing costs of weaving dept. | = 400,000 | | |
| Cloth produced | | 1,000 m | 400.-/m |

**Selling Prices**

(A) Tops
(B) Fabrics

(A) Tops (7,450 kg)

| | |
|---|---|
| Manufacturing cost | 24.-/kg |
| + 6.55 % administrative overhead surcharge | + 1.57 |
| + Profit margin (10 per cent of the above total) | + 2.56 |
| + Turnover tax (5 per cent of selling price) | + 1.48 |
| = Calculated selling price | = 29.61/kg |

(b) Fabrics (1,000 m)

| | |
|---|---|
| Manufacturing cost | 400.-/m |
| + 6.55 per cent administrative overhead surcharge | + 26.10 |
| + Profit margin (10 per cent of the above total) | + 42.61 |
| + Turnover tax (5 per cent of selling price) | + 24.64 |
| Calculated selling price | = 493.35/m |

Example B: VEGETABLE OIL REFINERY

Oil-pressing is preceded by cleaning seeds, grains and other oil-carrying material to remove foreign matters and parasites. After the material has been shelled it is pressed and crude oil is extracted. In this particular process, 10,000 kg of raw material at 10.- per kg were processed, yielding 6,000 kg of crude oil.

Oil-refining is a process to neutralize oils, i.e. to extract free acdity, wash, bleach and de-odorize oils in order to produce edible oils. This cost center processes the total output of crude oil and produces the following amounts of three different brands of edible oils:

Brand A 3,000 kg
Brand B 1,000 kg
Brand C 1,000 kg.

The relative process time required to produce Brands A, B, and C is in the ratio of 5:4:1. Brands A and B are sold while brand C will receive additional treatment. The turnover tax amounts to 5 per cent of the selling price. A profit margin of 10 per cent is assumed.

The total output of brand C (1,000 kg) is further processed in the boiling department, resulting in 700 kg of final product The profit rate as well as the turnover tax are the same as for products A and B.

The total oil-milling process is characterized by the fact that each department (=cost centre) produces one product only with the exception of the cost centre "Refining" which has three different types of output. Process cost accounting, similar to that shown in Example A, is applicable in this example, but for the cost centre "Refining", it has to be supplemented by job order accounting to establish relative production costs of the three brands of oils produced in the department.

As in the case of Example A the "Administration and Sales" overheads are related to the calculated manufacturing costs in order to establish the rate of surcharge to be applied to various marketable products.

(B: Vegetable Oil Refinery)

## SCHEMATIC COST STATEMENT

| COST TYPES | COST CENTRES | | | | |
|---|---|---|---|---|---|
| | TOTAL | Pressing Dept. | Refining Dept. | Boiling Dept. | Administration and Sales Dept. |
| **Material Costs** | | | | | |
| Raw materials | (100,000) | (100,000) | | | |
| Auxiliary material and supplies | 45,000 | 15,000 | 10,000 | 20,000 | |
| **Personnel Costs** | | | | | |
| Wages | 468,000 | 190,000 | 180,000 | 90,000 | 8,000 |
| Salaries | 246,000 | 40,000 | | 20,000 | 184,600 |
| **Capital Expenditures** | | | | | |
| Imputed depreciation | 460,000 | 170,000 | 150,000 | 120,000 | 20,000 |
| Imputed interest | 82,400 | 30,000 | 30,000 | 20,000 | 2,400 |
| Imputed risks | 55,000 | 25,000 | 20,000 | 10,000 | |
| **Service Charges** | | | | | |
| Rent | 40,000 | 20,000 | | 20,000 | |
| Telephone + Postage | 25,000 | | 10,000 | | |
| **Taxes** | 40,000 | 10,000 | | | 30,000 |
| **Special Sales Costs** | | | | | |
| Turnover tax | (85,000) | | | | (85,000)[2] |
| TOTAL OVERHEAD COSTS[1] | 1,460,000 | 500,000 | 400,000 | 300,000 | 260,000 |

1/ Summation excluding direct costs (parenthesized figures).

2/ Accrual for the products sold during the accounting period.

**Basic for Computation of Administrative Overhead Surcharge:**

| | Manufacturing Costs |
|---|---|
| Total Costs of Pressing Dept. | 600,000 |
| + Overheads of Refining Dept. | + 400,000 |
| + Overheads of Boiling Dept. | + 300,000 |
| = Manufacturing Costs | =1,300,000 |

**Rate of Administrative Overheads Surcharge:**

$$\frac{\text{Overheads Administration and Sales Dept.} \times 100}{\text{Manufacturing Costs}} = \frac{260,000 \times 100}{1,300,000} = 20\%$$

(B: Vegetable Oil Refinery)

## CALCULATION OF SELLING PRICE

| | Total | | Unit Costs |
|---|---|---|---|
| **Pressing Department** | | | |
| Input of raw material: 10,000 kg à 10.- | 100,000 | | |
| + Total overheads pressing department | + 500,000 | | |
| = Manufacturing costs of pressing dept. | = 600,000 | | |
| Crude oil output | | 6,000 kg | 100.-/kg |
| **Refining Department** | | | |
| Input of raw material: 6,000 kg à 100.- | 600,000 | | |
| + Total overheads refining department | + 400,000 | | |
| = Manufacturing costs of refining dept. | = 1,000,000 | | |

Calculation for the costing of the three products:

| Brand | Relative Weight for Costing | Quantities Produced | Accounting Units |
|---|---|---|---|
| A | 5 | 3,000 | 15,000 |
| B | 4 | 1,000 | 4,000 |
| C | 1 | 1,000 | 1,000 |
| | | | 20,000 |

Manufacturing costs per accounting unit: $\frac{1,000,000}{20,000} = 50.-$

| Manufacturing costs per kg of brand | Quantity Produced | Manufacturing Cost Refining |
|---|---|---|
| A: 50.- x 5.- = 250.- | 3,000 kg | 750,000 |
| B: 50.- x 4.- = 200.- | 1,000 kg | 200,000 |
| C: 50.- x 1.- = 50.- | 1,000 kg | 50,000 |
| | | 1,000,000 |

(3: Vegetable Oil Refinery)

CALCULATION OF SELLING PRICES PER kg OF BRANDS A AND B

| | A | B |
|---|---|---|
| Manufacturing unit costs | 250.-/kg | 200.-/kg |
| + 20% administrative overheads | + 50.- | + 40.- |
| + Profit margin (10% of the above total) | + 30.- | + 24 - |
| + Turnover tax (5% of selling value) | + 17.37 | + 13.89 |
| = Calculated selling price | = 347.37/kg | 277.89/kg |

Boiling Department

| | |
|---|---|
| Inputs of raw material: 1,000 kg Brand C à 50.- | 50,000 |
| + Total overheads Boiling Dept. | +300,000 |
| = Manufacturing costs of Boiling Dept. | =350,000 |

Output: Quantity 700 kg
Unit cost 500.-/kg

Selling Price of Brand C After Boiling

| | C |
|---|---|
| Manufacturing unit cost | 500.-/kg |
| + 20% administrative overheads | + 100.- |
| + Profit margin (10 % of the above total) | + 60.- |
| + Turnover tax (5% of selling price) | + 34.74 |
| = Calculated selling price | = 694.74/kg |

## Example C: SOAP FACTORY

This case is similar to Example B in regard to the costing of different brands of product produced in one department. It also resembles Example A in that an intermediate product is partly sold on the market, but this case needs a different treatment for the costing of the internally processed part of the intermediate product, since its marketable price is no higher than its manufacturing cost (excluding administrative overhead and profit margin).

The enterprise comprises two departments: refinery and cooling press/ curd soap production. The refinery processes raw materials worth 200,000 into 10,000 kg of soft soap. Two thousand kg of soft soap is sold on the market. The selling price for soft soap is pre-fixed at 30./kg, which is no higher than the manufacturing unit cost.

The selling of soft soap at this price fails, therefore, to recover even the turnover tax and the administrative overhead charges. Thus, to shift this part of the cost burden to the subsequent processing department, the turnover tax (3,000) and 10 per cent profit margin (6,000) for the sold soft soap are charged against the manufacturing cost of the 8,000 kg of soft soap to be further processed internally. Since all this is intended to establish a correct selling price for the final products that can recover those "losses", the administrative overheads not recovered in the sales of soft soap is entirely absorbed in the costing of the final products.

Curd soap production utilizes the remaining quantity (8,000 kg) of soft soap, yielding 6,000 kg of curd-soap. Three types are produced. The process time required to produce Brands A : B : C is the ratio of 3:2:1. The quantities produced are A: 4,000 kg, B: 1,000 kg, and C: 1,000 kg. Brand C is exported, resulting in extra packing costs of 2.- per kg. A 10 per cent profit margin as well as the 5 per cent sales tax are to be included in the prices.

(C: Soap Factory)

SCHEMATIC COST STATEMENT

| COST TYPES | COST CENTRES | | | |
|---|---|---|---|---|
| | TOTAL | Refinery | Cooling and Curd Soap Production | Administration and Sales |
| **Material Costs** | | | | |
| Raw material | (200,000) | | | |
| Auxiliary material | 35,000 | 15,000 | 20,000 | |
| Supplies | 15,000 | 5,000 | 10,000 | |
| Electricity | 36,000 | 10,000 | 25,000 | 1,000 |
| **Personnel Costs** | | | | |
| Wages | 85,000 | 25,000 | 60,000 | |
| Salaries | 132,000 | 5,000 | 20,000 | 107,000 |
| **Capital Expenditures** | | | | |
| Imputed depreciation | 90,000 | 20,000 | 60,000 | 10,000 |
| Imputed interest | 11,000 | 2,000 | 7,000 | 2,000 |
| Imputed risks | 5,000 | 2,000 | 3,000 | |
| **Service Charges** | | | | |
| Maintenance | 11,000 | 6,000 | 5,000 | |
| Tools | 20,000 | | | 20,000 |
| Taxes | 10,000 | | | 10,000 |
| **Special Selling costs** | | | | |
| Packing | (2,000) | | | (2,000) |
| Turnover tax | (35,000) | | | (35,000) 2/ |
| TOTAL OVERHEAD COSTS 1/ | 450,000 | 100,000 | 200,000 | 150,000 |

1/ Excludes the direct costs (parenthesized figures).

2/ Corresponds to the actual sales proceeds during the accounting period.

**Basis for Computation of Surcharge:**

| | Manufacturing Costs |
|---|---|
| Manufacturing costs of refinery | 300,000 |
| + Overheads of cooling and curd soap production dept. | + 200,000 |
| = Manufacturing costs | = 500,000 |

**Rate of surcharge for administrative overheads:**

$$\frac{\text{Overheads administration and sales dept.} \times 100}{\text{Manufacturing costs}} = \frac{150,000 \times 100}{500,000} = 30\%$$

(C: Soap Factory)

## CALCULATION OF SELLING PRICE

| | | Total | Unit Costs |
|---|---|---|---|
| **Refinery** | | | |
| Input of raw material | | 200,000 | |
| + Total overheads refinery | | + 100,000 | |
| = Manufacturing costs of refinery | | = 300,000 | |
| | Quantity produced | 10,000 kg | 30.-/kg |

| | |
|---|---|
| Gross proceeds from soft soap sold (2,000 kg à 30.-) | 60,000 |
| - Turnover tax (5 per cent) | - 3,000 |
| - Profit (10 per cent) | - 6,000 |
| = Net calculated proceeds | = 51,000 |

Manufacturing costs of soft soap to be further processed (8,000 kg):

| | | |
|---|---|---|
| Total manufacturing costs of refinery | 300,000 | |
| - Net calculated proceeds from sold soft soap | - 51,000 | Adjusted |
| = Adjusted manufacturing costs | = 249,000 | 31.13/kg |

**Cooling Press and Curd Soap Production**

| | |
|---|---|
| Inputs of raw materials (8,000 kg of soft soap à 31.13) | 249,000 |
| + Total overheads of cooling press and curd soap production | + 200,000 |
| = Manufacturing costs of curd soap production | = 449,000 |

**Cost Allocation to three Brands of Product**

| Brand | Relative Weight | Quantity Produced | Accounting Units | Cost Curd Soap Production | Cost/kg |
|---|---|---|---|---|---|
| A | 3 | 4,000 kg | 12,000 | 359,200 | 89.80 |
| B | 2 | 1,000 kg | 2,000 | 59,867 | 59.87 |
| C | 1 | 1,000 kg | 1,000 | 29,933 | 29.93 |
| | | | 15,000 | 449,000 | |

Manufacturing costs per accounting unit = $\frac{449,000}{15,000}$ = 29.93

(C: Soap Factory)

CALCULATION OF SELLING PRICES PER kg OF BRANDS A, B, AND C

| | A | B | C |
|---|---|---|---|
| Manufacturing unit costs of curd-soap production | 89.80 | 59.87 | 29.93 |
| + 30% administrative overheads | + 26.94 | 17.96 | 8.98 |
| + Profit margin (10 per cent of the above total) | + 11.67 | 7.78 | 3,89 |
| + Special selling costs (packing for exports) | | | 2.-- |
| + Turnover tax (5 per cent of selling price) | + 6.75 | 4.50 | 2.36 |
| = Calculated selling price | =135.17 | 90.11 | 47.16 |

Example D: ORGANIC CHEMICALS

This enterprise has two process departments: esterisation and refinery. But these departments produce a variety of products. In such a case, the "process cost accounting" demonstrated in the earlier examples is not sufficient for product costing but it has to be systematically supplemented by "job order costing".

The cost statement, which covers the entier production lines of the enterprise, involves five cost centres, of which two relate to the "Electricity generation department" and the "Steam generation department", respectively. (Note that in the earlier examples "electricity" was treated as a cost category). To establish separate cost centres for these auxiliary production departments is particularly desirable since the rate of consumption of electricity and steam varies from one product (or product line) to another even within given process department.

The allocation of department overheads to specific products requires the identification of the magnitude of jobs performed on respective products in each process department. In this particular example, "production hours" are employed for this purpose in both Esterisation and Refinery departments. The overheads of the Electricity and the Steam departments are allocated according to kWh consumed and tons of steam consumed, respectively.

In the calculation of product cost-price, a demonstration is given with reference to only one of the various product lines in the enterprises, i.e. 100 t of raw ester (in the Esterisation department) which results in 90 t of refined alcohol (in Refinery department).

For this product line, the Esterisation department produces 100 tons of raw ester out of 75 tons of fat alcohol and 23 tons of organic acid. 95 tons of raw ester are refined; 5 tons of raw ester are stored for the time being (intermediate store). 32 tons of steam and 500 kWh of electricity have to be generated by the plant's own facilities. The process of esterisation takes 10 hours.

The <u>Refinery</u> then, processes the 95 tons of raw ester into 90 tons of refined products (alcohol), 85 tons of which are distilled, 5 tons being put in intermediate storage. 1.5 tons of soda lye (15.- per ton) and 2.5 tons of sulfuric acid (5.- per ton) are required in this process. The refinery consumes 25 tons of <u>steam</u> and 100 kWh of <u>electricity</u>. The refining process takes 5 hours. The prices of the refined products include a 20 per cent profit margin as well as the 5 per cent turnover tax.

(D: Organic chemicals SCHEMATIC ...)

| COST TYPES | TOTAL | (a) Esterisation department | (b) Refinery | (c) Generation of electricity | (d) Generation of steam | (e) Administration and sales dep. |
|---|---|---|---|---|---|---|
| | | COST CENTRES | | | | |
| **Material costs** | | | | | | |
| Raw material | (3,200,000) | – (3,200,000) – | | | | |
| Auxiliary materials | 200,000 | 100,000 | 100,000 | | | |
| **Personnel costs** | | | | | | |
| Wages | 386,560 | 96,560 | 220,000 | 30,000 | 10,000 | 30,000 |
| Salaries | 1,150,000 | | 180,000 | 30,000 | | 940,000 |
| **Capital expenditure** | | | | | | |
| Imputed depreciation | 1,420,000 | 230,000 | 540,000 | 450,000 | 200,000 | |
| Imputed interests | 190,000 | 50,000 | 60,000 | 50,000 | 30,000 | |
| Imputed risks | 90,000 | 40,000 | 20,000 | 10,000 | | |
| **Service charges** | | | | | | |
| Maitenance | 50,000 | | | 40,000 | | 10,000 |
| Cleaning | 90,000 | 20,000 | 30,000 | | | 40,000 |
| Rents | 100,000 | | 50,000 | | | 50,000 |
| Telephone + postage | 250,000 | | | | | 250,000 |
| Patents | (70,000) | | | | | |
| **Taxes** | | | | | | |
| Property taxes, etc. | 161,640 | | | | 10,000 | 151,640 |
| **Special selling costs** | | | | | | |
| Turnover tax | (21,330) | | | | | (21,330) 1/ |
| TOTAL OVERHEAD COSTS 2/ | 4,088,300 | 536,560 | 1,200,000 | 620,000 | 260,000 | 1,471,640 |

1/ Accrual to the sold output during the accounting period.
2/ Excludes the direct costs (parenthesized figures).

(9: [illegible] chemicals)

[illegible] OF SELLING PRICE FOR RAW ESTER-ALCOHOL PRODUCTION LINE

| [illegible] DEPARTMENT | Total | Input per ton of output | Value of inputs per ton of output |
|---|---|---|---|
| [illegible] of raw materials: | | | |
| [illegible] fat alcohol à 200.- | 15,000 | 750 kg | 150.- |
| [illegible] organic acid à 150.- | + 3,450 | + 230 kg | + 34.50 |
| | (18,450) | 980 kg | = (184.50) |
| [illegible] of energy: | | | |
| [illegible] steam à 13.- | 416 | 320 kg | 4.16 |
| [illegible] kWh à 0.62 | + 310 | 5 kWh | + 3.10 |
| | (726) | | = (7.26) |
| [illegible] manufacturing costs of [illegible] department: [illegible] à 282.40 | + 2,824 | | + 28.24 |
| [illegible] manufacturing costs of [illegible] of raw ester | 22,000 | | = 220.- |
| [illegible] | | | |
| [illegible] of raw materials: | | | |
| [illegible] à [illegible] | [illegible] | 1,[illegible] kg | 232.22 |
| [illegible] soda [illegible] à [illegible] | + [illegible] | + [illegible] kg | + 0.26 |
| [illegible] sulphuric acid à [illegible] | + [illegible] | + [illegible] kg | + 0.14 |
| | ([illegible]) | (1,[illegible].-kg) | (232.61) |
| [illegible] of energy: | | | |
| [illegible] of steam à 13.- | 324 | [illegible].77 kg | 3.61 |
| [illegible] of electr[illegible] à 0.62 | + 62 | 11.1 kWh | + 0.69 |
| | (387) | | (4.30) |
| [illegible] manufacturing costs of refinery: [illegible] | + 3,[illegible] | | + 33.33 |
| [illegible] of refined [illegible] | [illegible] | | 270.24 |

| | |
|---|---|
| [illegible] of refined [illegible] | 270.24 |
| [illegible] administrative and selling [illegible] costs | + 67.56 |
| [illegible] profit [illegible] the above totals | + 67.56 |
| [illegible] per cent of selling price | + 21.33 |
| [illegible] price | [illegible] |

(D: Organic chemicals)

**Basis for job order accounting:**

| (a) | (b) | (c) | (d) | (e) |
|---|---|---|---|---|
| Production hours: | Production hours | kWh | Tons produced: | Total manufacturing costs: |
| 1,900 hr | 2,000 hr | 1,000,000 kWh | 20,000 t | 3,200,000 |

**Rate of overhead charges:**

(a) $\frac{\text{Overheads esterisation}}{\text{Production hours}} = \frac{536,560}{1,900} = 282.40$/hr;

(b) $\frac{\text{Overheads refinery}}{\text{Production hours}} = \frac{1,200,000}{2,000} = 600.-$/hr;

(c) $\frac{\text{Overheads generation of electricity}}{\text{kWh}} = \frac{620,000}{1,000,000} = 0.62$/kWh;

(d) $\frac{\text{Overheads steam}}{\text{Tons}} = \frac{260,000}{20,000} = 13.-$/ton;

(e) $\frac{\text{Overheads "Administration and sales" x 100}}{\text{Manufacturing costs *}} = \frac{1,471,640 \text{ x } 100}{5,886,560} = 25$ per cent.

* **Total manufacturing costs:**

| | |
|---|---|
| Raw material | 3,200,000 |
| Patents | 70,000 |
| Overheads esterisation | 536,560 |
| Overheads refinery | 1,200,000 |
| Overheads electricity | 620,000 |
| Overheads steam | 260,000 |
| Manufacturing costs | 5,886,560 |

## Example 3: SUPERPHOSPHATE PLANT

This enterprise produces normal superphosphates. This is the simplest case in all the five examples presented here. The output consists of one type. The different process departments have mutually balanced capacities so that there is no sale of intermediate product. Sulphuric acid, as well as raw phosphate, is purchased from outside.

This example gives, in addition to the results of the normal process cost accounting, a calculation of parameters similar to those used in job order accounting. For the purpose of costing the final product (normal superphosphate) this procedure is not quite necessary. However, these parameters might be considered as useful for inter-firm comparisons as well as for evaluation of the plant design and work organisation.

The Grinding and sifting department processes 12,000 t (5.-/t) of phosphate rocks, yielding 10,000 t of ground raw phosphate which is then processed in the decomposition chambers. 2,000 t of sulfuric acid is required for this process. The cost per ton of sulfuric acid is 10.-. After completion of this process the output weighs 2,000 t. 2,000 working hours were recorded during the accounting period.

This output is then crushed in the mixer and the drum. The running time of the plant amounted to 4,000 hours. Approximately 5 per cent of the material input is lost during this process.=

The following milling results in an additional loss of 10 per cent. The running time of the mill was 3,000 hours.

Packing is done manually, wages amounted to 30,000 and this particular cost component is treated as "direct cost" in this case.

The selling price per ton of phosphate is to be calculated including a 10 per cent profit margin and the 5 per cent turnover tax.

| COST TYPES | COST CENTRES | | | | | | |
|---|---|---|---|---|---|---|---|
| | TOTAL | Grinding and sifting plant | Decomposition chambers | Mixer and drum | Mill | Packing | Administration and sales dept. |
| **Material costs** | | | | | | | |
| Raw phosphate [1] | (60,000) | (60,000) | | | | | |
| Sulfuric acid [1] | (20,000) | | (20,000) | | | | |
| Auxiliary materials and supplies | 2,100 | 500 | 400 | 600 | 200 | 100 | 300 |
| **Personnel costs** | | | | | | | |
| Direct wages [1] | (30,000) | | | | | (30,000) | |
| Supplementary wages | 10,000 | 4.000 | 2,000 | 200 | 1,500 | 2,300 | |
| Salaries | 25,700 | 4,700 | 3,400 | 700 | 2,900 | 5,000 | 9,000 |
| **Capital expenditures** | | | | | | | |
| Imputed depreciation | 58,000 | 7,000 | 10,000 | 13,000 | 3,000 | 25,000 | |
| Imputed interests | 5,800 | 700 | 1,000 | 1,300 | 300 | 2,500 | |
| Imputed risks | 5,000 | 2,000 | 1,000 | 2,000 | | | |
| **Service charges** | | | | | | | |
| Rent | 5,000 | | | | | | 5,000 |
| Packing material | 6,000 | | | | | 6,000 | |
| Electricity | 11,200 | 1,100 | 2,200 | 2,200 | 1,100 | 4,100 | 500 |
| **Tax costs** | | | | | | | |
| Taxes | 30,000 | | | | | | 30,000 |
| **Special selling costs** | | | | | | | |
| Turnover tax [1] | (15,000) | | | | | | (15,000) [2] |
| TOTAL OVERHEAD COSTS | 158,000 | 20,000 | 20,000 | 20,000 | 9,000 | 45,000 | 44,800 |
| | | (a) | (b) | (c) | (d) | (e) | (f) |

1 Direct costs not included in "total overheads".
2 Accrual to the sold output during the accounting period.

(3: Superphosphate plant)

CALCULATION OF THE SELLING PRICE

| | Total | Cost per ton |
|---|---|---|
| **GRINDING PLANT AND SIFTING** | | |
| Raw material: 12,000 t raw phosphate à 5.- | 60,000 | |
| + total overheads grinding and sifting plant (10,000 t of output à 2.-) | + 20,000 | |
| Manufacturing costs of grinding and sifting plant | = 80,000 | 8.- |
| **DECOMPOSITION IN CHAMBERS** | | |
| Raw materials: | | |
| 10,000 t raw phosphate à 8.- | 80,000 | |
| 2,000 t sulfuric acid à 10.- | + 20,000 | |
| + Total overheads decomposition in chambers (2,000 hours à 10.-)* | + 20,000 | |
| Manufacturing costs of decomposition in chambers | = 120,000 | 60.- |
| **MIXER AND DRUM** | | |
| Raw materials: 2,000 t à 60.- | 120,000 | |
| + Total overheads mixer and drum (1,000 hours à 20.-) * | + 20,000 | |
| Manufacturing costs of mixer and drum | = 140,000 | |
| Input 2,000 t | | |
| - 5 per cent loss of weight - 100 t | | |
| Output quantity 1,900 t | | 73.68 |
| **MILL** | | |
| Raw material 1,900 t à 73.68 | 140,000 | |
| + Total overheads mill (3,000 hours à 3.-) * | + 9,000 | |
| Manufacturing costs of mill | = 149,000 | |
| Input 1,900 t | | |
| - 10 per cent loss of weight - 190 t | | |
| Output quantity 1,710 t | | 87.13 |
| **PACKING** | | |
| Raw materials: 1,710 à 87.13 | 149,000 | |
| + Wages (direct) | + 30,000 | |
| + Total overheads packing (1.5 times of wages) * | + 45,000 | |
| = Manufacturing costs of packing | = 224,000 | 130.99 |
| 20 per cent administrative overheads | | 26.20 |
| 10 per cent profit margin | | 15.72 |
| 5 per cent turnover tax of selling price | | 9.10 |
| = Calculated selling price | | 182.01 |

* As mentioned in the introduction to this example, these parameters which relate each department's overheads to its amount of work are not quite necessary in the calculation of unit costs in this example.

(E: Superphosphate plant)

| Manufacturing overheads relative to performance: | Performance | Overheads per unit of performance |
|---|---|---|
| (a) Grinding and sifting plant | Output 10,000 tons | 2.- /ton |
| (b) Decomposition chambers | Machine hours 2,000 hr | 10.- /hr |
| (c) Mixer and drum | Machine hours 4,000 hr | 5.- /hr |
| (d) Mill | Machine hours 3,000 hr | 3.- /hr |
| (e) Packing | Direct wages 30,000 | 150 per cent |

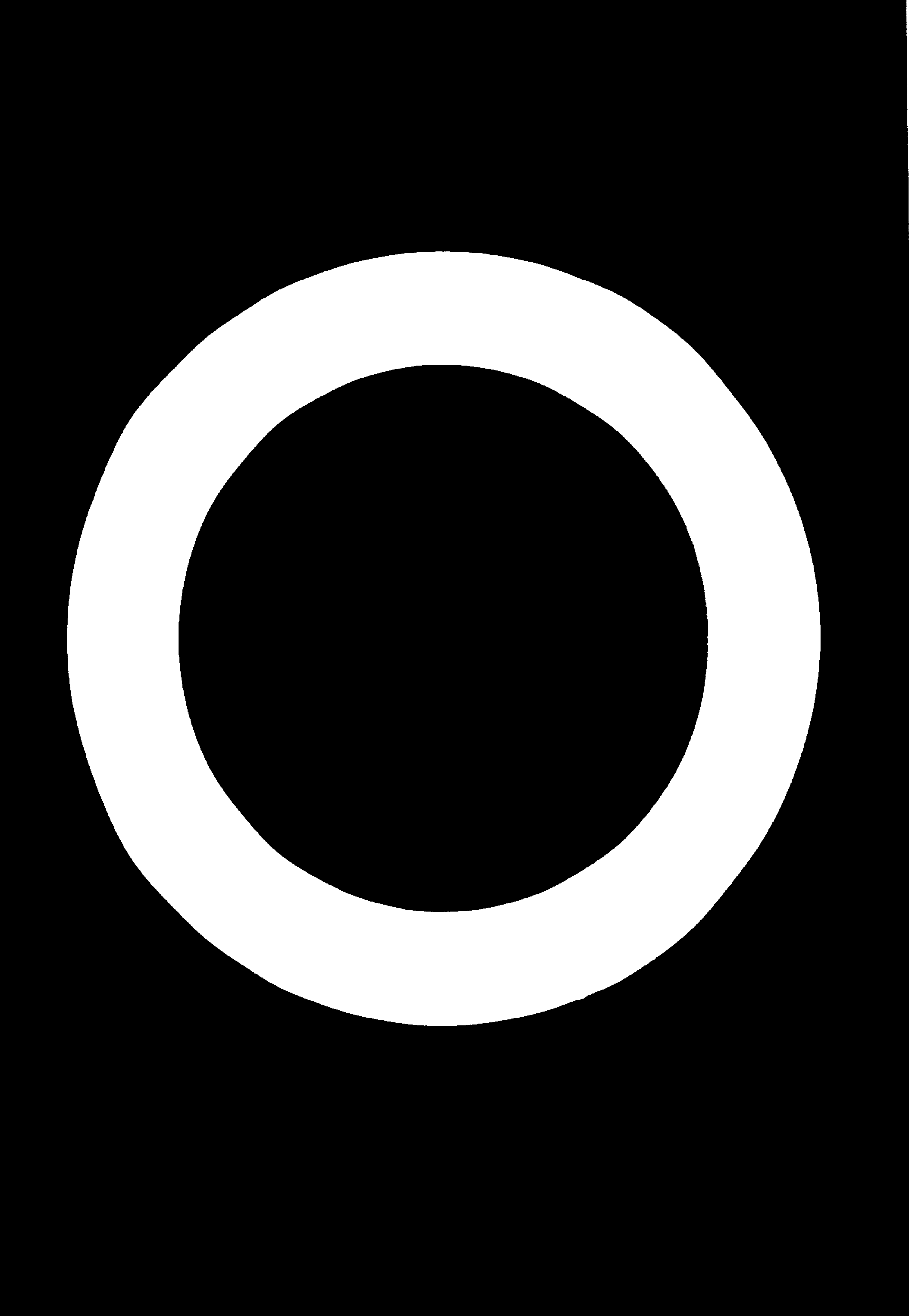
(f) Administration and sales department:

Manufacturing costs:

| | |
|---|---|
| Raw phosphate | 60,000 |
| Sulfuric acid | 20,000 |
| Direct wages | 30,000 |
| Overheads of grinding plant | 20,000 |
| Decomposition | 20,000 |
| Mixer | 20,000 |
| Mill | 9,000 |
| Packing | 45,000 |
| Manufacturing costs | 224,000 |

$$\frac{\text{Overheads Administration and sales department} \times 100}{\text{manufacturing costs}} =$$

$$\frac{44,800 \times 100}{224,000} = \underline{20 \text{ per cent}}$$



# Chapter 11 Technology and equipment

## Significance of Technology Selection

Once the size of demand of the candidate product has been ascertained, the next critical factor in project analysis is technology. In selecting technology - often a combination of several processes and techniques - there are many considerations to be reckoned with, such as size of the plant, sophistication of the workforce including that of technical personnel, product-mix, need for integration - backward or forward, quality of material inputs including auxiliary materials, fuel and water, geographical and meteorological conditions and locational constraints. There are other economic considerations relevant to the selection of technology, such as availability of foreign exchange. In countries where foreign exchange is a major constraint, every attempt is required to be made to ensure that indigenous equipment and technology is used to the maximum extent possible although it may be slightly more expensive.

In examining the application and impacts of the enumerated factors, utmost care is called for since a small divergence may make a substantial difference in the parameters of the right technology to be selected and consequently in the project itself. An example how characteristics of available inputs may change basically the technological complexion of a project, is provided by two seemingly insignificant conditions of a ceramics plant.

The country in which the plant was to be located has a bountiful supply of oil and petroleum products. The crude, however, has a high sulphur content. For the ceramics plant, a fuel with high sulphur content could not be used in the kilns unless muffle type kilns are installed. If muffle type kilns are provided for, it may raise the capital cost of the equipment appreciably. It was, therefore, necessary to analyse the relative economics of high capital cost of muffle kilns and the high fuel cost of alternative fuels. In considering the use of alternative fuel, it is not merely the price of the fuel but the cost of transportation and storage which was equally significant. Since transportation services could not be sub-contracted, additional provision in the capital cost for transportation fleet was called for.

The second significant consideration was the quality of water. For ceramics industry, water with a low content of dissolved solids (not exceeding 30 ppm) is required to avoid stains on the glaze. If the locally available water contains a very high proportion of solids, which in the case under review was as high as 3,000 ppm, the only possible alternative was to provide for a water treatment plant. The study incorporated the detailed analysis of water and did not provide for the needed water treatment plant. Prior to proceeding into the engineering analysis one should, however, be aware of the fact that at the stage of the feasibility study the major objective has to be the deterioration of investment and production costs. It is therefore not required to prepare detailed engineering plans and designs and to concentrate instead on the presentation of technological processes, their capacities, input requirements etc. In order to be able to base the final decision concerning the technological process on technical and economic grounds, it is strongly recommended that engineers and economists jointly undertake the selection of the most feasible technological process, size of plant and its location. Their decision has an immediate impact on the magnitude of total investment (Chapter 12) and the production costs (Chapter 15).

Steps for Selection of Technology

The process of technology selection normally involves a comparative analysis of advantages and disadvantages which calls for a series of steps which are delineated below. In cases where a special technology selection study (Chapter 15) was prepared, some of those steps might no longer be needed.

(a) Make a comprehensive, if not exhaustive, list of products which are likely to be manufactured. For a tyre and tube manufacturing project, for example, list all the possible sizes and types of tyres and tubes for which there is demand in the market.

(b) List all major patent and licence holders of the relevant processes or technologies.

(c) Examine if the technology has been tested in other plants.

(d) Survey the operational hazards and general performance of the technology in question.

(e) Assess if the technology is far too sophisticated to render maintenance a serious problem. Examine if the spares will be readily available.

(f) Examine thoroughly the conditions on which technical know-how is procured and specially those concerning the term of validity and access to developing know-how.

(g) Identify the restraints on use or transfer of technology with special reference to secrecy clauses.

(h) Determine the employment and skill requirements of each technology.

(i) Examine the extent of dependence of expatriate personnel and the period for which they would be required.

(j) Assess cost of training of personnel including foreign exchange costs.

(k) Identify major material inputs for each of the processes with quantities and specifications.

(l) Determine what raw materials are indigenously available.

(m) If the raw materials are not indigenously available, find out if it is possible to resort to imports. If yes, project the number of years for which imports can continue. Explore possibilities of early import substitution of the raw material through backward integration or proposed new projects. Examine the chances of tho foreign suppliers being manipulative.

(n) Determine if the technology is flexible enough to cater to wider products-mix and variable raw materials.

(o) Identify by-products of each process and the possibilities of their sales, recycling or disposal.

(p) Examine the economics of forward and backward integration.

(q) Ascertain if the technology presupposes certain levels of development of ancillary industries. If yes, find out if it exists.

(r) Determine infra-structural facilities required for each process and their availability.

(s) Find out if plans are in the pipeline or under contemplation of developing the deficient infra-structural facilities. Assess the relative economies in creating these facilities as an integral part of the project.

(t) Evaluate the risk of obsolescence of the process and technologies in question.

(u) Determine what is the likely cost of switchover of the facilities to a newer technology at a future date.

(v) Identify the relative gestation periods of the projects employing divergent processes and technologies.

(w) Determine the expected build-up of output (or capacity utilisation) in relation to each of the processes.

(x) Determine the effluent problems and their relative impact in terms of environment pollution.

(y) Identify the critical factors for the use of each process or technology and their relative applicability in terms of problem areas and costs.

(z) On the basis of steps (a) to (y) evaluate <u>prima facie</u> acceptability of the technologies considered and by a process of elimination, select two or three viable ones for detailed economic appraical. If a seperate supporting study on the selection of technology (see Chapter 5) was undertaken, step (2) may no longer be required.

The complexity of the selection of appropriate technology is best described by highlighting some of the factors which may necessitate the choice of different processes for the production of the same goods:

- different raw materials
- same raw materials but at different physical states

- same raw materials but using different reations
- same raw materials but different intermediate stages
- different catalysts
- differently designed equipment.

The agency or the team which undertakes the study must have full access to up-to-date technological information. There are a number of sources from which such information can be secured. It is here that data bank facilities possessing reference programming data on alternative technological information can be extremely helpful. It is imperative that the agency or team itself has the specialised expertise and experience of the industry to be able to identify, evaluate, assimilate and adapt the process of technology best suited to the project.

The problem of determination of cost of technology and technological know-how is a very difficult one. In many industries, technological know-how is furnished as a package with equipment supplies. The prices include necessary information required to plan and implement the project. In other cases, technological know-how has to be separately procured. Technical know-how costs vary greatly depending on the nature of the industry and the scope of services included in the package.

In a number of cases, technical know-how information and engineering services are procured simultaneously. The engineering services include drawings and designs of equipment, fabrication and supervision of installation of machinery and of civil works.

Engineering services, including testing and start-up services, may extend sometimes beyond the construction stage of the project and telescope into the operational stage. Under the operational stage, these services may either be confined to technological or plant operations or these may extend to general management.

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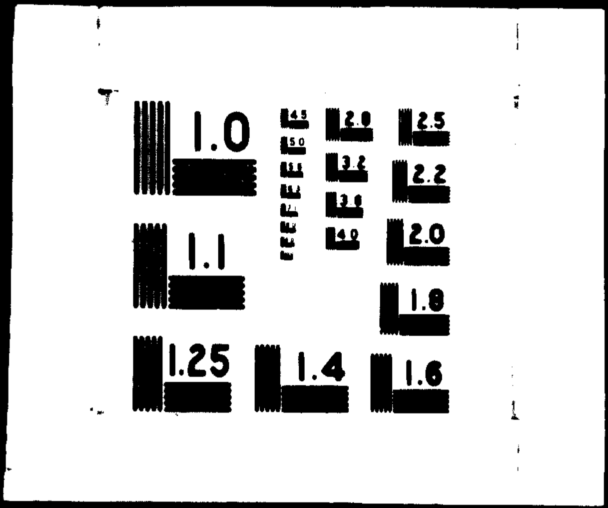


In cases in which patents and licences are involved, there would be a separate fee. Technical know-how, patents and licence fee may take two forms. It is either a lump sum fee for the entire information and services or it may be a certain royalty on the output. Sometimes, it is a combination of both. When royalties are involved, these are generally accompanied by the use of an established trade mark or trade name.

Royalties vary depending on the nature of the industry and the goodwill of the trade mark. These may range from 1 to 8 per cent, (sales ?) the typical rates varying from 2 to 5 per cent. Table 4 sets out a few selected rates permitted by the Government of India payable to foreign collaborators.

Equipment Selection

The questions of technology and equipment selection are inter-linked and interdependent. It is useful, and sometimes indispensable, to contact the machinery manufacturers and to obtain detailed information from them. This should be possible in most cases by a proper and tactful approach from a dependable source. In the event, necessary information is not forthcoming, a fee may have to be paid or recourse made to established consulting organisations which have direct access to process owners and equipment suppliers. In some unsophisticated industries, most of the technological information required is furnished by machinery manufacturers and suppliers. Technologists with proper experience and background should be able to extract from the quotations received from various machinery suppliers, the required information. This, however, is often a hen-and-egg problem. In obtaining the quotations for supply of machinery, certain basic data are required. These often relate to the technological characteristics adopted, which are not identified easily unless the information is available from equipment manufacturers.

No feasibility study should depend for information on costs on one source of supply of the equipment. Quotations should be obtained from a number of suppliers. This helps also to check on the selection of technology.

Table 4

**Selected Rates of Royalties Payable to Foreign Collaborators in India**

| Industry | Royalty Range |
|---|---|
| **Oil and Chemical Industries** | |
| Fertilizers (other than single super-phosphate) | No royalty |
| Selected pesticides | Up to 5% |
| Synthetic rubber | Up to 5% |
| **Paper, Pulp and Allied Industries** | |
| Newsprint | No royalty |
| Speciality papers | Up to 5% |
| **High Tension Insulators and Bushings and Solid Core Insulaters for Railways** | Up to 3% |
| **Industrial Machinery** | |
| Cylindrical, tapered, spherical and other special bearings (excluding ball bearings) | Up to 5% |
| Specialised printing machinery (for example, rotary printing presses, offset printing presses and composing machinery, etc.) | Up to 5% |
| Data processing machines | Up to 5% |
| Calculating and adding machines | Up to 3% |
| Machine tools and accessories (selected types) | Up to 5% |
| Chemical and fertilizers plant | Up to 5% |
| **Electrical Engineering Industries** | |
| DC motors and controls | Up to 3% |
| Power cables above 11KV | Up to 3% |
| Transformers above 1000KVA | Up to 3% |
| AC motors above 30 hp | Up to 3% |
| Power capacitors | Up to 3% |
| **Selected Ferro Alloys** | Up to 5% |
| **Non-Ferrous Metals** | Up to 3% |
| **Glass Industry** | |
| Polished plate glass laboratory glass-ware and silica-ware | Up to 3% |

There are several ways to deal with the question of cost of plant and equipment. Experienced technologists in touch with up-to-date market industry situation should be able to give information on plant costs, equipment by equipment. In some cases, the cost of the whole plant and equipment as a package may be ascertained. It is useful always to compare the package prices of equipment with piece by piece quotations.

In providing for machinery, due care should be taken to ensure that it includes equipment and facilities required for finishing, sorting and packaging including stamping, handling, auxiliary services, such as fire fighting. Two most important sections normally not to be included under equipment and plant, would be workshop and office equipment and tools. Both are essential features of any good industrial unit. In some cases, such as process industry, laboratory services are an indispensable element.

A constraint in adopting advanced technologies is the availability of proper maintenance facilities in the area where the plant is to be located. In a country in which proper maintenance facilities are not available, the best way may be to adopt less sophisticated technologies and minimum of automation.

In any case the equipment list should include a complete and detailed list of spare parts. There are required, in fact, two separate lists of spare parts, one which would include spare parts to be procured along with the first supply of plant and equipment; and the second containing spare parts which would be required for operations from year to year. The first supply should include spare parts which are needed for the first year or more.

The quantum of spare parts for either of the purposes would depend on the nature of the industry, availability of spare parts within the country and facilities and ease with which spare parts can be indented and imported when necessary. Where import procedures are very difficult and dilatory, it is necessary to keep a very high level of inventory. In developing countries, it is customary to provide inventory requirements of various items ranging from three months' requirements to one full year's requirements. The average should be minimum of six months' requirements.

Under the pre-feasibility study, a lump sum figure may be provided for spare parts with broad indications of the essential spare parts. This lump sum figure is obtainable along with the quotations of machinery furnished by machinery suppliers; alternatively, it may have to be estimated separately. The cost of spare parts is related to F.O.B. or installed cost of plant and machinery. This ranges from 3 per cent to 8 per cent of the f.o.b. cost. The typical figure is 5 per cent.

The study on technology and equipment must include ancillary facilities, such as water supply and treatment, electricity generation and distribution, electricity connextions, telecommunication facilities including internal communication system within the factory.

Production Flow Chart and Lay-out Plan

It must describe the process flow in very clear-cut terms making diagramatic representation in a chart. The chart should show material, fuel, utility and water balances at delimited stages of production. It is not necessary to have detailed machine drawings but a line diagramme of the plant and equipment ought to be included in the report.

A feasibility study must always incorporate a detailed lay-out plan. However, it should be recognised that the lay-out plan in the feasibility study need not be as detailed one as would be required for contracting, supervision of construction and erection of machinery.

In preparing the lay-out plan, the factors of utmost importance are (a) free flow of production and movement of materials, products and men; (b) economical use of space; (c) efficient operational framework facilitating mobility of workforce and better supervision by the supervisory force; (d) scope for expansion. Although meant for the future, the last consideration is a very significant one.

It is often necessary to support the lay-out plan with a detailed contour map of the site.

In order to illustrate the difficulties encountered in selecting the appropriate technology, equipment and capacity, four brief case studies are presented.

Selection of Technology: Case 1

In a project for the manufacture of small diametre black and galvanised tubes, the following criteria were used for selecting the process of welding.

Three main types of welding for pipes with their variations were identified:

I. Electrical Welding

(a) Inert gas metal arc welding

(b) Submerged arc welding

II. Resistance Welding

(a) Resistance welding at mains frequency (or a multiple of it), by means of contact rollers or roller transformers;

(b) Medium frequency induction welding, using a line inductor arranged in parallel to the weld;

(c) High frequency welding with sliding contacts;

(d) High frequency induction welding.

III. Continuous Butt Welding Process

(a) Using stationary-chain-type welding machine;

(b) Using travelling-chain-type welding machine.

Electrode welding is not used for black and galvanised tubes of small diametres. In continuous butt welding, the chain type machines used result in lower output, poor welds and are uneconomical in comparison to the continuous pipe mills. This process is becoming obsolete. Therefore, a resort to resistance welding at main, medium or high frequency with or without the application of sliding contacts was called for. In case of resistance welding at main or medium frequency, difficulties arise in working out an effective method for supplying current to the rotating welding electrodes. The application of sliding contacts involves high power losses, reaching 50 per cent, since very heavy currents are employed specially for mills operating on DC.

The high frequency induction welding process was selected. This process has the following advantages:

1. It has a high welding rate compared with other methods and a high electrical efficiency owing to contactless heating of a small area. The upper limit is not set by the welding process, but is governed by the way in which the strip is conveyed in the shaping section and especially by the capacity of the cut-off-saws.

2. The quality and uniformity of the welding are not affected by the surface quality of the strip.

3. No significant marking of the tube, no oxide formation or burning results and hence improved appearance of the end product is achieved.

4. High quality welding of the walled tubes is possible. The ratio of diametre to wall thickness can be greater than that with any other method. It is limited only by the mechanical design of the forming mill.

5. Non-pickled strip can be used without impairing the quality of the weld.

6. No contact or contact rollers are to be worn, which results in lower operating costs and less down-time.

7. For the same welding rate, the mains power required is roughly half of what is required in welding with contact rollers. Thus substantial economy in power cost is secured.

Selection of Technology: Case 2

In a project for the manufacture annually of 800 tonnes of PVC plasticized films and unsupported sheets and 1,500 kms. of supported PVC sheet, the following processes were considered for selection:

1. Extrusion
2. Injection moulding
3. Calendering
4. Blow moulding
5. Sintering
6. Hot melt roll coating

Of these, extrusion, injection moulding, blow moulding and calendering are widely used. For manufacture of PVC flat products, extrusion, calendering and spreading are used.

PVC films are flat products having a thickness of not more than 0.25 mm. (0.04 inches). These are either blown film (lay flat) or flat die cast films. These can be manufactured by extrusion and by calendering.

Unsupported PVC sheets (thickness more than 0.25 mm.) may be made from plasticised or rigid PVC. Here again, any of the processes mentioned above can be used.

Supported PVC sheets refer to PVC coated fabrics (rexin) or other substrates such as paper. These are calendered or spread coated. The calendering process also includes an extruder for feeding the calender.

A comparison of the two processes is given below:

Extrusion process

* Preferred for small capacities;
* Equipment costs 40 - 50 per cent less;
* Manpower requirement higher for comparable output;
* Conversion costs marginally lower;
* Greater latitude to increase product width;

* Product thickness ranges from 0.02 to 2.5 mm.;
* Variation in thickness across product makes it difficult to product evenly wound rolls consistently;
* Permits utilization of extrusion equipment for products other than films and sheets.

Calendering process

* Preferred for large projects;
* Very high output, more than one extruder required to match for the same output;
* Versatile in product pattern;
* Capable of producing film sheets on substrates like fabric and paper;
* Product width restricted by design; increase possible but at much expense;
* Restricted range in product thickness;
* Better control of product thickness hence available to lower tolerances;
* More uniform properties across product width;
* Better optical properties due to cooling by chilled rolls.

The proposed production of films and unsupported sheets envisaged is not large enough to opt for a calendering process. Among others, therefore, the capacity is an over riding consideration for the selection of the extrusion process.

In the extrusion of films, we have to use the blown film process because the flat film extrusion process is employed only for rigin (unplasticised) films.

Supported sheets can also be manufactured by calendering or spread coating. In case of calendering the investment is quite high and only longer runs of 50,000 to 1,000,000 metres are economical. In case of spread coating, the investment is small and also smaller runs of 50,000 metres for each design may be economical. For summported PVC sheets, therefore, the spread coating process was selected.

## Selection of Equipment Size: A Case

In a project for the manufacture of ferro-silicon a critical point for project planning was the selection of the furnace size.

The international trend, particularly over the past decade, has been towards larger ferro-silicon furnaces. Furnaces with capacities as large as 30,000 to 40,000 KVA have been set up.

The trend towards large furnaces arises from economies of scale both in terms of fixed costs and wage costs per ton of capacity/production.

The drive for economies of scale has necessitated major sophistications in production technology. With increases in capacity, it has been possible to incorporate automated equipment for raw material charging and furnace operation. But in larger furnaces, sizing and composition of raw materials become increasingly critical and metallurgical imbalances resulting from power failures, for instance, cannot be corrected as rapidly as in smaller units.

The country in which the project was to be located has also witnessed a trend towards increasing furnace size. A few years ago, the sizes of electric smelting furnaces were of the order of 9,000 to 10,000 KVA with the largest ferro alloys furnaces being of 12,000 KVA capacity. An operating company recently selected a 21,000 KVA furnace for ferro-silicon production.

There are, however, several factors which tend to discourage the installation of furnaces in the country, as large as those in other advanced countries. These are:

(i) Labour costs - a relative advantage is not a decisive factor in the subject industry;

(ii) Sophisticated automation brings in its wake the problems of maintenance, facilities for which are limited;

(iii) The sizes and composition of indigenous raw material supplies are considerably variable;

(iv) Fluctuations in the supply of power and other inputs require the selected furnace to respond more promptly;

(v) shut down of a single furnace lead to highly adverse financial results and a twin-furnace complex tends to reduce them.

Balancing the technical, supply and economic conditions, complex of two furnaces each with 20,000 KVA was preferred to a single large furnace of 40,000 KVA. This capacity of furnace shall be sufficient for the manufacture of 24,000 tonnes of ferro-silicon per annum.

## Capacity Selection: A Case

A small capacity plant was selected for the manufacture of paper because of, among others, the following considerations:

1. It was becoming increasingly difficult to procure a sustained supply of raw materials for larger units within "economic"
7 distance.

2. Availability of adequate supplies of power and water to large units was found to be difficult in most locations.

3. Difficulties have been encountered in procuring machinery and equipment for large units from indigenous sources, which is insisted on by the Government.

4. The delivery periods were long for large plants from local suppliers.

5. Public participation in capital of large paper plants has been shy due to:

   (a) poor return on investment;

   (b) difficulty in procuring foreign exchange and technical know-how;

   (c) the longer gestation periods of about 6 years before returns could be earned.

The following table shows some selected indicators of the relative economics of small and large plants:

| | Plant Capacity | | | | |
|---|---|---|---|---|---|
| | 5 tons/ day | 5 tons/ day | 5 tons/ day | 5 tons/ day | 5 tons day |
| Total Investment (US$ '000) | 1,200 | 2,000 | 6,250 | 46,250 | 58,750 |
| Per ton Investment (US$ '000) | 240 | 200 | 208 | 462 | 293 |
| Return on Investment after Depreciation (ROI) | 13.0 | 13.0 | 13.5 | 7.5 | 14.0 |
| Foreign Exchange Requirements (US$ '000) | 75 | 75 | 390 | 10,000 | 18,875 |
| Pay-Back Period (Years) | 8.5 | 8.5 | 8.1 | 10.1 | 8.0 |

In order to achieve the ROI shown for small units, a careful raw material mix and end product mix are very essential. It may also be pointed out here that economics shown for small units is possible only because of the availability of recovery units from indigenous sources which were non-existant until recently. Although the economics of 30 tons/day and 200 tons/day units are similar, the above mentioned difficulties in case of larger units, discouraged the prospective investors.

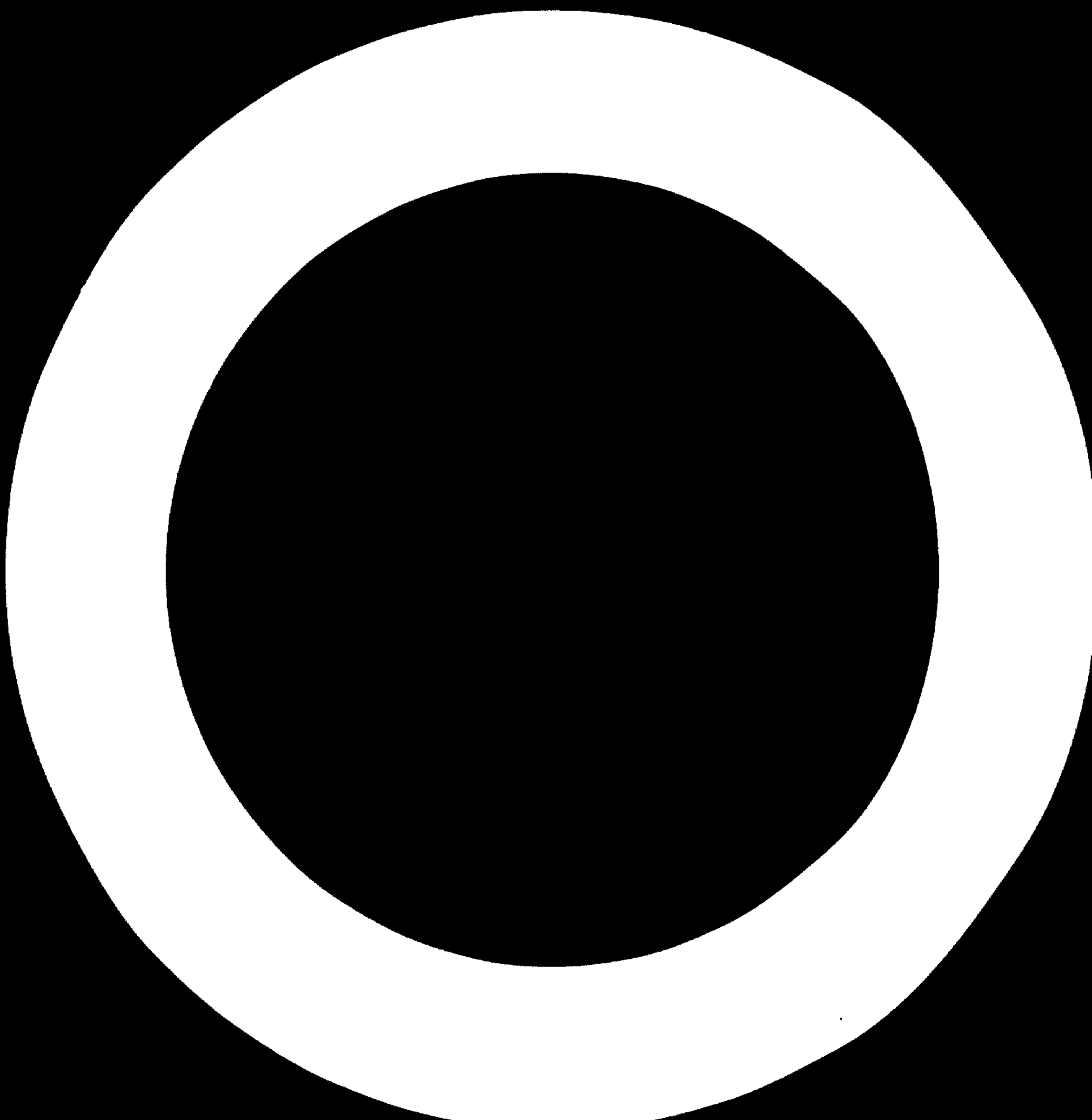
Apart from basic economics, such as ROI, pay back period and foreign exchange requirements, the following socio-economic points have been claimed in favour of small units:

1. Small units would use agricultural non-wood residues and other waste materials. Thus, raw materials, being thrown away or burnt, can be put to better use.
2. As the quantities of raw materials required for small units are not enormous, these can be established at the selected location. This will help to decentralise large industrial centres providing a necessary economic boost to relatively backward rural areas. Indigenous, and especially, the local machine building industry will receive encouragement.

3. The pollution of the environment will be kept to a minimum level at reasonable cost.

4. The employment potential per tonne of output will be much higher.

In view of the above considerations, a small unit with a capacity of up to 30 tons/day was preferred.



## Chapter 12 Total Investment

When looking at this important item of a feasibility study, one should first of all keep in mind whether total assets or the means needed for their financing are to be determined. Fixed assets, pre-production capital costs and current assets add up to total assets (see Table 5); fixed assets, pre-production capital costs and working capital, however, do not add up to the same amount, since the item working capital is composed of current assets diminished by current liabilities which gives the amount of financing needed to maintain the industrial venture operational. The manual adheres to the second approach with the understanding that total assets can easily be determined since all its elements are available.

The determination of fixed assets, pre-production capital costs and working capital requirements necessitates a systematic approach which is frequently missing in feasibility studies. It has always to be kept in mind that the production costs, and consequently the profitability of the project proposal, are influenced by the amount of investment required. The manual therefore presents a detailed description of the major components of fixed assets, pre-production capital costs and working capital requirements and includes model tables for their calculation.

There is, however, no fast rule to compute investment costs in exact terms. In order to partly compensate this deficiency, reference is made in the cases of fixed assets and pre-production capital costs to two supplements: "Contingencies" and "Price escalation". In doing so, one has to realize that profitability calculations have to be based on a range of data and that each particular set of data is only valid under specific assumptions which have to be given.

### Contingencies

Contingencies include those items under the respective headings which cannot be foreseen at the pre-investment study stages. Some items cannot be clearly foreseen even at the project

Table 5 **Total Assets**

| Item | Investment item | Local currency | Foreign currency | Total |
|---|---|---|---|---|
| A | **Fixed assets** | | | |
| | (a) Land | | | |
| | (b) Site development | | | |
| | (c) Buildings and civil engineering works | | | |
| | (d) Machinery and plant | | | |
| | (e) Workshop and office equipment, tools | | | |
| | (f) Spare parts | | | |
| | (g) Incorporate fixed assets | | | |
| | Total A | | | |
| B | **Pre-production capital costs** | | | |
| | (a) Preliminary and capital issue expenses | | | |
| | (b) Pre-production expenses | | | |
| | (c) Trial runs, start-up and commissioning costs | | | |
| | Total B | | | |
| C | **Current assets** | | | |
| | (a) Accounts receivable | | | |
| | (b) Inventory | | | |
| | (c) Work-in-process | | | |
| | (d) Finished products | | | |
| | (e) Cash-in-hand | | | |
| | Total C | | | |
| | Total assets | | | |

implementation stage. It is, therefore, a matter of financial prudence that a separate provision is made for contingencies depending on the nature of the contracts envisaged and quotations obtained from the various suppliers, including those for plant and equipment. If the quotations are based on a total plant basis or on a turn-key basis, the level of contingencies should be kept low. Normally contingencies range from 5-10% of the estimated costs.

Price escalation

Because of inflationary conditions prevailing all over the world, the prices rise in a very short span of time. If adequate provision is not made for such rises, there would be heavy overruns. Since the financing of a project has to be based on the total pre-determined capital costs and the components thereof, it is imperative that a provision for a price escalation is made. In the absence of such a provision, there would be no scope for meeting the additional costs. The promoters will then run into financial difficulties jeopardising progress of the project. Unless there are over-riding considerations, provision for price escalation should be made at 5 to 15% p.a. depending on the rate of inflation in the country which in turn depends on internal and external economic conditions.

A. Fixed assets

Fixed assets include: (1) land, (2) site development, (3) building and engineering civil works, (4) machinery and plant, (5) workshops and office equipment and tools, (6) spare parts and (7) incorporate fixed assets.

1. Land

When determining the value of land one has to keep in mind whether the land is to be utilized as premises for the factory or whether it will serve as raw material base which will gradually be exploited - (quarry of a cement factory). In both cases the following items have to be considered: price of land, taxes, registration and notary fees, land survey costs, soil tests, etc.

The value of land should be depreciated if the land's resources are being exploited by the firm. The depreciation rate depends on the annual output of the pit or quarry as compared to the resources available The exact determination of this value is not easy since it is frequently difficult to assess the total resources available. In the case of a brick factory, the residual value of the barren land after termination of the exploitation should theoretically correspond to the value obtained after all depreciation has been terminated. In view of the difficulty to estimate the existing resources, one has to refrain from calculating this type of depreciation.

2. Site development includes: site clearing (wrecking and removing of old structures, deforestation, removal of rocks, relocation of power lines); draining; grading (levelling, leackfil and disposal, fine grading); connecting costs with public utilities; access and internal roads; fencing and gates; railroads, piers; parking area; landscaping; recreational areas; etc. Site development and preparation is an important cost item under land. It would depend on the nature of facilities required and soil conditions. In feasibility studies, it is customary to take a lumpsum figure based on cost per cubic meter for site development which includes filling and levelling of land, laying of roads. Obviously, this figure is based on an appropriate inspection of the site and estimation.

The depreciation of site developments does not create any problems since it is fairly easy to determine their lifetime which serves as basis for the computation of the annual depreciation rates: Roads: 10-15 years· sewerage: 5-15 years; fences (wood and/or wire): 5-15 years, etc.

Table 6 summarizes the individual cost item of land and site development. The figures of this table will have to be entered into Table 5

Table 6. Land and site development

| | Local currency | Foreign currency | Total |
|---|---|---|---|
| 1. Land | | | |
| Price of land | | | |
| Soil tests | | | |
| Land survey cost | | | |
| Registration fee | | | |
| Notary fee | | | |
| Other fees | | | |
| Taxes | | | |
| Contingencies | | | |
| Price escalation | | | |
| Total land costs | | | |
| 2. Site development | | | |
| Site clearing | | | |
| Site grading | | | |
| Drainage | | | |
| Connecting costs with public utilities (gas, electricity, water, sewerage) | | | |
| Sewerage | | | |
| Access and internal roads | | | |
| Railroad | | | |
| Fence and gates | | | |
| Wells, water-pool | | | |
| Bridges | | | |
| Parking areas | | | |
| Landscaping | | | |
| Recreational areas | | | |
| Others | | | |
| Contingencies | | | |
| Price escalation | | | |
| Total site development | | | |
| Total land and site development (1. + 2.) | | | |

3 Building and civil engineering works

This category can be divided into broad groups:

- factory or process buildings
- ancillary buildings (such as maintenance building, garages, change and locker house, cafeteria, research and control laboratories, medical service, etc.)
- stores and warehouses (for raw, auxiliary and process materials, finished and semi-finished products, tools and spare parts)
- administration buildings
- staff welfare buildings
- residential buildings

Costs of these different types of buildings have to be calculated separately because the specifications and facilities for each differ widely. The buildings and civil engineering works costs are an item like land and site development which are based on local conditions. It should therefore not be difficult to arrive at building costs based on per $ft^2$ or $m^2$ of constructed area for different kinds of buildings, by resorting to planning parameters or by obtaining suitable quotations from contractors. Care should, however, be exercised when applying such parameters. First of all, their definitions should be given in the feasibility study. In addition, it should be possible to find out whether the data applied are based on local conditions or whether such data were merely obtained by modifying data valid in industrialized countries, where they exist in abundance. Experience with feasibility studies prepared for developing countries shows that frequently only modified parameters are being utilized in a rather careless manner. It would go beyond the scope of this manual to attempt to present such data even for a group of structured countries. In view of the worldwide inflation rates, all parameters would be out-dated too quickly. Table 7 is to be considered only as a guide in case buildings and civil engineering costs are estimated based on parameters. In any event it would be advisable to utilize local consultants to assist particularly in the preparation of those items of pre-investment studies where knowledge about the local conditions is indispensable

BUILDINGS AND CIVIL ENGINEERING WORKS

| Item | Building sections | Type of construction | Number of floors | Build-up area Length m | Build-up area Breadth m | Floor area $m^2$ | Height m | Rate of constr. per $m^2$ | Esti-mated cost |
|---|---|---|---|---|---|---|---|---|---|
| A | **Factory buildings** | | | | | | | | |
| | (a) | | | | | | | | |
| | (b) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) Total of A | | | | | | | | |
| B | **Ancillary fact.build.** | | | | | | | | |
| | (a) | | | | | | | | |
| | (b) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) Total of B | | | | | | | | |
| C | **Warehouses + stores** | | | | | | | | |
| | (a) | | | | | | | | |
| | (b) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) Total of C | | | | | | | | |
| D | **Administrat. build.** | | | | | | | | |
| | (a) | | | | | | | | |
| | (b) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) Total of D | | | | | | | | |

(Buildings and civil engineering works)

| Item | Building sections | Type of construction | Number of floors | Build-up area Length m | Build-up area Breadth m | Floor area $m^2$ | Height m | Rate of constr. per $m^2$ | Estimated cost |
|---|---|---|---|---|---|---|---|---|---|
| E | **Staff welfare facil.** | | | | | | | | |
| | (a) | | | | | | | | |
| | (b) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) Total of E | | | | | | | | |
| F | **Employees housing** | | | | | | | | |
| | (a) | | | | | | | | |
| | (b) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) Total of F | | | | | | | | |
| | Total of A to F | | | | | | | | |
| G | Architects fees | | | | | | | | |
| H | Engineering and supervision cost | | | | | | | | |
| I | Other costs | | | | | | | | |
| J | Contingencies | | | | | | | | |
| K | Price escalation | | | | | | | | |
| | Total of A to K | | | | | | | | |

When possible, one should, however, be rather meticulous already at the stage of the feasibility study and avoid too much reliance on parameters. The calculation of costs for certain fixed installed equipment such as plumbing, central heating and hot water plants, electrical wiring, gas piping, air conditioning, telephones, lifts and elevators, deserves in many countries particular attention in view of the prevailing depreciation policies. In order to be able to depreciate properly - and to calculate the production costs correctly - it is recommendable, already at the pre-investment stage, to keep the actual construction costs of buildings separate from such fixed installed equipment items since the latter are being treated differently depending on whether one is dealing with office, administration and residential buildings or with factory buildings, stores, warehouses and ancillary buildings. In the former case plumbing, heating, air condition, lighting, ventilation, telephones, intercommunication systems, elevators, gas, air and warm water supply systems, from an integral part of the buildings. They are to be capitalized under the heading of construction and civil engineering, however, to be kept apart from the actual building costs. In the case of factory, ancillary buildings, warehouses and stores, fixed installed equipment is to be calculated separately and has either to be listed under process machinery and plant or under non-process equipment as in the case of pipings and storage facilities for gas, electricity, heating and warm water, telephone and telex installations.

In providing for specifications of buildings and especially for factory buildings, the height and load-bearing capacities of the columns should be provided for. The cost of factory buildings differ very widely, and therefore areas for different purposes should be clearly defined.

The cost of foundations depend on the nature of equipment and soil conditions. These may either be included with the building costs specifying the item clearly as "buildings and civil works" or under installed costs of machinery. Both practices are followed. The latter is preferable.

While considering building costs, social facilities to be provided to workers should never be lost sight of, especially in developing countries. Therefore, depending on the location of the factory and the size of workforce, it would be necessary to provide for residential accommodation, hospitals, schools and other public facilities.

Many studies prepared by consultants or industrial enterprises from advanced countries have overlooked or undermined the need for social welfare facilities. It is, among other reasons, due to the extensive and wholesome facilities available in their countries to the ordinary citizens and the emphasis on profits or commercial profitability. Of equal significance is the availability of infrastructure facilities. Since they are in many cases neither provided by the government nor by the municipalities, they have to be financed by the investment project. An omission of this item may endanger the entire venture. On the other hand, the financing of infrastructure investments by the investor frequently renders such new establishments less profitable.

When calculating building and civil work costs provision should be made for the architect's fee. These fees differ from building to building but depending on the sophistication of the buildings required, this may vary between 2 and 8% of the building cost. The typical figures vary between 3.5 and 5%. In addition, provision should be made for engineering and supervision cost which, depending on the case, can also be included in the architect's fee.

As far as depreciation is concerned no particular difficulties are envisaged since the annual depreciation rates depend on the expected lifetime of each item. Buildings usually last less long in tropical countries. Factory and process buildings have to be depreciated faster depending on whether the plant utilizes a wet or a vibrating process which have a greater tear and wear on the buildings. The following depreciation rates are indicative:

**Factory buildings**

| | |
|---|---|
| First class concrete work | 4% |
| Ordinary factory buildings | 5% |
| Office buildings | 2% |
| Warehouses | 4% |

In case building and civil engineering costs are not calculated with the help of parameters, the following questions as summarised in Table 8 should be answered.

Table 8

**Summary statement: building and civil engineering costs**

| | Local currency | Foreign currency | Total |
|---|---|---|---|
| 1. **Foundation and floors** | | | |
| 1.1 **Loading requirements** (for each area) | | | |
| 1.2 Excavation | | | |
| outside well footings | | | |
| inside column footings | | | |
| for sub-level areas, trenches etc. | | | |
| 1.3 Footings and supports | | | |
| 1.4 Type of floors and finish (for each area) | | | |
| 2. **Structural framework** | | | |
| 2.1 Type of framing | | | |
| steel | | | |
| concrete | | | |
| wood | | | |
| 2.2 Clear height requirements (for each area) | | | |
| 2.3 Bay-spacing in plant | | | |
| 2.4 Structural load requirements | | | |
| Cranes | | | |
| Monorails | | | |
| Others | | | |
| 2.5 Special structures (stacks, etc.) | | | |
| 3. **Walls, exterior** | | | |
| 3.1 Materials | | | |
| Brick | | | |
| Concrete | | | |
| 3.2 Finish | | | |
| 3.3 Sills | | | |

| | Local currency | Foreign currency | Total |
|---|---|---|---|
| 4. <u>Walls, interior</u> | | | |
| 4.1 Materials | | | |
| 4.2 Finish | | | |
| 4.3 Partitions | | | |
| Plan area | | | |
| Office areas | | | |
| Store rooms | | | |
| Other areas requiring special wall treatment | | | |
| 5. <u>Roofs</u> | | | |
| 5.1 Type | | | |
| flat | | | |
| inclined | | | |
| 5.2 Decking | | | |
| 5.3 Finish | | | |
| 5.4 Bonding | | | |
| 5.5 Drainage | | | |
| 6. <u>Ceilings</u> | | | |
| 6.1 Materials for each area | | | |
| 6.2 Finish | | | |
| 6.3 Acoustical treatment | | | |
| 7. <u>Stairways</u> | | | |
| 7.1 Treads | | | |
| 7.2 Balusters | | | |
| 7.3 Trim | | | |
| 8. <u>Elevators and lifts</u> | | | |
| 8.1 For freight | | | |
| 8.2 For passengers | | | |
| passengers | | | |
| manlifts | | | |
| escalators | | | |
| 9. <u>Windows</u> | | | |
| 9.1 Type and operation | | | |
| by hand | | | |
| mechanically | | | |
| 9.2 Sash and hardware | | | |
| 9.3 Screening requirements | | | |
| 9.4 Louvres, awnings and jalousies | | | |
| 9.5 Glazing | | | |
| normal | | | |
| special | | | |
| 10. <u>Doors</u> | | | |
| 10.1 Special size requirement | | | |
| 10.2 Type | | | |
| Rolling | | | |
| Sliding | | | |
| Swinging | | | |
| 10.3 Operation | | | |
| by hand | | | |
| mechanically | | | |

| | Local currency | Foreign currency | Total |
|---|---|---|---|
| 10.4 Framing | | | |
| 10.5 Materials | | | |
| 10.6 Hardware | | | |
| 10.7 Glazing | | | |
| 11. Painting | | | |
| 11.1 Exterior | | | |
| 11.2 Interior | | | |
| 11.3 Special requirements | | | |
| 12. Plumbing and piping | | | |
| 12.1 Cold water (potable and non potable) | | | |
| Drinking fountains | | | |
| Food service | | | |
| Lavatories and showers | | | |
| Water closets and urinals | | | |
| Cooling and refrigeration | | | |
| General plant use | | | |
| Fire protection | | | |
| Landscape sprinkler system | | | |
| 12.2 Hot water | | | |
| Showers and washrooms | | | |
| Food service | | | |
| Plant | | | |
| Heating system, capacity and type | | | |
| Fuel to be used | | | |
| Controls | | | |
| 12.3 Gas and compressed air | | | |
| Pressure requirements | | | |
| Power of compressors | | | |
| Appurtenant equipment | | | |
| 12.4 Process piping according to process requirements | | | |
| 12.5 Drainage (including all elements of drainage systems, such as manholes, catch basis, etc.) | | | |
| Sanitary | | | |
| Stormwater | | | |
| 13. Fire protection | | | |
| 13.1 Sprinkler systems | | | |
| 13.2 Hose cabinets and equipment | | | |
| 13.3 Extinguishers | | | |
| 13.4 Hydrants | | | |
| 13.5 Special requirements (based on plant inflammables) with particular refernece to chemical control | | | |

| | Local currency | Foreign currency | Total |
|---|---|---|---|
| 14. Electrical systems | | | |
| 14.1 Power and lighting (state for each): | | | |
| Energy (KVA) | | | |
| Voltage requirements | | | |
| Utility tie-in | | | |
| Substations and distribution system | | | |
| Wiring (including poles and subterranean conduits) | | | |
| Fixtures | | | |
| Outlets | | | |
| 14.2 Telephone circuits and inter-communication system | | | |
| 14.3 Public address systems | | | |
| 15. Heating, ventilating and air-conditioning | | | |
| 15.1 Temperature and relative humidity requirements and/or limits | | | |
| for general areas | | | |
| for special areas | | | |
| for process | | | |
| 15.2 Methods and equipment | | | |
| 15.3 Controls | | | |
| 16. Scales and weighing stations | | | |
| 17. Special protective equipment | | | |
| Guardhouse | | | |
| Warning lights | | | |
| Search lights | | | |
| Sirens and protective devices | | | |
| Electronic safeguards | | | |
| 18. Contingencies | | | |
| 19. Price escalation | | | |
| 20. Total building and civil engineering costs | | | |

NOTE: Items 12, 13, 14, and 15 are only to be included under "Building and civil engineering costs" in the case of office and administration buildings and housing. In all other cases these items have to be listed under "Machinery and plant".

4 Machinery and plant

This item normally includes all movable and immovable machines and buildings like facilities (plant) which form an integral part with the machines and which would not serve any other purpose (e g substations, cooling towers, etc ) Broadly speaking, one could divide machinery and plant into 5 groups

a) machinery and plant for production, processing and control
b) prime movers
c) energy generation and distribution machinery
d) process transportation equipment
e) other machinery and plant

For the calculation of the total cost of machinery and plant, the following types of installations have to be considered which occur in the erection of machinery and plant: foundations, special supporting walls and ceilings, beams, etc As already indicated in the preceding sub-chapter 2, fixed installations such as plumbing, heating, air-conditioning, gas piping, etc can be considered as machinery and plant as far as factory buildings, stores, warehouses and ancillary buildings are concerned. In order to facilitate their computation, it is recommended, however, to include them further below under "Equipment, workshop and office equipment, tools"

Installed value of machinery

The calculation of the installed value of machinery is based on the f.o b. or c i.f prices for imported machinery and on the f.o r. or ex-works prices of indigenous machinery which are to be obtained from quotations received from different sources. In selecting the acceptable quotations, a great deal of discretion is warranted. It should be ensured that the identified source suits the project most from the points of view of technology, collaborative convenience and foreign exchange and capital financing

Table 9 summarizes all cost items which have to be considered in order to arrive at the total installed cost of machinery and plant including fabrication of components of equipment, i.e. vessels, piping, etc. and installation costs It is recommended to calculate the installed costs for each item of machinery separately and to use only Table 10 for the calculation of the final amount.

Table [illegible]: INSTALLED COST OF MACHINERY AND PLANT (for each item)

| Item | Cost components | Local currency | Foreign currency | Total |
|---|---|---|---|---|
| A | Imported machinery | | | |
| | (a) f.o.b. cost | | | |
| | - major items<br>- ancillaries | | | |
| | Total of (a) | | | |
| | (b) + insurance and freight | | | |
| | (c) = c.i.f. cost | | | |
| | (d) clearing charges including loading and unloading | | | |
| | (e) customs and port charges | | | |
| | (f) internal transportation | | | |
| | (g) loading, unloading and incidentals | | | |
| | (h) internal insurance | | | |
| | (i) local taxes (octroi) | | | |
| | (j) Delivered cost (total of a to i) | | | |
| B | Indigenous machinery | | | |
| | (a) f.o.b. cost<br>- major items<br>- ancillaries | | | |
| | Total of (a) | | | |
| | (b) Packaging cost | | | |
| | (c) Purchase, sales or production taxes | | | |
| | (d) Transportation, loading and unloading | | | |
| | (e) Insurance | | | |
| | (f) Local taxes | | | |
| | (g) Delivered cost (total of a to f) | | | |
| C | Engineering fee and costs | | | |

(installed cost of machinery and plant)

| Item | Cost components | Local currency | Foreign currency | Total |
| --- | --- | --- | --- | --- |
| D | Installation/Fabrication costs | | | |
| | (a) Materials and tools | | | |
| | (b) Utilities and services | | | |
| | (c) Fees | | | |
| | (d) Buildings costs, e.g. foundations | | | |
| | Total of a to d | | | |
| E | Contingencies | | | |
| F | Price escalation | | | |
| Total installed costs | | | | |

Table 10: MACHINERY AND PLANT: Process facilities

| Item | Classification and item description | Origin | Capacity | Power Load Required | Installed cost | | |
|---|---|---|---|---|---|---|---|
| | | | | | Local | Foreign | Total |
| A | Plant department I | | | | | | |
| | (i) | | | | | | |
| | (ii) | | | | | | |
| | ... | | | | | | |
| | (n) Total of A | | | | | | |
| B | Plant department II | | | | | | |
| | (i) | | | | | | |
| | (ii) | | | | | | |
| | ... | | | | | | |
| | (n) Total of B | | | | | | |
| ... N | Plant department N | | | | | | |
| | (i) | | | | | | |
| | (ii) | | | | | | |
| | ... | | | | | | |
| | (n) Total of N | | | | | | |
| | Total of A to N | | | | | | |
| | Contingencies | | | | | | |
| | Price escalation | | | | | | |
| | **Total installed cost** | | | | | | |

The fabrication and installation cost can be computed either item by item or on the basis of a percentage figure of the costs of delivered machinery and equipment. The installation cost should vary between 5 to 15% depending on the nature of equipment. In some cases where a great deal of fabrication and erection work is involved, the installation cost may go up to 20% of the delivered cost of equipment. For a cotton mill project, the machinery installation cost was as low as 2%, the installation costs, on the other hand, for an asbestos pressure pipes plant and a glass bottles plant involving the same magnitude of investment (approximately $5 million), were respectively 5% and 6%. In cases where installation costs are computed on the basis of a percentage figure, Table 10 should also be used in order to obtain the total cost of installed machinery and plant.

With regard to depreciation of machinery and plant items, it is to be noted that the installed value is to be capitalized and to be depreciated according to the prevailing regulations of each country. The following depreciation rates are only indicative and will have to be verified in each individual case.

Machinery and plant of:

| | |
|---|---|
| a) Metal working industry | 12% |
| b) Engineering industries | 10% |
| c) Process industries | 15% |
| d) Textile industries | 10% |

5. Workshop and office equipment, tools

Workshop equipment is composed of transportation equipment such as cars, trucks, railroads, etc. (see Table 11), however, excluding process transportation equipment, small lifting equipment, batteries, pumps, ventilators, air-conditioning, piping, heating, equipment of process workshops (benches, forges, shelves, etc.), laboratory equipment, fire fighting equipment, durable packaging, canteens, showers and lockers, welfare equipment.

Office equipment includes such items as electrical lighting and heating equipment, furniture (for offices, factories, staff welfare and residential units), office machines, telephones and intercommunication systems, telex, reproduction facilities, and clocks. See Table 15.

Tools are composed of machine and precision tools, devices, models, electrical power tools such as drills and saws, mechanical tools, etc. Costs estimates for workshop and office equipment and tools can in the majority of cases be obtained locally. In many feasibility studies it has been observed, however, that the costs for these items are provided in three separate lump sums. This presumes that sufficient expertise is available locally which is unfortunately not always the case. On the other hand, foreign consulting firms undertaking a study from abroad, might not always have an intimate knowledge of the cost level in the country concerned. A detailed computation might be therefore in many cases the most appropriate solution. Table 15 is suggested as model for this purpose. It has to be observed that the valuation of the tools and the equipment has to be at "delivered cost" as outlined in Table 9 for both imported and locally available commodities.

Concerning the depreciation of the above-mentioned items, it is to be noted that no generally valid rate can be provided. The differences from one country to the other are too large. The following figures are therefore only to be viewed at as a bench mark:

a) workshop equipment: 20-25%
b) office equipment: 20-50%
c) tools: 30-50%

In many cases capitalized items of equipment and tools are depreciated entirely already during the year of acquisition in view of their short durability.

6. Spare parts

Machinery, plant, workshop and office equipment and tools must also include as a separate item essential spare parts sufficient for an identified period. The cost of initial spare parts represents a definite item of capital expenditure. Six month's requirements of spare parts are the minimum level. In most developing countries, a full year's spare parts requirements are provided for in pre-investment studies. Many public financial institutions in countries facing chronic foreign exchange shortages and having rigorous impact controls insist on a provision on spare parts requirements of critical items for two years. This is certainly on the high side but has proved prudent in some cases.

The valuation of spare parts has to be at "delivered costs" as outlined in Table 16 for both imported and locally available items.

7. Incorporated fixed assets

This item mainly comprises patents, licences and occasionally also the goodwill of a firm in the case, e.g. where a local investor associates his firm through a joint venture with a well known foreign company and whose name is included in the title of the newly created firm.

Patents (lump sum fees), concessions, quotas and special rights are capitalised and amortised according to the prevailing regulations. Patents and licences are valid for a certain period of time. It is common practice to write them off during a shorter period than their legal lifetime. Goodwills and trade marks do normally not diminish in value and it is therefore not necessary to amortise them.

Patent fees which are charged according to the size of production (royalties), are included in the production costs and do not have to be capitalised.

Table 11: WORKSHOP EQUIPMENT

| Item | Equipment | Broad description | | | Quantity | Cost | | |
|---|---|---|---|---|---|---|---|---|
| | | Size | Capacity | Other | | Local | Foreign | Total |
| A | Transport equipment (see table (still to be designed | | | | | | | |
| B | Workshop process equipment (see table 12) | | | | | | | |
| C | Laboratory equipment (see table 13) | | | | | | | |
| D | Power and electrical equipment (see table 14) | | | | | | | |
| E | Water: supply, treatment and disposal (to be further elaborated) | | | | | | | |
| F | Heating, ventilating and air conditioning system (to be further elaborated) | | | | | | | |
| G | Fire protection (to be further elaborated) | | | | | | | |
| H | Durable packaging (to be further elaborated) | | | | | | | |
| I | Social facilities<br>a) Canteen<br>b) Medical services<br>c) Others | | | | | | | |
| J | Others | | | | | | | |
| K | Contingencies | | | | | | | |
| L | Price escalation | | | | | | | |

Table 12 WORKSHOP PROCESS EQUIPMENT

Table 12 WORKSHOP PROCESS EQUIPMENT

| Item | Equipment | Broad description | | | Quantity | Cost | | |
|---|---|---|---|---|---|---|---|---|
| | | Size | Capacity | Other | | Local | Foreign | Total |
| A | Mechanical equipment | | | | | | | |
| | (i) | | | | | | | |
| | (ii) | | | | | | | |
| | .... | | | | | | | |
| | (n) Total of A | | | | | | | |
| B | Electrical equipment | | | | | | | |
| | (i) | | | | | | | |
| | (ii) | | | | | | | |
| | .... | | | | | | | |
| | (n) Total of B | | | | | | | |
| C | Civil engineering equipment | | | | | | | |
| | (i) | | | | | | | |
| | (ii) | | | | | | | |
| | .... | | | | | | | |
| | (n) Total of C | | | | | | | |
| D | Electronic equipment | | | | | | | |
| | (i) | | | | | | | |
| | (ii) | | | | | | | |
| | .... | | | | | | | |
| | (n) Total of D | | | | | | | |
| E | Measuring instruments/meters | | | | | | | |
| | (i) | | | | | | | |
| | (ii) | | | | | | | |
| | .... | | | | | | | |
| | (n) Total of E | | | | | | | |
| F | Miscellaneous, e.g. furniture | | | | | | | |
| | (i) | | | | | | | |
| | (ii) | | | | | | | |
| | .... | | | | | | | |
| | (n) Total of F | | | | | | | |
| | Total of A to F | | | | | | | |

Table 13 **LABORATORY EQUIPMENT AND INITIAL SUPPLIES**

| Item | Equipment and supplies | Broad description | | | Quantity | Cost | | |
|---|---|---|---|---|---|---|---|---|
| | | Size | Capacity | Other | | Local | Foreign | Total |
| A | Physical testing equipment | | | | | | | |
| | (a) | | | | | | | |
| | (b) | | | | | | | |
| | ... | | | | | | | |
| | (n) Total of A | | | | | | | |
| B | Chemical testing equipment | | | | | | | |
| | (a) | | | | | | | |
| | (b) | | | | | | | |
| | ... | | | | | | | |
| | (n) Total of B | | | | | | | |
| C | Mechanical testing equipment | | | | | | | |
| | (a) | | | | | | | |
| | (b) | | | | | | | |
| | ... | | | | | | | |
| | (n) Total of C | | | | | | | |
| D | Electrical testing equipment | | | | | | | |
| | (a) | | | | | | | |
| | (b) | | | | | | | |
| | ... | | | | | | | |
| | (n) Total of D | | | | | | | |

(Laboratory equipment and initial supplies)

| Item | Equipment and supplies | Broad description | | | Quantity | Cost | | |
|---|---|---|---|---|---|---|---|---|
| | | Size | Capacity | Other | | Local | Foreign | Total |
| E | Accessories | | | | | | | |
| | (a) | | | | | | | |
| | (b) | | | | | | | |
| | ... | | | | | | | |
| | (n) Total of D | | | | | | | |
| F | <u>Ovens, refrigerators, etc.</u> | | | | | | | |
| | (a) | | | | | | | |
| | (b) | | | | | | | |
| | ... | | | | | | | |
| | (n) Total of F | | | | | | | |
| G | <u>Chemicals, materials, solutions</u> | | | | | | | |
| | (a) | | | | | | | |
| | (b) | | | | | | | |
| | ... | | | | | | | |
| | (n) Total of G | | | | | | | |
| | Total of A to G | | | | | | | |

**Table 14:** POWER AND ELECTRICAL EQUIPMENT

| Item | Particulars + No. | Description/ specifications | Cost | | |
|---|---|---|---|---|---|
| | | | Local | Foreign | Total |
| A | Generators<br>including standby emergency generators | | | | |
| B | Transformers | | | | |
| C | Fuse switch units | | | | |
| D | Circuit breakers | | | | |
| E | Distribution boards | | | | |
| F | Power factor improvement equipment | | | | |
| G | Transmission lines from public supply to power substation | | | | |
| H | Internal cabling outside factory | | | | |
| I | Cabling within factory | | | | |
| J | Outdoor lighting | | | | |
| K | Lighting: factory, stores, warehouses, and ancillary buildings | | | | |
| L | Other electrical installations | | | | |
| M | Incidental equipment facilities | | | | |
| | Total of A to M | | | | |

Table 15: OFFICE EQUIPMENT AND [illegible]

| Item | Equipment | Broad description | | | Quantity | Cost | | |
|---|---|---|---|---|---|---|---|---|
| | | Size | Capacity | Other | | Local | Foreign | Total |
| A | Office equipment | | | | | | | |
| | a) Furniture | | | | | | | |
| | b) Telephone and intercommunication system | | | | | | | |
| | c) Telex system | | | | | | | |
| | d) Reproduction facilities | | | | | | | |
| | e) Clocks | | | | | | | |
| | f) Others | | | | | | | |
| | ...... | | | | | | | |
| | Total of A | | | | | | | |
| B | Tools | | | | | | | |
| | a) Precision tools | | | | | | | |
| | b) Devices | | | | | | | |
| | c) Fixtures | | | | | | | |
| | d) Hand tools | | | | | | | |
| | e) Machine operated tools | | | | | | | |
| | f) Others | | | | | | | |
| | ...... | | | | | | | |
| | Total of B | | | | | | | |
| | Total of A + B | | | | | | | |

**Table 16: SPARE PARTS REQUIREMENTS**

| Item | Plant division and item description | Inventory requirements | | Annual requirements | |
|---|---|---|---|---|---|
| | | Quantity | Value | Quantity | Value |
| A | Machinery and plant | | | | |
| | (a) Department I | | | | |
| | (b) | | | | |
| | ... | | | | |
| | (n) Total of A | | | | |
| B | Workshop equipment | | | | |
| | (a) Transport | | | | |
| | (b) Power + electrical equipment | | | | |
| | ... | | | | |
| | (n) Total of B | | | | |
| C | Office equipment | | | | |
| | (a) | | | | |
| | (b) | | | | |
| | ... | | | | |
| | (n) Total of C | | | | |
| D | Tools | | | | |
| | (a) Precision tools | | | | |
| | (b) | | | | |
| | ... | | | | |
| | (n) Total of D | | | | |
| E | Contingencies | | | | |
| F | Price escalation | | | | |
| | Total of A to F | | | | |

B. PRE-PRODUCTION CAPITAL COSTS

Apart from and in addition to capital costs of fixed assets, every industrial project, big or small, involves costs incurred before commercial production commences but not resulting directly in the acquisition, construction, fabrication, erection or generation of capital assets. These costs have to be capitalized and include a whole series of items from the dream to the stream stages of the project. These cover, among others, costs of conducting pre-investment studies, for the formation of the company, for acquisition of funds, engineering and consultants' fees, salaries, wages and travel, costs of test runs and start-up operations. It is customary to divide them into the three categories as also shown in Table 17.

1. Preliminary and capital issue expenses cover costs incurred for registration and formation of the company, including legal fees for preparation of memorandum and articles of association and similar documents and for capital issue expenses. The capital issue expenses include costs incurred for the preparation and issue of prospectus, advertising for public announcements, underwriting commission, brokerage, expenses for processing of share applications and allotmant of shares. Preliminary expenses also include legal fees for loan applications, land purchase agreements, etc.

Preliminary and capital issue expenses constitute some 5% of the share capital (?) of the company. The proportion, however, varies from one project to another.

2. Pre-production expenses include:

a) all pre-investment studies - including opportunity, pre-feasibility, feasibility and support or functional studies

b) engineering and other studies undertaken for the implementation of the project

c) consultant fees for preparing studies, engineering, supervision of erection and construction. Consulting services are debited to the

**Table 17:** PRE-PRODUCTION CAPITAL COSTS

| Item | Categories | Local currency | Foreign currency | Total |
|---|---|---|---|---|
| A | **Preliminary and capital issue expenses** | | | |
| | (a) Registration/incorporation Fees | | | |
| | (b) Printing and incidentals | | | |
| | (c) Prospects and other printing expenses | | | |
| | (d) Public announcement expenses | | | |
| | (e) Under writing commission | | | |
| | (f) Brokerage | | | |
| | (g) Legal fees | | | |
| | (h) Other expenses | | | |
| | Total of A | | | |
| B | **Pre-production expenses** | | | |
| | (a) Pre-investment studies | | | |
| | (b) Engineering fees | | | |
| | (c) Consulting fees | | | |
| | (d) Salaries, wages, benefits and social security | | | |
| | (e) Office expenses | | | |
| | (f) Legal expenses | | | |
| | (g) Travel and transportation | | | |
| | (h) Pre-production product promotion | | | |
| | (i) Training costs | | | |
| | (j) Communications | | | |
| | (k) Rentals | | | |
| | (l) Fees of directors, auditors and others | | | |
| | (m) Interest during construction | | | |
| | - on term loans | | | |
| | - on current bank credits | | | |
| | (n) Other expenses | | | |
| | Total of B | | | |
| C | **Trial runs, start-up and commissioning costs** | | | |
| | (a) Consulting and supervision fee | | | |
| | (b) Costs of foreign experts | | | |
| | (c) Raw materials | | | |
| | (d) Auxiliary materials and supplies | | | |
| | (e) Utilities | | | |
| | (f) Others | | | |
| | Total of C | | | |
| D | Contingencies | | | |
| E | Price escalation | | | |
| | Total of A to E | | | |

relevant fixed asset and are not included under pre-production expenses in cases where they can be directly related to the creation of an asset, such as for supervision of erection of plant and machinery

d) other expenses for planning the project

e) salaries, fringe benefits and social security contributions of personnel engaged during the pre-production period

f) travel expenses

g) preparatory installations, such as workers' camps, temporary offices, stores, etc.

h) pre-production product promotion costs, creation of the sales network and promotional advertising

i) training costs, including fees, travel and living expenses of the trainees and their salaries and stipend, fees payable to external institutions

j) interest on loans during construction.

This last item is rather important in developing countries. The equity-debt ratio is often as low as 1:3. The gestation period of projects is also generally high. Interests which the equity capital would have earned up to the time of production if it would have been used elsewhere, is not to be capitalised but is only considered for evaluation purposes. It is in any case recommended to have separate accounts for interest on loans during construction and operations. The former are investment costs, the latter production costs.

3. Trial runs, start-up and commissioning costs

This item includes consultant fees for the supervision of trial runs and start-up operations, wages, salaries, fringe benefits and social security contributions, consumption of raw and auxiliary materials and supplies, utilities and other incidental start-up costs. Operating losses incurred during the running-in period up to the moment where production has become satisfactory have also to be capitalised. Start-up costs caused by periodic close downs (e.g. after holidays) are not to be capitalised but have to be charge to production costs.

4. Allocation of pre-production capital costs

Two practices are normally adhered to:

a) To capitalize the entire pre-production capital costs and to amortise them over a certain period of time. This practice is to adopt a period of two to ten years for this purpose.

b) The second method first allocates - where attributable - a part of the pre-production capital costs to the respective fixed assets and amortise the sum of both. Pre-production capital costs which are not attributable are capitalized as a total and are also amortized as described in the preceeding paragraph, e.g. in two to ten years.

## C. WORKING CAPITAL REQUIREMENTS

The term working capital simply defines the financial means required to operate the project according to its objectives, i.e. the manufacturing of industrial goods. In broad terms working capital can be defined as current assets minus current liabilities. Current assets comprise debtors (accounts receivable), inventories (raw material, auxiliary material, supplies, funds, packaging material, spares and small tools), work-in-process and finished poducts and cash-at-hand. Current liabilities are mainly composed of creditors (accounts payable) free of interest.

In order to be able to compute the amount of working capital required, a clear understanding of the annual operations of the project is needed. By the same token, the composition of the annual operating and production costs has to be known. Since working capital requirements change as the project becomes operational at full capacity, it is imperative to obtain cost data for a period of time, preferably equivalent to the timing of the cash flow table. In the following particular attention will be paid to the scheduling of working capital requirements (see example Table 18 A, B and C).

1. Accounts receivable (debtors)

The amount of this item is pre-determined by the company's policy with regard to credit sales. Since the ratio credit sales to gross sales differs from company to company depending on the competitive situation prevailing in the industry, it is difficult to come up with a valid generalization. Each case has therefore to be assessed individually according to the formula:

$$\text{Debtors} = \frac{\text{Credit terms (in months)}}{\text{12 months}} \times \text{Annual gross sales}$$

Accounts receivable are valued at production costs net of depreciation and interests in loans.

2. Inventories

Working capital requirements are greatly influenced by the amount of capital immobilised - inventories. Every attempt has therefore to be undertaken by management to minimise stocks.

a) Raw materials

In computing inventories, consideration should be given to the sources and modes of supplies of materials and finished goods. If the materials are locally available, are in plentiful supply and can be transported in minimal time, stocks of materials equivalent to two weeks consumption should normally be in order unless there are special transportation and storage problems. If the materials are imported and if the procedures are dilatory - as in most developing countries which have elaborate import and foreign exchange controls -, the inventories equivalent of upto six months consumption may have to be maintained.

Other factors influencing the size of raw materials stocks are the reliability and seasonality of supplies, the number of suppliers, possibilities of substitution and expected price changes.

The computation of raw material inventory is based on the annual (12 months or 360 days) raw material requirement divided by the number of months (or days) requirements. This computation may have to be repeated for groups or individual raw materials depending on the number of months' (days') requirements.

b) Spare parts

Levels of spare parts inventories depend on the local availability of supplies, import procedures and maintenance facilities in the area, and of course, on the nature of the plant itself.

c) Work-in-process

The assessment of the work-in-process requirements does not only necessitate a comprehensive analysis of the entire production, but also of the degree of processing already reached by the different material inputs during each stage.

The requirements are expressed in months (days) of production. The valuation is at production costs net of depreciation and interests on loans.

d) Finished goods

The inventory of finished goods depend on a number of factors, such as the nature of commodity and the trade usage. In many trades, it is customary that large stocks of finished goods are maintained by the producers at trading centres from which the replenishments of the inventories required by the trade are made. In such a case the inventory of finished goods would be quite high combining the two, the one which is maintained at the production centre and the other at the distribution stage. In some industries it is customary to have a chain store distributive system. Under this system, the project should also provide for inventories to be maintained at its chain stores unless th chain store business is financed separately and makes adequate provision for the inventories.

Other factors influencing the inventory of finished goods are the possibilities of increasing production to meet seasonal fluctuations in demand, the competitive situation of th industry and the relia ility of the sales forecast.

The value of the inventory is calculated by dividing the annual (12 months or 360 days) production costs (net of depreciation and interests on loans) by the number of months (days) requirements.

3. Cash-in-hand

It may sometimes be necessary to add interest to the working capital. If the interest is charged on a half-yearly basis - which often is the case - no provision is normally necessary, except insofar as the working capital required at the end of six-month period may not have been covered by the finished stocks or receivables.

It is also prudent to provide for a certain amount of cash-in-hand. One method by which this could be done is to add a contingency. Feasibility studies should make a provision of 5% for a contingency on working capital which will fully take care of the small amounts of cash-in-hand required.

Another method of calculating cash requirements would be to estimate the number of weeks for which cash has to be secured in order to pay for all production costs other than depreciation, amortisation and those expenses for which credit can be received. See example.

4. Accounts payable (debitors)

Raw and auxiliary materials, supplies, utilities, etc., are normally purchased on credit up to 30 days and taxes are paid during the year after the income was gained. All these credited payments reduce the amount of working capital required.

Working capital would vary from year to year depending, among other things, on levels of output. Provision for long terms financing for working capital is made on the basis of first year production which is assumed to be low. Increased requirements in the subsequent period are expected to be financed out of internal generation of funds (depreciation and undistributed profits). However, there is no unalterable rule about it. If the project is developed in a number of phases drawing upon the internal generation of funds for fixed investments, additional investments may have to be injected into the operations to attain higher levels of capacity utilization.

Working capital for purposes of seasonal factories (e.g. sugar factory) has to be calculated on a slightly different basis. A year has to be divided into two phases: operational and non-operational periods. The working capital requirements during the operational phase are calculated on a normal basis. For the slack season, the working capital requirements are to be scaled down since only fixed costs have to be maintained. However, during the operational season, inventory must be very high, and therefore, working capital requirements are high too. A seasonal factory requires a build-up of working capital in the operational season and tapering off of the working capital in the slack season.

The calculation of the working capital for seasonally employed firms is based on an annual forecast of payments and receipts. In Table 19 all payments are listed which are compared with monthly receipts coming from sales. See Table 20

This table starts with the month during which larger payments have first to be undertaken (May). The last column of Table 20 shows the aggregate deficits of the year, 3,180 being the lowest and 13,500 the highest deficits. The table reveals that a permanent working capital of some 6,000 would be most appropriate assuming that credits can be obtained for the balances.

Table 18

Example: Working capital scheduling

**Table A: Annual production costs (in 000)**

| Years | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Production schedule (tons) | 185 | 354 | 530 | 580 | 580 |
| Raw material | | | | | |
| - local material A | 50 | 100 | 150 | 165 | 165 |
| - local material B | 20 | 30 | 40 | 50 | 50 |
| - imported material | 70 | 140 | 210 | 230 | 230 |
| Labour | 25 | 45 | 65 | 75 | 75 |
| Utilities | 5 | 15 | 20 | 25 | 25 |
| Repair | 15 | 25 | 40 | 45 | 45 |
| Maintenance - spare parts | 25 | 25 | 25 | 25 | 25 |
| Factory admin. overhead | 80 | 80 | 80 | 80 | 80 |
| Operating costs | 290 | 460 | 630 | 695 | 695 |
| Depreciation | 190 | 190 | 190 | 190 | 190 |
| Interest on loans | 30 | 30 | 30 | 30 | 30 |
| Production costs | 510 | 680 | 850 | 915 | 915 |

The working capital schedule is based on the following assumptions:

| | Requirement |
|---|---|
| a) Accounts receivable: | 30 days at operating costs |
| b) Inventory: | |
| Local raw material A: | 30 days |
| Local raw material B: | 15 days |
| Imported raw material: | 90 days |
| Spare parts: | 180 days |
| Work-in-process: | 6 days at operating costs |
| Finished products: | 15 days at operating costs |
| c) Cash-in-hand | 15 days, see separate calculations Table C |
| d) Accounts payable | 30 days, for raw materials and utilities |

Based on the number of days required, a coefficient of turnover is calculated:

$$\text{coefficient of turnover} = \frac{360 \text{ days}}{x \text{ days}}$$

In order to obtain the various annual values for the sub-items of current assets and current liabilities of Table B, divide the respective figures of Table A by the coefficient of turnover.

Table B: Working capital schedule

(X: No.of days of inventory Y: coefficient of turnover)

| Years | X | Y | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| I. Current assets | | | | | | | |
| A. Accounts receivable | 30 | 12 | 24 | 38 | 52 | 58 | 58 |
| B. Inventory | | | | | | | |
| a) Raw material | | | | | | | |
| - Local material | | | | | | | |
| Material A | 30 | 12 | 4 | 8 | 12 | 14 | 14 |
| Material B | 15 | 24 | 1 | 1 | 2 | 2 | 2 |
| - Imported material | 90 | 4 | 17 | 35 | 52 | 57 | 57 |
| b) Spare parts | 180 | 2 | 12 | 12 | 12 | 12 | 12 |
| c) Work-in-process | 6 | 60 | 5 | 8 | 10 | 12 | 12 |
| d) Finished products | 15 | 24 | 12 | 19 | 26 | 29 | 29 |
| C. Cash-in-hand * | 15 | 24 | 7 | 9 | 10 | 11 | 11 |
| Total current assets | - | - | 82 | 130 | 176 | 195 | 195 |
| II. Current liabilities | | | | | | | |
| A. Accounts payable | 30 | 12 | 12 | 24 | 35 | 39 | 39 |
| Working capital | | | 70 | 106 | 141 | 156 | 156 |
| Increase in working capital | - | - | - | 36 | 35 | 15 | - |

* Required cash balance from Table C

Table C: Required cash balance

| Years | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Total production costs | 510 | 680 | 850 | 915 | 915 |
| less: Raw material | 140 | 270 | 400 | 445 | 445 |
| Utility | 5 | 15 | 20 | 25 | 25 |
| Depreciation | 190 | 190 | 190 | 190 | 190 |
| | 175 | 205 | 240 | 255 | 255 |
| x $\frac{360 \text{ days}}{15 \text{ days}}$ = required cash balance | 7 | 9 | 10 | 11 | 11 |

Table 19

**Estimate of Payments**

| Months | Salaries and wages | Basic raw material | Other mate-rials | Payment of taxes and profit | Other pay-ments | Total |
|---|---|---|---|---|---|---|
| May | - | - | - | - | - | 5,680 |
| June | - | - | - | - | - | 3,160 |
| July | - | - | - | - | - | 2,100 |
| August | - | - | - | - | - | 440 |
| September | - | - | - | - | - | 1,300 |
| October | - | - | - | - | - | 780 |
| November | - | - | - | - | - | 680 |
| December | - | - | - | - | - | 940 |
| January | - | - | - | - | - | 3,280 |
| February | - | - | - | - | - | 2,840 |
| March | - | - | - | - | - | 3,060 |
| April | - | - | - | - | - | 4,020 |
| Total | - | - | - | - | - | 29,180 |

Table 20 Estimated monthly receipts and payments

| Month | Receipts | Payments | Deficit | Surplus | Aggregated deficits |
|---|---|---|---|---|---|
| May | 2,500 | 5,680 | 3,160 | | 3,180 min. |
| June | 1,340 | 3,160 | 1,820 | | 5,000 |
| July | 840 | 2,100 | 1,260 | | 6,230 |
| August | 1,080 | 840 | | 240 | 6,020 |
| September | | 1,800 | 1,800 | | 7,820 |
| October | | 780 | 780 | | 8,600 |
| November | | 680 | 680 | | 9,280 |
| December | | 940 | 940 | | 10,220 |
| January | | 3,280 | 3,230 | | 13,500 max. |
| February | 5,260 | 2,840 | | 2,420 | 11,080 |
| March | 8,100 | 3,060 | | 5,040 | 6,040 |
| April | 10,060 | 4,020 | | 6,040 | - |
| Total | 29,180 | 29,180 | 13,740 | 13,740 | - |

D. Cash flow analysis

In chapter 15 all questions related to the calculation of production costs will be discussed mainly from the point of view of cash flow analysis. This way it will be possible to gear the manual towards the final stage of pre-investment studies: project evaluation. Although it is not the objective of the manual to deal with project evaluation at great length, it is still necessary to inform the team in charge of project preparation about all the data required for this purpose.

In this context attention is therefore drawn to the fact that the planning of investment costs has also to be done with the objective of filling the forecasted expenditures into the cash flow concept. Tables 33, 35 and 37 should be consulted for this purpose since they contain the respective lines on investment costs.

# Chapter 13 Material Inputs

Material inputs are commonly divided into three major subgroups: raw materials, auxiliary materials and supplies. Since it is a matter of definition whether material inputs should also include packaging materials, repair materials, energy and water, it is recommended to treat these items separately in Chapter 15 Production Costs.

## A) Raw materials

Raw material is a crucial element in the determination of technical and economic viability of most industrial projects. In many industries, the selection of technology, process equipment and product-mix depend substantially on the specifications of the raw material; in others, its (potentially available) quantities determine the size of the project. The prices of raw materials are a determining factor of the financial, commercial and economic feasibility of most industrial projects. In fact a number of projects are conceived basically for the utilization of exploitable raw materials, may it be an agricultural, forest, mineral, marine or animal product. It is therefore of prime importance that the raw material - the basic input - is analyzed in a feasibility report in sufficient detail, depth and with utmost care and caution.

The scope and depth of raw material analysis depend on the nature of the material and its use-history. Broadly speaking, the following factors may have to be examined:

1. The basic characteristics of the material with defined standard specifications, gradations, sizes, colours, physical, mechanical, chemical and other properties and reactions:

a) Physical properties, such as size, dimensions, form (plate, rod, liquid, gas, granule, paste), density, viscosity, porosity

b) Mechanical properties, such as formability, tensile, compressive, tearing and load bearing strength, stiffness, elasticity, machinability, response to fatigue, hardening and annealing properties.

c) Chemical properties, such as grades (emulsion, suspension, low monomer), melting and boiling points, resistance to corrosion, purity (the proportion of content of the desired material or element), stability at various temperatures, absorption, oxidising and reduction properties, flamability and self-extinguishing property;

d) Electrical properties, such as magnetic properties, resistance, conductance, dielectric properties

2. Industrial experience in the use of the candidate quality of the material; if no use-history is available, the need for and the results of pilot plant and other relevant tests;

3. Organic consistency among the materials used (for example, mixture of bamboos and bagasse for paper production);

4. Quantities required and indigenous and external, present and potential supplies, indicating the substitute uses and alternative demands expected to be made on the supplies and the projected development for their exploitation;

5. The sources of supplies and the degree of dependability of the supplies for the project;

6. The machinery and mechanics of securing the supplies;

7. The location of the supplies, the concentration and dispersal of areas of supplies, the distances involved, the available and proposed modes of transportation indicating the retrospective and apprehended bottlenecks;

8. Present raw material prices, past price trends and future projections with the impact, if any, on the sales prices of the products of the candidate project.

9. Costs of handling and transportation at alternative locations of the project and their impact on the product prices. The factors affecting prices are not only the quantities of supplies - in relation to changing demand - and the qualities of the materials, transportation costs are sometimes an overwhelming element. The plant locations have, therefore, often to be directed, notwithstanding other factors, to the sources of raw material supplies. Transportation costs must include costs of handling and storage. In some cases of special products, such as LPG, the transportation equipment itself becomes a major factor.

10. Wastage, leakages and process losses of the materials indicating the net material yields;

11 Cost component of the component candidate materials in the final product costs relative to alternative raw materials, qualities and sources.

12. Investments and exploitation costs including other input requirements especially if the exploitation of the raw materials is proposed as an integral part of the candidate project.

As it has been pointed out earlier, the extent and the depth of the study would depend on, among other things, the nature of the materials. From this point of view, the raw materials may be broadly classified as follows:

(i) Agricultural products (such as raw cotton, sugarbeet) or residues (such as cotton seed or paddy straw)

Illustratively, if the candidate raw material is an agricultural product, it is invariably necessary to identify first the quality of the product. In the cotton textile industry, for example, long staple cotton only is amenable to production of finer counts and certain varieties of cotton are suitable only for production of low counts such as 10s and 20s. It is also necessary to know if the specific raw material from the specific areas has in the past been used for the production of the candidate product. Thus certain woods are suitable for certain varieties of papers and not for others. Similarly, certain grasses may be used for production of newsprint; other grasses in the same area may not be suitable.

The assessment of the quantities, available presently and potentially, may become a cardinal feature in most pre-investment studies involving use of agricultural produce. Agricultural produce is perishable. It is cultivated only when it can be sold. If the project involves relatively large quantities, the production of the raw material shall have to increase. This may need extension of the area under cultivation since it may not be easy to increase appreciably the productivity of land in the given period. This may often require substitution of another crop. In the case, for example, of sugar cane, it would be necessary to increase the area under cane cultivation in the same regions since cane cannot be transported over long distances without involving prohibitive transportation cost or loss of sucrose content or both.

In order to estimate the supplies and availability of the agricultural produce, it may be necessary to collect data on past crops and their distribution by market segments, geographical or by end-uses. While the data on yield per hectare may be of peripheral significance, those on size of market surpluses and prices are of considerable importance. For making projections in future, it would be necessary to study additional areas to be brought under irrigation schemes, programmes of improved agriculture, such as by use of mechanized methods or of other inputs such as chemical fertilizers, insecticides and pesticides, or by adoption of improved silos and storage methods.

Storage and transportation costs often assume major significance in industrial pre-investment studies envisaging use of agricultural products if such costs have a sizeable bearing on delivered prices.

In some cases, machinery and methods of collection have also to be studied. For paper plants, the felling and collection of the material from the forests are an important consideration for detailed analysis. Special arrangements have to be contemplated for conservation, inspection and collection. For some products, such as bamboos, special features emerge as of cardinal import. It is known, for example, that after some period, the bamboo forests in a large area begin to flower. The flowering of the bamboos is followed by the end of the crop. A new crop takes several years to develop. It becomes necessary, therefore, to study the historical records on the forest and to plan in advance for rotational sowings.

The collection of raw materials also becomes important if no collection machinery already exists and if the sources are widely spread out. For paper plants using waste paper or rags, the collection has to be organized in the waste producing centres and for those using agricultural residues, such as paddy straw, the material has to be collected from scores of farms.

Projects based on agricultural produce to be grown in future call for actual cultivation on experimental farms under a series of variable conditions. The produce has then to be tested in laboratories, and if necessary, in pilot plants. The laboratory facilities for pilot plants may not be available within developing countries. The samples, scientifically selected, may have to be sent to other countries where such facilities exist. No project should be undertaken on an entirely new crop to be grown in the area unless the tests, based on the actual produce from the area, have established the validity and viability of the subject produce for the candidate project.

(ii) Livestock products (such as meat, milk, wool), by-products (hides and skins), wastes (bones), and

(iii) Forest products (including items such as gums and resins)

In most cases of livestock produce and forest resources, specific surveys are called for to establish the validity of an industrial project. The general data may be obtained from official sources and those of local authorities, but these are sufficient only for opportunity studies. For feasibility studies, a much more dependable and precise data-base is required and this can be built only by specific surveys, however, expensive these may tend to be. A survey would cost much less than the losses involved in the total project investment when an erroneous investment decision has been made.

(iv) Marine products (including items such as sea-shells, a material for production of high quality white cement).

In regard to marine-based raw materials, the major problem is the potential of collection, the yields and the cost of collection. The facilities required for marine operations have often to be provided for under the industrial project. The possible yields need to be estimated with utmost caution.

(v) Mineral products (metallic and non-metallic including clays)

For minerals, detailed information on the proposed exploitable deposits are indispensable for feasibility studies. As pointed out elsewhere in this manual, it is not sufficient to identify the deposits by general mineral surveys, which may be sufficient for opportunity studies. An industrial feasibility study of a project can be legitimately based only on proven reserves. The study should give details unless the reserves are known to be too extensive, on

- the precise location of the deposits with area and contour maps;
- the size of the deposits in terms of the length and thickness of the seams and estimated deposits;
- the depth of the deposits indicating the size of over-burden;
- the viability of open-cast and underground mining;
- the quality of the deposits in terms of relevant estimated content;
- the composition of the ore with other elements - that is, the impurities and the need for beneficiation.

mineral products differ very widely in their physical and chemical compositions. Products of any two locations may hardly ever be uniform. The processing of each type may involve distinctly divergent methods and equipment.

It is frequently necessary to obtain a detailed analysis of physical, chemical and other properties of the subject ores to be processed and the results ought to be reproduced in the feasibility report as its integral part. It is only a matter of presentation whether it forms a part of the text or is appended as an annex. Analysis and tests of most mineral products for identification of their physical, chemical and other properties can be organized in most developing countries. However, in many cases, pilot plant tests may be called for. For such test, it may be necessary to send samples to laboratories or research facilities in other countries where these exist. Here again, no risks should be taken and when it is considered necessary to carry out pilot plant tests, no short-cut methods should be adopted. The economy in this regard is not only a false economy, it may, as indeed it has in many cases, prove highly detrimental to the candidate investment programme. A potteries plant in a South-Asian country had to be abandoned and scraped because the China clay was found unsuitable after the plant had been erected.

(vi) Semi-manufactures (such as base metals, synthetic fibres, petrochemical intermediates) and components.

When an industrial semi-manufacture and components are involved as a raw material or material inputs, the problems of an industrial feasibility study are reduced to easily manageable proportions. The product characteristics are more conveniently estimated, so are the quantities available. It will be necessary, however, to ensure that the specifications suit the processing (or fabrication), such as forging, punching, assembling, required for the candidate project and if adequate quantities would be available. It is likely under conditions of scarcities in developing countries that the quantities may be presently available but these might run in short supply as expanded demands are made on them by other programmes of development.

(vii) Industrial wastes and effluents (such as liquor from paper and pulp plants for soda recovery, used transformer and machine oils for recovery of oils, used tyres for recovery of rubber or steel scrap for reproduction of steels).

In the case of industrial wastes and effluents, significant considerations often requiring special attention are the problems of collection and pre-treatment for processing. In many cases, projects are sponsored for recycling of wastes and rejects within the existing industrial unit. Examples of these are chip or hardboards from a furniture manufacturing unit or soda recovering from the effluent liquor of a paper plant. In cases such as of rubber and oil reclamation plants, the collection (of used tyres or lubricating or machine oils) poses to be the main problem.

(viii) Atmospheric and natural elements (such as water, air).

Since negligible or no costs are involved in using atmospheric or plentifully available natural elements as raw materials, these are supposed to present no problems. The two basic questions are the available quantities and qualities. An example of atmospehric air for production of oxygen gas by air separation would make the point clear. If the plant is located adjacent to inhabited areas, the intake may reduce the oxygen content of the air to an extent which may pose to be a health hazard. On the other hand, oxygen separation plant drawing air from an area where coal gasification is carried on, may reduce the oxygen yield appreciably and may not be conducive to the candidate project.

B) Auxiliary materials and factory supplies

All investment proposals for manufacturing establishments utilize auxiliary materials and factory supplies in addition to the main raw materials. It is, however, sometimes not easy to differentiate clearly between raw materials, auxiliary materials and supplies. Particularly auxiliary materials and supplies are frequently used interchangeably, some supplies (oils, greases, varnishes, paints) are also used as auxiliary materials. Other types of auxiliary materials would be chemicals, additives, etc. Cleaning materials would be another typical example for supplies. Most feasibility studies try to estimate the required auxiliary materials and supplies separately in both physical and monetary terms.

Table 21 could be used as an example of how to compute the costs of material inputs in a feasibility study. The table was designed in such a way in order to be able to use the total costs of material inputs for the computation of production costs.

3) Utilities

A third major input are the various types of utilities which are required for the operation of the plant. In order to facilitate their estimation a set of tables has been provided for electricity, water, steam, compressed air, air conditioning, dust control, fuel and effluent disposal. Frequently feasibility studies tend to underestimate the requirements of utilities which in many instances has led to falsely calculated production costs. In addition, a rather precise estimation of the consumption of utilities at the feasibility stage is very useful in identifying the existing sources of supply, the shortages and to take appropriate measures to provide for either internal or external additional supplies. This type of estimate is particularly important since it ultimately also influences the investments to be undertaken in terms of buildings, machinery and equipment, laboratories and equipment if the lacking utilities are to be provided internally.

As already described in greater detail in chapter 5, questions related to the availability of utilities have normally to be dealt with in a separate location study. Since such a supporting study might not always be furnished, some of the major points to be looked at in the context of utilities are briefly summarized here. In addition separate tables are given as examples on how to calculate utility costs for a feasibility study.

Electric energy

An analysis of the electric energy situation must specify the requirements and the sources of supply as well as the costs of electric power. It is therefore indispensable for a feasibility study to list all electrical motors and power consuming installations in order to be able to estimate the maximum power demand, the connected load, peak-load and standby requirements, daily and annual consumption both by shifts and in total. Tables 22 and 23 are to be considered as guides for the calculation of power requirements and their costs.

The ready availability of electric power has caused severe problems in many developing countries. A feasibility study has therefore to assure that the necessary infrastructure exists or that it will be provided either by public utility companies or by the project itself. The provision of costly transmission lines from the power plan to the construction and production site, including substractions, or the erection of an own power station have to be considered in this context.

The high investment costs required for the provision of electric power can upset the profitability of a project if they are not included already at the feasibility stage

**Water**

The planning of water supplies and their costs is of crucial importance at the feasibility stage provided this question has not yet been solved during the preparation of the location study. Tables 24 and 25 should be used for this purpose

**Other utilities**

A feasibility study should support the selection of particular fuels, specify their costs, requirements and the sources of supply. Similarly, the requirements of the following items have to be estimated: steam, compressed air, air conditioning, dust control, effluent disposal, etc. See table 26.

**Transport**

Although not a typical utility, it seems to be appropriate at this point to provide also for the estimation of external-internal transport facilities. The amount of external means of transport is mainly influenced by the choice of the location of the project. The general infrastructure of the country's transport system has a great bearing in this regard. If transport facilities (connecting roads, railroads, ports, etc.) are insufficient, the question arises as to who will provide for and pay the costs of their development. A transport study will, however, mainly consider the type and amount of company-owned equipment for external and internal transport. The layout of the factory has a strong impact on the magnitude of internal transports and their costs. Table 27 summarizes all these considerations.

Table 21 MATERIAL COSTS

| Item | Type of material and "I" or "L" | Broad specifications | Consumption at output levels $X_1$ | $X_2$ | ....... | $X_n$ | Unit cost * | Tot. cost at full capacity | LC | FC |
|---|---|---|---|---|---|---|---|---|---|---|
| A. | SPECIFIC PRODUCT. MATERIAL includ. components | | | | | | | | | |
| | 1 | | | | | | | | | |
| | 2 | | | | | | | | | |
| | 3 | | | | | | | | | |
| | 4 | | | | | | | | | |
| | 5 | | | | | | | | | |
| | - | | | | | | | | | |
| | - | | | | | | | | | |
| | Total of A | | | | | | | | | |
| B.1 | AUXILIARY MATER. | | | | | | | | | |
| | 1 | | | | | | | | | |
| | 2 | | | | | | | | | |
| | 3 | | | | | | | | | |
| | 4 | | | | | | | | | |
| | - | | | | | | | | | |
| | Total of B.1 | | | | | | | | | |
| B.2 | SUPPLIES | | | | | | | | | |
| | 1 | | | | | | | | | |
| | 2 | | | | | | | | | |
| | 3 | | | | | | | | | |
| | 4 | | | | | | | | | |
| | - | | | | | | | | | |
| | Total of B.2 | | | | | | | | | |
| | TOTAL MATERIAL COSTS (A + B.1 + B.2) | | | | | | | | | |

* Unit costs: c.i.f. and clearing charges (includ. loading + unloading) + customs duties + port charges + local transport + local insurance + local taxes + incidentals.

"I": imported "L": local LC: local currency FC: foreign currency

Table 22: POWER REQUIREMENTS

| Item | Plant divisions | Operating years | | |
| --- | --- | --- | --- | --- |
| | | 1 | 2 | ..... n |
| | | Peak-load kW / Energy kWh | | |
| | | Shifts: 1 2 3 / 1 2 3 | | |
| A | Main plant divisions/shops | | | |
| | (a) | | | |
| | (b) | | | |
| | ... | | | |
| | (n) Total of A | | | |
| B | Ancillary plant facilities | | | |
| | (a) | | | |
| | (b) | | | |
| | ... | | | |
| | (n) Total of B | | | |
| C | Others, like offices, housing | | | |
| | (a) | | | |
| | (b) | | | |
| | ... | | | |
| | (n) Total of C | | | |
| | Total of A to C | | | |

Table 23: PLANNING OF POWER SUPPLIES AND THEIR COSTS

| Item | Characteristics and units in V, kW, kWh and LC'000 | Construct. period Quarters | | | | Output levels | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $Q_1$ | $Q_2$ | ... | $Q_n$ | $x_1$ | $x_2$ | ... | $x_n$ |
| A | Maximum demand | | | | | | | | |
| B | Connected load | | | | | | | | |
| C | Peak-load requirements | | | | | | | | |
| D | Standby requirements | | | | | | | | |
| E | Energy requirements (kWh) | | | | | | | | |
| | (a) Daily | | | | | | | | |
| | (b) Annual | | | | | | | | |
| F | Of the connected load | | | | | | | | |
| | (a) External source | | | | | | | | |
| | (b) Own generation | | | | | | | | |
| | (c) Standby capacity | | | | | | | | |
| G | Voltage (V) | | | | | | | | |
| | (a) Unio sub-station | | | | | | | | |
| | (b) Plant | | | | | | | | |
| H | Power costs (annual) (LC) | | | | | | | | |
| | (a) Basic charge | | | | | | | | |
| | (b) Energy cost | | | | | | | | |
| | (c) Conversion charge | | | | | | | | |
| | (d) Rentals | | | | | | | | |
| | (e) Power duty/tax | | | | | | | | |
| | Total of H | | | | | | | | |

LC: local currency in 000

Table 34: WATER REQUIREMENTS

| ITEM | CONSUMPTION | OPERATING YEARS 1 | 2 | ...................... n | | |
|---|---|---|---|---|---|---|
| | | $m^3$ | $m^3$ | $m^3$ | $m^3$ | $m^3$ (in 000) |
| A | Process | | | | | |
| | (a) | | | | | |
| | (b) | | | | | |
| | (c) | | | | | |
| | Total of A | | | | | |
| B | Boiler feed | | | | | |
| C | Cooling | | | | | |
| D | Effluent disposal | | | | | |
| E | Human consumption | | | | | |
| | 1. Drinking | | | | | |
| | 2. Washing, cleaning | | | | | |
| | Total of E | | | | | |
| F | Housing colony | | | | | |
| G | Other uses | | | | | |
| | Total of A to G | | | | | |

Table 25: PLANNING OF WATER SUPPLIES AND THEIR COSTS

| Item | Characteristics and units in 000m$^3$ and LC'000 | Construct. period Quarters | | | | Output levels | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $Q_1$ | $Q_2$ | ... | $Q_n$ | $x_1$ | $x_2$ | ... | $x_n$ |
| A | Total water requirements | | | | | | | | |
| | (a) Potable | | | | | | | | |
| | (b) Filtered | | | | | | | | |
| | (c) Treated | | | | | | | | |
| | (d) Cooled | | | | | | | | |
| B | Treatment specifications | | | | | | | | |
| | (a) | | | | | | | | |
| | (b) | | | | | | | | |
| | (c) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) | | | | | | | | |
| C | Sources of supplies | | | | | | | | |
| | (a) Internal | | | | | | | | |
| | (b) Public | | | | | | | | |
| | (c) Other | | | | | | | | |
| | ... | | | | | | | | |
| D | Cost of water supply (annual) | | | | | | | | |
| | (a) Internal | | | | | | | | |
| | (b) Public | | | | | | | | |
| | (c) Other | | | | | | | | |
| | (d) Filtration | | | | | | | | |
| | (e) Treatment | | | | | | | | |
| | (f) Cooling | | | | | | | | |
| | (g) Other | | | | | | | | |
| | Total of D | | | | | | | | |

LC: Local currency in 000

Table 26: **PLANNING OF UTILITIES OTHER THAN POWER AND WATER**

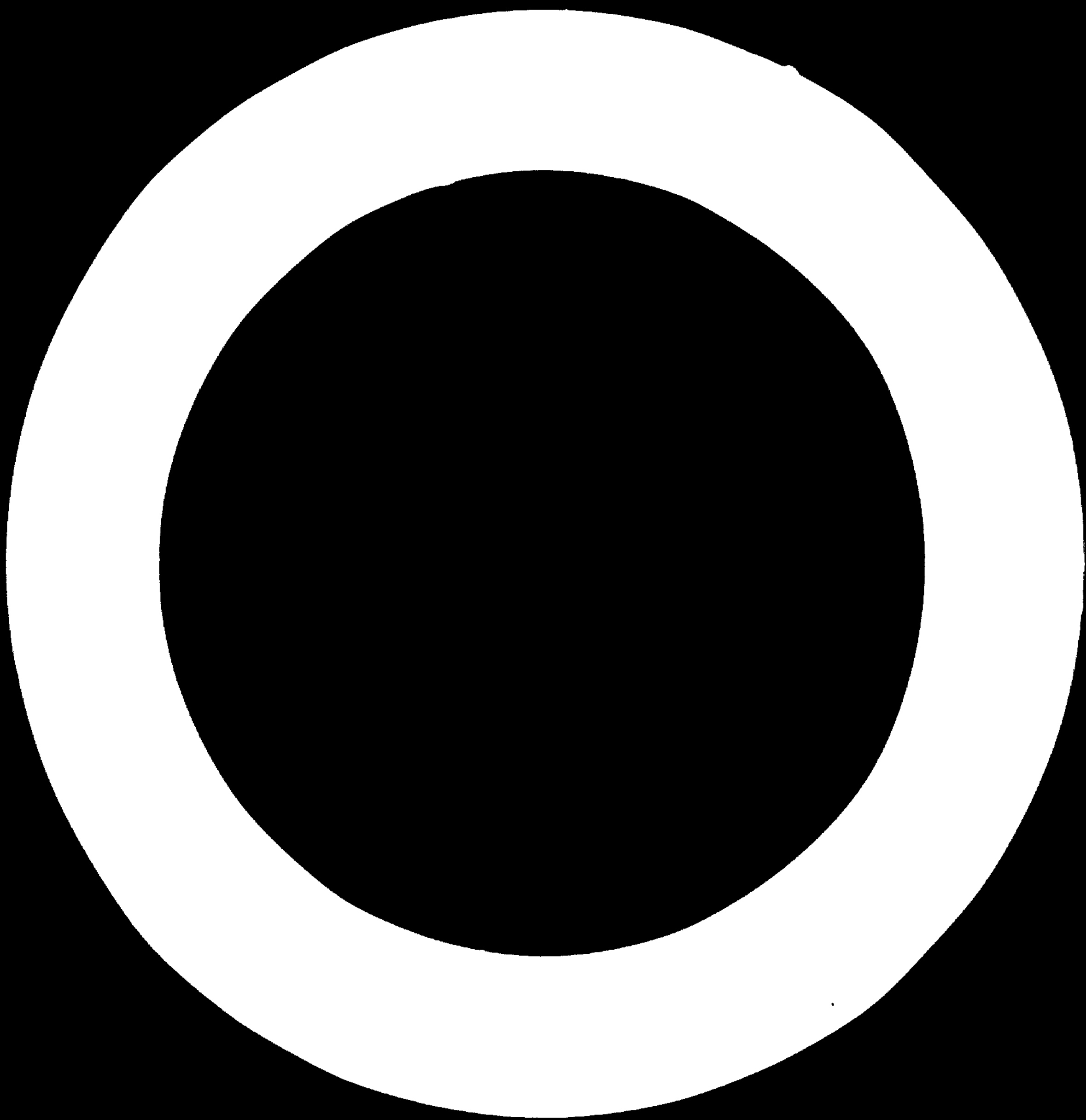
| Item | Characteristics and units in '000 | Construction period Quarters | | | | Output levels | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $Q_1$ | $Q_2$ | ... | $Q_n$ | $x_1$ | $x_2$ | ... | $x_n$ |
| A | Steam | | | | | | | | |
| | (a) Total requirements by plant divisions (t) | | | | | | | | |
| | (i) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) Total of (a) | | | | | | | | |
| | (b) Capacity of boiler | | | | | | | | |
| | (c) | | | | | | | | |
| B | Compressed air | | | | | | | | |
| | (a) Total requirements by plant divisions ($m^3$) | | | | | | | | |
| | (i) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) Total of (a) | | | | | | | | |
| | (b) Capacity of compressor | | | | | | | | |
| | (c) | | | | | | | | |
| C | Air conditioning | | | | | | | | |
| | (a) Total requirements by plant divisions | | | | | | | | |
| | (i) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) Total of (a) | | | | | | | | |
| | (b) Capacity of air conditioners (BTU/hr) | | | | | | | | |
| | (c) | | | | | | | | |
| D | Dust control | | | | | | | | |
| | (a) Total requirements by plant divisions ($m^3$/hr) | | | | | | | | |
| | (i) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) Total of (a) | | | | | | | | |
| | (b) Capacity of filters ($m^3$/hr) | | | | | | | | |
| | (c) | | | | | | | | |

(Planning of utilities other than power and water)

| Item | Characteristics and units in '000 | Construction period Quarters | | | | Output levels | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $Q_1$ | $Q_2$ | ... | $Q_n$ | $x_1$ | $x_2$ | ... | $x_n$ |
| E | Fuel | | | | | | | | |
| | (a) Total requirements by plant divisions (t) | | | | | | | | |
| | (i) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) Total of (a) | | | | | | | | |
| | (b) Types of fuel | | | | | | | | |
| | (i) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) Total of (b) | | | | | | | | |
| | (c) Sources of supply | | | | | | | | |
| | (i) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) | | | | | | | | |
| | (d) | | | | | | | | |
| F | Effluent disposal | | | | | | | | |
| | (a) Types and amount of materials of effluents | | | | | | | | |
| | (i) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) | | | | | | | | |
| | (b) Methods of disposal | | | | | | | | |
| | (i) | | | | | | | | |
| | ... | | | | | | | | |
| | (n) | | | | | | | | |
| | (c) | | | | | | | | |

Table 27: PLANNING FOR TRANSPORT FACILITIES

| Item | External and internal transport requirements and units in '000 | Construction period Quarters | | | | Output levels | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $Q_1$ | $Q_2$ | ... | $Q_n$ | $x_1$ | $x_2$ | ... | $x_n$ |
| A | Main raw materials (t) | | | | | | | | |
| B | Construction materials (t) | | | | | | | | |
| C | Auxiliary materials (t) | | | | | | | | |
| D | Supplies (t) | | | | | | | | |
| E | Fuels (t) (l) ($m^3$) | | | | | | | | |
| F | Others (e.g. water, rejections) ($m^3$) | | | | | | | | |
| G | Finished products (t) (No.) | | | | | | | | |
| H | Workers (daily) (No.) | | | | | | | | |
| I | Transport facilities (No.) | | | | | | | | |
| | (a) Passenger cars | | | | | | | | |
| | (b) Station wagons | | | | | | | | |
| | (c) Buses | | | | | | | | |
| | - hired | | | | | | | | |
| | - owned | | | | | | | | |
| | (d) Trucks | | | | | | | | |
| | - hired | | | | | | | | |
| | - owned | | | | | | | | |
| | (e) Tank-trucks | | | | | | | | |
| | - hired | | | | | | | | |
| | - owned | | | | | | | | |
| | (f) Railroad equipment | | | | | | | | |
| | (g) Water transport | | | | | | | | |
| | (h) Others (specify) | | | | | | | | |



# Chapter 14 Manpower

Estimation and evaluation of manpower requirements and availability are an essential part of industrial project formulation and appraisal since the availability of manpower has, among other factors, an important impact on the technical feasibility of the project. The planning of manpower should be looked upon in broad terms, covering the required managerial, administrative and engineering staff and the various types of works. In addition manpower planning should also outline the trading needs at the various stages of the development of the investment project.

## Scope of manpower assessment

Manpower planning for industrial projects involves a number of steps which should respond to the following queries:

a) General assessment of the demand and supply of manpower and especially labour in the area

b) appraisal of manpower and occupational skills available at national and regional levels in view of the skills and technological requirements of the project

c) a survey of the leading provisions of labour legislation covering industrial relations (individual and collective), wage levels, fringe benefits, procedures of recruitment and discharge.

d) estimation of manpower requirements of the project in the contexts of the selected technology, manpower availability and levels of productivity after providing for necessary reserves such as for leave and training.

e) estimation of the variations in manpower requirements for the planning (pre-investment) and construction period, start-up and commissioning and for the operational period at expected - or projected - variation in production levels (Table 28).

f) break-down of the manpower requirements by functions, levels, skills and shifts (Tables 29 and 30).

g) broad job descriptions of important personnel

h) indication of the basic prerequisites - educational and professional - of the personnel required

i) appraisal of manpower not locally available and to be supplied from external sources

j) estimation of the salary-wage levels of the manpower (male and female) required as well as of fringe benefits, social securiry costs, welfare costs, in order to arrive at total manpower costs, (Table 31 )

k) assessment of the on-the-job and external training requirements and facilities at home and abroad of the manpower during pre-production and post-construction periods

l) design of an indicative organizational chart showing lines of communication, delegation and control

The degree of detail required varies with the type of pre-investmnet study under preparation. Opportunity and pre-feasibility studies may only inidcate broad categories of personnel required, their numbers and total costs. A feasibility study should, however, specify each category of personnel preferably by shifts and levels of capacity utilizations, (Tables 29, 30 and 31)

A feasibility study should specify also the levels at which all the important personnel would be required to operate and the kind of experience and background they must possess

For studies involving very large investments, more details have to be provided on the personnel requirements such as levels of competence, qualifications, educational background and professional experience. In important cases, job descriptions may also be given.

The study should explore the sources of different kinds of personnel, internal as well as external, and the extent to which personnel has to be secured from collaborators and machinery suppliers. The requirements of expatriate personnel in terms of their skill levels and tenure should be clearly spelt out. The procedures for recruitment and training programmes are to be outlined with responsibilities assigned to specific positions.

When preparing the different tables related to manpower requirements of a feasibility study it should always be kept in mind that the ultimate objective of this exercise is not only to identify the labour force to be recruited and trained, but to calculate the total labour costs which constitute an important element of production costs. In this context it should be kept in mind that manpower costs should preferably divided into fixed and variable costs in order to facilitate the calculation of manpower costs at different levels of capacity utilization

## Management requirements

The timely provision of qualified managerial personnel at all functions within the establishment to be created is of utmost significance. Experience has shown that it is in most cases not too difficult to provide the financing for a project proposal and that even its implementation is not of such major difficulty if the project is e.g. delivered on a turn-key basis. Many investment projects which are today showing a poor performance suffer mainly from bad management. As the level of the feasibility study provision should therefore be made to obtain a clear picture about the needs of managerial staff. In many cases it was observed that the needs of locally recruited and expatriate managerial staff were not differentiated well enough in the feasibility study. As a consequence too many expatriates had to be recruited from abroad at the operating stage which in turn had a strong impact on the total manpower costs and the profitability of the investment project. Therefore, before approving a new project or a major extension, it should be known from where to get the managerial staff and at what cost. It is simply too costly to rely in this matter on remedial actions to be taken only during the operating phase of the project.

The lack of managerial skills at the technical, administrative and commercial levels can only partly be offset by training as frequently stipulated in the contracts with the suppliers of equipment. The lack of sufficiently long professional experience has therefore to be compensated in providing the above-mentioned expatriate staff either by direct individual hire or by management contracts with foreign companies. The selection of such firms may frequently cause problems not only from the cost point of view but particularly with regard to the expertise internationally available. A feasibility study should indicate the duration of foreign assistance needed, and its conditions: individual experts advising local counterparts or assuming full management responsibility or management contracts with foreign consulting firms. In answering the questions related to the management of the plant, the feasibility study should also provide an organization chart which indicates the levels of responsibility, the experience required, and the interrelationships between the various components of the organization. Since it is not the intention of this manual to outline the pros and cons of different organizational set-ups, only reference will be made in the bibliography to some literature in this regard.

## Labour requirements

A commonly observed mistake made in feasibility studies is the adoption of labour norms prevailing in industrialized countries. Although it should be a well-known fact by now that lacking skills and experiences, unfavourable climatic conditions, etc, lower the performance and productivity considerably, it can still be observed that the size of the labour force is frequently insufficiently planned. This deficiency is augmented by applying salary and wage rates which do not properly take account of social security regulations, family allowances, annual and sick leave, national holidays, etc prevailing in the country concerned. An omission of these important cost items frequently leads to unrealistically low labour costs which in fact in many developing countries do no longer exist. Low productivity, larger employment figures and comparatively high social costs have led to an increase of labour costs.

Low labour productivity results from the lack of skills. Feasibility studies must therefore consider training measures to be taken during the pre-production and the operating phases. The timing, the costs and the location of training activities have to be determined and provided for in a feasibility study.

In order to facilitate the calculation of labour costs, it is recommended to utilize pro-forma costs for the various skill levels which incorporate monthly wages or salaries, and fringe benefits, and social security contributions.

## Training

As already indicated above, one of the major constraints of industrial projects in developing countries is the lack of technical personnel and skills. Training programmes are therefore an indispensable and ubiquitous feature of most industrial projects.

Training may be organized at the factory, at other training institutes or similar factories in the country or abroad. The training at the factory may be provided by the managerial staff - both technical and others - at the higher levels by specially recruited experts and expatriate personnel the services of which may be provided by technical or operating collaborators.

The provision for training is required not only before the start-up operations: upgrading of skills and management development is a continuous process. The training requirements should be spelt out separately for the pre-production and operational periods to enable adequate provisions to be made under pre-production and operational costs.

The calculation of training costs should possibly be based on pro-forma costs incorporating wages/salaries, fringe benefits, social security contributions, etc. Travel costs and training fees should be calculated separately since they differ widely. Table 32 summarizes the training costs for the pre-production and operating phases.

Table 28 : MANPOWER REQUIREMENTS + COSTS DURING PRE-PRODUCTION PERIOD

| Item | Categories of personnel | Number | | Period of engagement in man months | | Monthly pro-forma costs * | | Total costs | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Local | Foreign | Local | Foreign | Local | Foreign | Local | Foreign | Total |
| A | Managerial | | | | | | | | | |
| | (a) See Table 30 A | | | | | | | | | |
| | (b) | | | | | | | | | |
| | ... Total of A | | | | | | | | | |
| B | Engineering | | | | | | | | | |
| | (a) Division/Dept. | | | | | | | | | |
| | (b) Division/Dept. | | | | | | | | | |
| | ... Total of B | | | | | | | | | |
| C | Technical | | | | | | | | | |
| | (a) Division/Dept. | | | | | | | | | |
| | (b) Division/Dept. | | | | | | | | | |
| | ... Total of C | | | | | | | | | |
| D | Administrative (econ.+comm.staff) | | | | | | | | | |
| | (a) | | | | | | | | | |
| | (b) | | | | | | | | | |
| | ... Total of D | | | | | | | | | |
| E | Workers | | | | | | | | | |
| | (a) Div/Dept.+skills | | | | | | | | | |
| | (b) " | | | | | | | | | |
| | ... Total of E | | | | | | | | | |
| | Total of A to E | | | | | | | | | |

* covers monthly salary/wage + fringe benefits + social security contributions

| Item | Plant - Departments | First shift | | | | Second shift | | | | Third shift | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Categories of skills | | | | | | | | | | | | | | | |
| | | S* | Sm | Us | T | S | Sm | Us | T | S | Sm | Us | T | S | Sm | Us | T |
| | **Note: specifications according to conditions prevailing** | | | | | | | | | | | | | | | | |
| A | **Production - processing departments** | | | | | | | | | | | | | | | | |
| | (a) Department I | | | | | | | | | | | | | | | | |
| | (b) Department II | | | | | | | | | | | | | | | | |
| | ... | | | | | | | | | | | | | | | | |
| | Total of A | | | | | | | | | | | | | | | | |
| B | **Auxiliary plants** | | | | | | | | | | | | | | | | |
| | (a) Product + material storage | | | | | | | | | | | | | | | | |
| | (b) Off-site transport | | | | | | | | | | | | | | | | |
| | (c) Utilities | | | | | | | | | | | | | | | | |
| | (d) Laboratory | | | | | | | | | | | | | | | | |
| | (e) Tool shop | | | | | | | | | | | | | | | | |
| | (f) Repair and maintenance | | | | | | | | | | | | | | | | |
| | (g) Cleaners, guards, etc. | | | | | | | | | | | | | | | | |
| | Total of B | | | | | | | | | | | | | | | | |
| C | **Administration** | | | | | | | | | | | | | | | | |
| | (a) Purchasing | | | | | | | | | | | | | | | | |
| | (b) Production planning + control | | | | | | | | | | | | | | | | |
| | (c) Finance and accounting | | | | | | | | | | | | | | | | |
| | (d) Personnel | | | | | | | | | | | | | | | | |
| | (e) Research and development | | | | | | | | | | | | | | | | |
| | (f) Sales, etc. | | | | | | | | | | | | | | | | |
| | Total of C | | | | | | | | | | | | | | | | |
| | Total of A to C | | | | | | | | | | | | | | | | |

* S: skilled; Sm: semi-skilled; Us: Unskilled; T: Total.

Table 30: MANNING TABLE: EMPLOYEES 1/ (for each production level)

| Item | Plant - Departments | First shift | | | | Second shift | | | | Third shift | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Categories of professions | | | | | | | | | | | | | | | |
| | | E* | Te | EC | T | E | Te | EC | T | E | Te | EC | T | E | Te | EC | T |
| A | Management | | | | | | | | | | | | | | | | |
| | (a) Board of directors | | | | | | | | | | | | | | | | |
| | (b) Production | | | | | | | | | | | | | | | | |
| | (c) Sales | | | | | | | | | | | | | | | | |
| | (d) Finance | | | | | | | | | | | | | | | | |
| | ... Total of A | | | | | | | | | | | | | | | | |
| B | Production - processing departments (same as Table 29 A.) | | | | | | | | | | | | | | | | |
| C | Auxiliary plants (same as Table 29 B.) | | | | | | | | | | | | | | | | |
| D | Administration (same as Table 29 C.) | | | | | | | | | | | | | | | | |
| | Total of A to D | | | | | | | | | | | | | | | | |

1/ In most cases only the "first shift" will be applicable

* E: Engineers; Te: Technicians; EC: Economic and commercial staff; T: Total

Table 31 : TOTAL MANPOWER COSTS (in 000)

| Item | Categories of personnel | Pre-production period in quarters | | | | | | Operating years | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | | 2 | | 3 ..... n | | 1 | | 2 | | 3 ..... n | |
| | | L | F | L | F | L | F | L | F | L | F | L | F |
| A | Managerial | | | | | | | | | | | | |
| B | Engineering | | | | | | | | | | | | |
| C | Technical | | | | | | | | | | | | |
| D | Administrative (econ.+comm.staff) | | | | | | | | | | | | |
| E | Workers | | | | | | | | | | | | |
| | (a) skilled | | | | | | | | | | | | |
| | (b) semi-skilled | | | | | | | | | | | | |
| | (c) unskilled | | | | | | | | | | | | |
| Total of A to E | | | | | | | | | | | | | |

NOTE: The manpower costs by categories of personnel for the pre-production period can be obtained from Table by converting the monthly into quarterly figures.

The manpower costs by categories of personnel for the operating years are obtained by multiplying the number of employees (Table ) and workers (Table ) by an annual pro-forma figure for salary wage costs. The pro-forma costs should be composed of salaries wages, fringe benefits, social security contributions, etc.

Table 32: TRAINING PROGRAMMES AND COSTS

| Item | Categories of personnel | Number | Period of training | Location | Pro-forma salary wages | Travel costs | Fees and other costs | Total costs | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | LC | FC | Total |
| A | Managerial | | | | | | | | | |
| | (a) See Table 30 A | | | | | | | | | |
| | (b) | | | | | | | | | |
| | ... Total of A | | | | | | | | | |
| B | Engineering | | | | | | | | | |
| | (a) Division Dept. | | | | | | | | | |
| | (b) | | | | | | | | | |
| | ... Total of B | | | | | | | | | |
| C | Technical | | | | | | | | | |
| | (a) Division Dept. | | | | | | | | | |
| | (b) | | | | | | | | | |
| | ... Total of C | | | | | | | | | |
| D | Administrative (econ.+comm.staff) | | | | | | | | | |
| | (a) | | | | | | | | | |
| | (b) | | | | | | | | | |
| | ... Total of D | | | | | | | | | |
| E | Workers | | | | | | | | | |
| | (a) Div/Dept.+ skills | | | | | | | | | |
| | (b) " | | | | | | | | | |
| | ... Total of E | | | | | | | | | |
| | Total of A to E | | | | | | | | | |

LC: local currency FC: foreign currency

# Chapter 15. Production costs

In chapter 10 a detailed description of the various methods of product costing was given with the objective of providing sufficient supporting data for the pricing policy and market strategy to be adopted for the products of the new investment project. In this chapter annual production costs will be discussed with a view of preparing the information required for the profitability analysis of the entire project. Two approaches are possible: discounting methods and those which do not take account of the time factor. Since the discounting method is the more realistic one, the scheduling of production costs should be done accordingly. For this purpose a number of schedules have to be designed in order to be able to forecast the profitability of a project until the end of its lifetime. The duration of these schedules and of the cash flow table has to be the same. The approach chosen in the Manual is to design the schedules as components which can easily be fitted into the cash flow table as will be seen further below. Chapters 12, 13 and 14 should be consulted in this context.

Based on the results of the market study and the limitations imposed by the chosen technology of bringing a new manufacturing establishment only gradually up to full capacity output, the following schedules are suggested:

- production schedule
- raw material consumption schedule (chapter 13)
- utilities consumption schedule (chapter 13)
- labour schedule (chapter 14)
- overhead cost schedule
- investment schedule: fixed assets, pre-production capital cost and working capital (chapter 12)
- sales schedule

This list can easily be expanded depending on the details required for the cash flow table. Such a breakdown has the advantage that the project planner is forced to review the evolution of each item of the cash flow table which may be a very useful exercise particularly in the case of reinvestment, e.g. vehicles, machines, etc., which have to be replaced periodically.

Prior to designing a cash flow table it should be understood that different types are being used by project planners depending on the objectives to be achieved. In order to avoid the confusion which is frequently met, the most common types of cash flow tables are presented:

- one for commercial profitability evaluation without outside financing (Table 33);
- one for commercial profitability evaluation with outside financing (Table 35)
- one for financial planning (Table 37)

All these cash flow tables (Tables 33, 35 and 37) start off with a production schedule although it is not a proper component which would be required for the actual computation of the flow of funds (sources and uses). It is, however, recommendable to insert the production schedule always as first line of the cash flow table as it constitutes the main guide to forecast the flow of all funds. Since it was proposed to prepare a number of schedules which are to be incorporated later on into the cash flow table, it is equally advisable to plan the other schedules also according to the production forecast.

Before setting up the various schedules it is appropriate to have a full comprehension about the major cost components and the way in which they vary with changes in production. Therefore the division of production costs into capital and operating cost respectively into variable and fixed costs is needed.

Capital costs are mainly composed of depreciation of fixed assets and of amortization of pre-production capital costs. In cash flow analysis they are, however, of no relevance since the investment costs are counted as an outflow of funds in the year they actually occur. Annual depreciation charges are consequently not to be included. Only break-even analysis and profitability criteria not applying the time factor (e.g. simple rate of return, payback period) and profit estimates include depreciation and amortization charges.

Operating costs are of course all costs related to the operation of the plant and include material, labour and overhead costs.

Variable costs or direct costs change in close proportion to variations in production. Typical variable costs are material, production labour and utility costs.

**Table 33:** **Cash flow table without outside financing** (in 000)

**(NOTE: This table is to be used to calculate the internal rate of return of the project)**

| | Construction | | Start-up and full production | | | | | Terminal value of A.1, A.3 |
|---|---|---|---|---|---|---|---|---|
| **Year** | 1 | 2 | 3 | 4 | 5 | ... | last year | |
| **(Production schedule)** | 0 | 0 | | | | | | |
| **A. Investment** (total) | | | | | | | | |
| **1. Fixed assets** (total) | | | | | | | | |
| **a. Land** | | | | | | | | |
| **b. Site development** | | | | | | | | |
| **c. Building + civil engineering works** | | | | | | | | |
| **d. Machinery + plant (new)** | | | | | | | | |
| **e. Idem** (replacement) | | | | | | | | |
| **f. Workshop + office equipm., tools** (new) | | | | | | | | |
| **g. Idem** (replacement) | | | | | | | | |
| **h. Spare parts** | | | | | | | | |
| **i. Incorporate fixed assets** | | | | | | | | |
| **2. Pre-prod. capital costs** (total) | | | | | | | | |
| **a. Prelim. + capital issue expenses** | | | | | | | | |
| **b. Pre-prod. expenses** | | | | | | | | |
| **c. Trial runs, start-up +commissioning costs** | | | | | | | | |
| **3. Working** capital | | | | | | | | |
| **B. Production costs (total)** 1/ | | | | | | | | |
| **1. Raw materials** 2/ | | | | | | | | |
| **2. Utilities** | | | | | | | | |
| **3. Labour** | | | | | | | | |
| **4. Overheads** | | | | | | | | |
| **a.** Production | | | | | | | | |
| **b.** Administration | | | | | | | | |
| **c.** Sales+marketing | | | | | | | | |
| **C. Corporate tax** (see supporting table 34) | | | | | | | | |
| **D. Sales** 3/ | 0 | 0 | | | | | | |
| **E. Cash flow** (D-A-B-C) | | | | | | | | |

1/ "Production costs" does not include depreciation; instead of depreciation allowances, the anticipated replacement expenditures are to be entered in A.1.e "Machinery and plant" (replacement). 2/ Annual purchase minus annual accumulation of materials inventory. 3/ Annual value of production of finished goods minus annual accumulation of finished goods inventory.

**Table 34: Supporting table to calculate the corporate tax**

| | Construction | | Start-up and full production | | | | |
|---|---|---|---|---|---|---|---|
| **Year** | 1 | 2 | 3 | 4 | 5 | ... | Last year |
| (Production schedule) | 0 | 0 | | | | | |
| A. **Sales** | | | | | | | |
| B. **Production** costs 1/ | | | | | | | |
| C. **Gross profit** (A-B) | | | | | | | |
| D. **Fiscal depreciation** | | | | | | | |
| E. **Taxable income** (C-D) | | | | | | | |
| F. **Tax** 2/ | | | | | | | |

1/ To be taken from table 33.

2/ According to the rules peculiar to the country, industrial branch - occasionally even company.

Table 35: Cash flow table with outside financing for investment (in 000)

(NOTE: This table is to be used to calculate the profitability of equity investment of the entrepreneur)

| | Construction | | Start-up and full production | | | | | Terminal value of A.1 |
|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | ... | last year | |
| (Production schedule) | 0 | 0 | | | | | | |
| A. Investment (total) | | | | | | | | |
| 1. Investment out of equity funds | | | | | | | | ( ) |
| 2. Financial charges (total) | | | | | | | | |
| a. Interest on loans | | | | | | | | |
| b. Repayment of loans | | | | | | | | |
| B. Production costs (total) 1/ | | | | | | | | |
| 1. Raw materials 2/ | | | | | | | | |
| 2. Utilities | | | | | | | | |
| 3. Labour | | | | | | | | |
| 4. Overheads | | | | | | | | |
| a. Production | | | | | | | | |
| b. Administration | | | | | | | | |
| c. Sales + marketing | | | | | | | | |
| C. Corporate tax 3/ (see supporting table 36) | | | | | | | | |
| D. Sales 4/ | 0 | 0 | | | | | | |
| E. Cash flow (D-A-B-C) | | | | | | | | |

**Table 36: Supporting table to calculate the corporate tax when interest payments have to be made**

| | Construction | | Start-up and full production | | | | |
|---|---|---|---|---|---|---|---|
| **Year** | 1 | 2 | 3 | 4 | 5 | ... | last year |
| (Production schedule) | 0 | 0 | | | | | |
| A. Sales | | | | | | | |
| $B_1$ Production costs 1/ | | | | | | | |
| $B_2$ Interest payments on loans | | | | | | | |
| C. Gross profit $(A-B_1-B_2)$ | | | | | | | |
| D. Fiscal depreciation | | | | | | | |
| E. Taxable income (C-D) | | | | | | | |
| F. Tax 2/ | | | | | | | |

1/ To be taken from Table 33.

2/ According to the rules peculiar to the country, industrial branch and occasionally even company.

Table 37: Cash flow table for financial planning (in 000)

| Year | Construction 1 | 2 | Start-up and full production 3 | 4 | 5 | ... | last year | Terminal value of B.1,B.3 |
|---|---|---|---|---|---|---|---|---|
| (Production schedule) | - | - | | | | | | |
| A. Source of cash | | | | | | | | |
| 1. Financial resources: total 1/ | | | | | | | | |
| 1.1 Loan 1/ | | | | | | | | |
| 1.2 Equity | | | | | | | | |
| 1.3 Suppliers' credits | | | | | | | | |
| 1.4 Subsidies | | | | | | | | |
| 2. Sales revenue: 2/ | | | | | | | | |
| B. Uses of cash | | | | | | | | |
| 1. Fixed assets (total) | | | | | | | | |
| 1.1 Land | | | | | | | | |
| 1.2 Site development | | | | | | | | ( ) |
| 1.3 Building + civil engineering works | | | | | | | | ( ) |
| 1.4 Machinery + plant (new) | | | | | | | | ( ) |
| 1.5 Machinery + plant (replacement) | | | | | | | | ( ) |
| 1.6 Workshop + office equipm., tools (new) | | | | | | | | ( ) |
| 1.7 Workshop + office equipm., tools (replac.) | | | | | | | | ( ) |
| 1.8 Spare parts | | | | | | | | ( ) |
| 1.9 Incorporate fixed assets | | | | | | | | |
| 2. Pre-prod. capital costs (total) | | | | | | | | ( ) |
| 2.1 Prelim.+ capital issue expenses | | | | | | | | |
| 2.2 Pre-prod. expenses 3/ | | | | | | | | |
| 2.3 Trial runs, start-up +commissioning costs | | | | | | | | |
| 3. Working capital (total) | | | | | | | | ( ) |
| 4. Production costs 4/ | | | | | | | | |
| 4.1 Raw materials 5/ | | | | | | | | |
| 4.2 Utilities | | | | | | | | |
| 4.3 Labour | | | | | | | | |
| 4.4 Overheads (product., administr. + sales) | | | | | | | | |
| 5. Debt services (total) | | | | | | | | |
| 5.1 Interest on loans | | | | | | | | |
| 5.2 Repayment of loans and credits | | | | | | | | |
| 6. Dividends + profit taxes paid 6/ | | | | | | | | |
| C. Surplus/Deficit (A-B) | | | | | | | | |
| Surplus/Deficit cumulative: 7/ | | | | | | | | |

1/ Loans of different terms should be shown separately. 2/ Annual value of production of finished goods minus annual accumulation of finished goods inventory. 3/ Not including interest during construction. 4/ "Production costs" does not include interests on loans and depreciation. Interests are entered in B.5.1 "Interest on loans". Instead of depreciation allowances, the anticipated replacement expenditures are to be entered in B.1.5 "Machinery and plant (replacement)". This table is arranged in such a way that internally cumulated profits and depreciation funds are not so isolated, but are absorbed into C. "Surplus/Deficit after being adjusted for yearly expenditures on the capital account (replacement expenditures and repayments of loans and credits). 5/ Annual purchase minus annual accumulation of materials inventory. 6/ This item stands for the part of profit which is to be paid out, namely profit tax, dividends, fees of the members of the executive board, managerial staff's share in profits, etc. Actually this sum will be established after allowances have been made for depreciation which are not included under item 4. (production costs). The cash flow balance should be programmed, therefore, in such a way that all necessary replacement (B.1.5) can be covered in any year by the cumulated surplus. 7/ This item should never become negative.

Fixed costs remain unchanged regardless of changes in the level of activity and include mainly overhead costs. Fixed costs are equally incurred on a time basis (e g long-term contractual services, rents, administrative salaries)

There are normally two other categories of costs which are only mentioned here but which are not being used in the forthcoming analysis. Semi-variable costs vary with the level of activity but not in direct proportion (maintenance costs are usually semi-variable since some maintenance work has to be done regardless of the level of activity, e.g. daily oiling of machines and periodical overhauling of plant and equipment) Semi-fixed costs remain fixed within a certain range of the level of activity and increase by steps at a given time (examples are: supervision, product inspection)

Taking fixed and variable costs into account, the breakdown of production costs looks as follows:

Variable costs:
- Variable operating costs:
  (direct) material
  (direct) labour and overtime and bonuses
  utilities
  packaging material
  sales and distribution costs

Fixed costs:

a) Fixed operating costs (mainly overheads):
   maintenance (contractual)
   factory rents
   factory insurance
   licenses
   wages, salaries, benefits, social security contributions,
   material and services consumed by own repair and maintenance,
   laboratories, off-site transport, stores, utility generation, etc.

b) Administrative overheads:
   salary, wages, benefits and social security contributions of administrative staff
   telephone and postage
   printing and stationery
   rents and rates for administration building
   water and lighting for administration building
   insurance and fire resk for administration
   building, office furniture and equipment
   maintenance cost of administration building
   vehicles and office furniture and equipment
   legal and audit fees
   entertainment and sundry expenses
   medical fees
   taxes: property tax, indirect business taxes

c) Capital costs:
   depreciation
   amortization

**Production schedule**

The first step in estimating production costs is the determination of production levels in terms of capacity utilization It is seldom possible to achieve full production in the initial period of operations Due to commercial, technological and managerial constraints, every project passes through a certain period of operational aberrations The frequently experienced problems are delays in infra-structural facilities, non-adaptation of feedstocks, manpower and equipment to conditions of adopted technology, delays in supplies of the right quality of feedstocks, problems of manpower recruitment and training and deterrents to market penetration by the new entrant

The problem of market penetration is almost ubiquitous It is very unlikely that the entire capacity production may be sold in the very first year of production It is therefore both prudent and necessary to start with a lower than capacity production Depending on the nature of the industry and local conditions, the project may be able to realize a production level only of 40% to 50% in the first year

The production level should rise in the second year but it is seldom possible to achieve full production even in the second year of operation. This does not, however, mean that many projects may not be able to start with full capacity production from the second year, at least in the later half of the year.

From the third year onwards, one may reasonably assume full capacity production unless there are overriding constraints, such as fierce competitive conditions in the market, non-availability of raw materials or technological deterrents. In India, for example, due to shortages of foreign exchange, the Government allocates, out of the imported asbestos fibre, only such quantities as would permit 75% utilization of the capacity of asbestos products industry Even this figure may vary with the prevailing foreign exchange position

From the third year, it is prudent to assume a level anywhere between 90 and 100% providing for short period oscillations and operational problems during the year, such as breakdowns or shutdowns. Some plants, however, are planned with a little additional built-in capacity, which is often ensured by machinery suppliers This is intended to give 100% rated capacity. In such cases, full production level may be assumed from the third year

Capacities can be measured both in terms of physical as well as monetary characteristics In physical terms it may be expressed by value of output (such as 10,000 passenger cars per month, 60,000 tons of aluminium per annum) or by volume of major input to be processed, such as fabrication of 100,000 tons of steel per annum. In cases of single product plants, the unit of capacity is not difficult to compute. For multiple product plants, a contribution analysis, product by product, and subsequent application of various programming approaches will help to arrive at the plant capacity consistent with demand and production constraints. For plants having varying market conditions for its divergent products, the assessed installed capacity will shift with one set of product-mix to another In controlled or semi-controlled economics, the manipulations may be limited by licensed capacities.

The determination of capacity may become extremely difficult if the product-mix is variable. In such cases, the capacity is best determined by a reference to the feedstock. Thus the capacity of a refinery is expressed in terms of the crude processing capacity In most cases, it would be discovered that the capacity may vary with the changes in the qualities of inputs. The capacity may also change with the product-mix.

Monetary values should be avoided as far as possible. Monetary values are a highly mercurial phenomena and unless constant prices are assumed, it may lead to highly distorted results Prices, however, change in different proportions for different products constituting the product-mix and assumption of a constant price structure may therefore be distorting.

For better comprehension and application of the capacity concepts, industrial projects may be divided into four classifications:

a) continuous single product processes like that of cement;
b) continuous multiple proudct processes, such as of an oil refinery;
c) batch/job order production for example, a fabrication and engineering organization;
d) assembly/mass manufacture, for example, automobile manufacture.

For determining the capacity of a plant producing a single homogenous product, it is necessary to develop the flow process chart identifying major steps involved in the process including transportation and storage. For cement, the major process or movement points are: quarrying, crusher, raw mills, silos for storage of slurry raw feed, pre-heater, coal storage, coal mills, kilns, clinker storage, cement grinding mill, cement silo, packaging machines and utilities like compressors. The process flow chart is necessary because the installed capacity of the most critical process is the installed capacity of the plant. Once the flow chart has been developed, it is easy to assign or determine the capacities of each step in the flow. This is best achieved by determining the material balances at each phase.

The capacities of manufacturing plants can generally be increased only in steps. A kiln for a cement plant has to have a minimum (economic) capacity, and therefore the addition of one kiln increases <u>ceteris paribus</u>, the capacity of the plant by the whole capacity of the kiln.

The design of the production schedule depends very much on the conditions prevailing in each project. Nevertheless, a brief schedule is proposed as a model.

<u>Production schedule (in 000)</u>

| Year | 1 | | 2 | | ... | | last year | |
|---|---|---|---|---|---|---|---|---|
| | Quantity | Value | Q | V | Q | V | Q | V |
| <u>Products</u> | | | | | | | | |
| $P_1$ | | | | | | | | |
| $P_2$ | | | | | | | | |
| $P_{...}$ | | | | | | | | |
| $P_n$ | | | | | | | | |
| Total | | | | | | | | |

Raw material consumption schedule

This schedule will include the estimated annual cost of all raw materials, components, auxiliary materials and supplies needed to achieve the production forecast. Chapter 13 is to be consulted in this connection as it contains all the relevant tables to calculate the cost of material inputs at various levels of output.

Factors of prime importance in estimating raw material costs are material yields, wastage, breakage and rejection ratios. The material yield is the coefficient indicating the quantity of raw materials required for each unit of output. The material yield coefficient takes account of the wastage factor but it should be ensured that losses in handling and leakages are adequately provided for. The rejection factor - the estimated quantity of output found to be sub-standard to give net sales of one unit of output - gives the quantity of output which needs to be produced to get the projected net sales. Breakages are an additional element of cost and must be assimilated in computing raw material costs.

For illustration, the case of an asbestos pressure pipes plant, may be taken. The ratio of cement and asbestos fibre per 100 tons of AC pressure pipes is 85:15 but in handling cement, 1.5% of the quantity is lost. The required quantity of materials required for production of 100 tons of pipes shall be approximately 101.5 tons, with 86.5 tons of cement and 15 tons of asbestos fibre. Every 100 tons of output also gives 10 tons of pipes of sub-standard size - less than 4 meters each. Half of the sub-standard pipes are saleable at 50% of the normal price and the other half at 25% of the price. In other words, to obtain the sales realization of 100 tons, additional production of approximately 3.75 tons will have to be made to provide for sub-standard size. This does not, however, provide for the breakage in transit and rejections by the customers. It is estimated that these two factors constitute a loss of 2.5% of the output. The total quantity of raw materials required therefore will be

Cement (100 + 2 + 3.75 + 2.5)% of 86.5 tons or 93.6 tons

Asbestos fibre (100 + 2 + 3.75 + 2.5)% of 15.0 tons or 16.2 tons

In identifying material costs, the three primary factors, apart from quantities, are the precise technical specifications, sources of supply and prices.

Every project analysis must provide for unforeseen contingencies. Several financial institutions in developing countries require a 5% provision for contingencies over the operational costs. The 5% level may assume very large proportions in substantially large projects. Here again, the analyst has to use his discretion. A provision varying between 2% to 8% should be considered the reasonable range from which to select the most appropriate figure.

Investment schedule

As mentioned earlier, it is the main objective of this chapter to deal with production costs in a way which enables the project planner to prepare the grounds for project evaluation with the help of discounting methods. Investment costs do normally not constitute a production cost item, but in the context of cash flow analysis they become an outflow of funds which has to be deducted from the sources of funds (e.g. sales, see Tables 33 and 35). It is therefore justified to discuss the contents of the investment schedule in this chapter.

A detailed description of how to compute fixed assets, pre-production costs, current assets and working capital was already given in chapter 12. Based on this information it is not too difficult to design the investment schedule for the cash flow table.

Most of the investment costs will occur during the construction period which in the three model cash flow tables is assumed to last for two years. During the start-up period (beginning with year 3 in the cash flow tables) only minor investments will occur. Of importance are, however, replacement investments which have to be undertaken in the course of the project. Typical replacements would be new automobiles, machines, major overhauls of machines, tools, etc. Replacements are frequently omitted in feasibility studies.

Reduced to its main elements, the investment schedule should take the following form as given below. The production schedule is only to be considered as example (Table 33).

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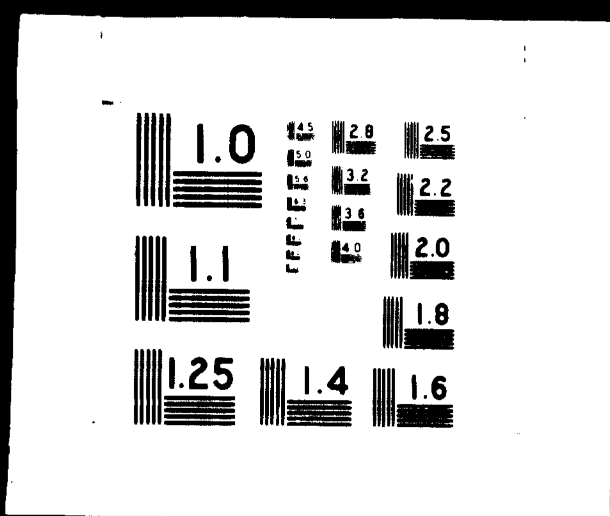


The cost items to be included in the operating and administrative overhead schedules are to be taken from the preceding listing of variable and fixed costs. Most of the items listed are self-explanatory with the exception perhaps of maintenance costs which may be computed by the direct or indirect method. The direct method is to identify the costs of materials, labour and services item by item. By the indirect method, one may apply a percentage figure to the total installed value of machinery. In some industries, replacement costs are an important factor. Some parts of the machinery last for quite a long time, while others have a short life-span. Thus in the case of a ceramics plant, relining of kilns involving substantial expenditure has to be carried out once every three to four years and has, therefore, to be provided for. These costs are to be located for all equipment and especially major equipment. For smaller items, the provision may be lumped together on a percentage basis.

As far as the sales and distribution overheads are concerned, the following cost items have to be covered:

- salesmen's salaries and commissions
- advertising cost
- sales literature - catalogues, price lists
- travelling and entertaining expenses
- sales production and product introduction costs
- wages, benefits and social security contributions of packers and drivers
- depreciation charges and running costs of delivery vehicles.

Escalations and contingencies

In some cases escalation of costs is necessary. Wages and salaries and maintenance and repair costs must be escalated from year to year by a fixed percentage or on any other rational basis or by actual estimates. The escalation here does not imply inflationary impacts.

Escalations in prices due to inflationary tendencies should be provided for if it is possible to make appropriate adjustment throughout the analysis. In the alternative, the estimates should be confined to prevailing prices. But, nevertheless, a clear qualification should be inserted in the study making it clear that the inflationary impacts have been ignored.

Every project analysis must provide for unforeseen contingencies. Several financial institutions in developing countries require a 5 provision for contingencies over the operational costs. The 5 level may assume very large proportions in substantially large projects. Here again, the analyst has to use his discretion. A provision varying between 2, to 8 should be considered the reasonable range from which to select the most appropriate figure.

## Investment schedule

As mentioned earlier, it is the main objective of this chapter to deal with production costs in a way which enables the project planner to prepare the grounds for project evaluation with the help of discounting methods. Investment costs do normally not constitute a production cost item, but in the context of cash flow analysis they become an outflow of funds which has to be deducted from the sources of funds (e.g. sales, see Tables 33 and 35). It is therefore justified to discuss the contents of the investment schedule in this chapter.

A detailed description of how to compute fixed assets, pre-production costs, current assets and working capital was already given in chapter 12. Based on this information it is not too difficult to design the investment schedule for the cash flow table.

Most of the investment costs will occur during the construction period which in the three model cash flow tables is assumed to last for two years. During the start-up period (beginning with year 3 in the cash flow tables) only minor investments will occur. Of importance are, however, replacement investments which have to be undertaken in the course of the project. Typical replacements would be new automobiles, machines, major overhauls of machines, tools, etc. Replacements are frequently omitted in feasibility studies.

Reduced to its main elements, the investment schedule should take the following form as given below. The production schedule is only to be considered as example (Table 33).

Table [illegible]: Investment schedule (in 000)

| | Construction | | Start-up and full production | | | | | Terminal |
|---|---|---|---|---|---|---|---|---|
| Year | [illegible] | 2 | [illegible] | 4 | 5 | ... | Last year | value |
| (Production schedule) | [illegible] | [illegible] | [illegible] | [illegible] | 90% | | | |
| 1. Fixed assets | | | | | | | | |
| 2. Pre-production capital costs | | | | | | | | |
| 3. Working capital | | | | | | | | |
| Total investment | | | | | | | | |

Sales schedule

Based on the results of the demand studies as outlined in chapters 9, 10 and 11, a detailed sales schedule has to be established. It is obvious that major inaccuracies can enter into the cash flow table at this very stage since changes in sales prices and quantities sold alter the value of sales and by the same token the main "source of cash". It goes without saying that the validity of the cash flow analysis is limited by the precision with which the data of its components were collected.

The above list of supporting schedules is by far not exhaustive, it would, however, go beyond the scope of this manual to present model tables for all eventualities. It is, e.g. obvious that sub-tables are required for the investment schedule in order to cover the various items of fixed assets in more detail. It is left to the responsible project planner to design such sub-tables himself.

In addition, it might be desirable to calculate the commercial profitability of the project not by applying discounting methods. In this case profit estimates have to be made preferably for the "normal" year of operation (See Table 39).

Table 39: Profit estimate (in '000)

| | Start-up and full production | | | | |
|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | etc. |
| Production schedule | 40% | 60% | 90% | 100% | |
| 1. Sales | | | | | |
| 2. -Variable operating costs | | | | | |
| 3. -Fixed operating costs | | | | | |
| 4. =Operating profit 1 - (2 + 3) | | | | | |
| 5. -Depreciation of fixed assets | | | | | |
| 6. -Amortization of pre-production capital costs | | | | | |
| 7. =Gross profit (4 - 5) | | | | | |
| 8. -Interest on debts | | | | | |
| 9. =Net profit before taxes | | | | | |
| 10. -Taxes | | | | | |
| 11. =Net profit after taxes (9 - 10) | | | | | |

## Chapter 16. Financial Planning

### Sources of finance

Once the total investment of a project has been computed and its structure analyzed, it is necessary to identify the sources of finance. A pre-investment study need not go into great detail of financial ramifications and scheduling; and yet it is imperative that a rational and practical plan of financing is designed and developed. A major constraint of industrial projects in developing countries is the shortage and shyness of capital, especially risk or venture capital.

Numerous financial institutions which emerged during the last quarter of a century intended to provide capital to new industrial project in public, joint and private sectors. As pointed out in earlier chapters of this manual, practically all developing countries have established some developmental financing institutions under diverse names, such as Industrial Finance Corporation, Industrial Development Bank. In most countries, there are more than one institution available for project finance. Larger countries have established financial institutions at different levels. Thus in India, financing institutions for new industry have been set up at the national level (such as the Industrial Finance Corporation of India, the Industrial Development Bank of India, the Industrial Credit and Investment Corporation of India) and at the state level, State Finance Corporations and State Industrial Development Corporations. There are other institutions catering to the requirements of small-scale industries.

Some of the national institutions provide foreign currency loans. The sources of foreign currency loans are international institutions, such as the World Bank (IBRD) and its affiliates, the International Development Association (IDA) and the International Finance Corporation (IFC), and national institutions in industrialized countries, such as the Export-Import Banks of the USA and Japan.

Many projects are financed by external sources of which some are international in character. For selected industries and against Government guarantees, loans are available from the World Bank (IBRD). For other projects, finances may be obtained from the International Finance Corporation, Export-Import Bank of the USA, of Japan and the like. There are commercial banks also operating on international or national level which provide or participate in term-financing. A model of how to outline the sources of finance is given in Table 40.

Table 40: SOURCES OF FINANCE

| Item | Sources of finance | Local currency | Foreign currency | Total |
|---|---|---|---|---|
| A | Promoters | | | |
| | a) Equity | | | |
| | b) Preference capital | | | |
| | c) Loans | | | |
| | d) Other forms such as deferred credits for supply of assets | | | |
| | Total of A | | | |
| B | Collaborators | | | |
| | a) Equity | | | |
| | b) Preference capital | | | |
| | c) Loans | | | |
| | d) Other forms such as deferred credits for supply of know-how or equipment | | | |
| | Total of B | | | |
| C | Financial institutions or developmental agencies | | | |
| | a) Equity | | | |
| | b) Preference capital | | | |
| | c) Loans | | | |
| | d) Other forms | | | |
| | Total of C | | | |
| D | Government | | | |
| | a) Loans | | | |
| | b) Subsidy | | | |
| | Total of D | | | |
| E | Banks | | | |
| F | Internal accruals | | | |
| G | Public subscriptions | | | |
| H | Suppliers | | | |
| | Total of A to H | | | |

## Structure of financing

The assistance available as institutional finance has grown to a point which makes it possible for new entrepreneurs to promote industrial projects with their own capital limited only to 10% to 20% of the total investment. Official developmental financing institutions in India, for example, frequently finance projects with a condition that the promoter's share is 15% of the project cost. For capital-intensive and basic industries, this limit is further reduced to 10%. A typical plan of financing a new industrial project is structured as follows:

Table 41: Financing Plan

| | Million $ | Million $ | % |
|---|---|---|---|
| **Equity capital** | | | |
| Promoters | 1.0 | | 10 |
| Foreign collaborators | 0.3 | | 3 |
| Public | 1.2 | 2.5 | 12 |
| | | 2.5 | 25 |
| **Preference capital** | | | |
| (Underwritten mainly by financial institutions) | | 0.5 | 5 |
| **Term loans** | | | |
| (Provided by financial institutions) | | 6.0 | 60 |
| **Bank borrowings for working capital** | | | |
| (Margin is required from equity capital) | | 1.0 | 10 |
| Total investment | | 10.0 | 100 |

## Other sources of capital

The investments of industrial projects may also be financed on deferred credit terms. Machinery suppliers of industrialized countries sell machinery on deferred payment terms with payments being spread over from one year to 15 years, with 6 to 10 year period very much in vogue. Deferred payment terms are available against bank guarantees which help the suppliers to obtain refinancing facilities from their bankers.

The investment may be financed partly by bonds and debentures. The market for bonds and debentures for new enterprises is limited But these industrial securities are frequently resorted to for expansion projects of existing industrial establishments.

The residual capital requirements must be met out of investors' direct investments These fall into two categories the share of promoters or principal investors - including foreign collaborators, and the share of public investors. The capital can be of different kinds, such as equity and preference Preference capital normally carries a fixed rate of dividend and limited voting rights The preference shares are cumulative or non-cumulative (in terms of dividends) and redeemable or non-redeemable. The redemption period varies between 5 and 15 years. Equity capital is the real venture capital and forms the basis of a project. Once the investment project has become operational, internal financing may be envisaged through retained profits, depreciation and accumulated reserves

<u>The problem areas</u>

The unconventional financial pattern now being adopted to finance industry raises a number of significant questions with direct bearing on the commercial validity of the project There are four distinct problem areas:

i) relative costs of capital deployed - or the identification of the most economic mode

ii) feasibility of obtaining - or availability of - capital on the designed basis

iii) consistency with public policy and regulations;

iv) maturity, redemption or repayment schedules geared to project cash flows.

The problem-areas establish the need to develop a financing pattern which (i) conforms to official and semi-official regulations (such as of stock exchanges), (ii) is practical, (iii) is consistent with the cash flow projections, and (iv) is the most economical from the point of view of the investors

Loan financing

It has been found that, barring exceptions, loan financing is the most preferable mode of financing a new project. It continues, by and large, to be the most economical and in developing countries the most easily available source. Borrowings are available at rates which are lower than the return one expects on venture capital. The higher the proportion, therefore, of borrowings, the higher shall be the return on venture capital. It is not merely the cost but also its relatively easy availability - against the deficient and hesitant supply of venture capital - that makes this source an attractive one. The loan capital is unfavourable only from one point of view: its cost is constant even when there are inadequate profits.

In view of the availability and cost of borrowings, the financial schemes may best start by identifying the amount for which loan capital can be secured. The loan capital is split up into two parts:

i) borrowings from commercial banks for working capital purposes, and
ii) term borrowings mostly from developmental financial institutions, public or private, national or international.

Short-term borrowings from commercial banks are available against hypothecation or pledging of inventories. The limits to which inventories are financed by commercial banks are fixed by each bank for each client company depending on the banking usage in the country, the nature of the candidate project and of the inventories and the creditworthiness of the company (and its management). The limits normally vary between 50% and 80% with the margin of 20% to 50% of the inventories and production costs to be financed by venture capital.

Bank borrowings for working capital are estimated on the basis of the requirements of the first year operations. It will be found that from the second year, there would be normally enough cash flows generated out of depreciation and no increase in bank credits would be needed although the level of output would continue to increase. Indeed, the project would soon generate surplus funds which would dispense with the requirements of bank borrowings for working capital purposes.

In a dry cell batteries project with a capacity of 60 million dry cells per annum, the working capital and commercial bank financing was computed on the following basis:

| Inventories of | Inventory/Cost requirements | Bank financing |
|---|---|---|
| Imported materials and components | 4 months | 70% |
| Indigenous materials and components | 2 months | 60% |
| Process stock (priced at 50% of sale) | 10 days | 60% |
| Finished goods | 10 days | 75% |
| Consumable stores | 3 months | 60% |
| Salaries and wages | 1 month | - |
| Power, fuel and water | 1 month | - |
| Miscellaneous expenses including maintenance | 3 months | - |

The computation of working capital requirements and financing adopted in an asbestos pressure pipes project is set out in Table 41. It may serve, when read with the supplementary notes, as a possible guide.

In providing for loan financing, certain norms pertaining to capital market usages and State regulations must be borne in mind. Loan financing is available with certain restrictions, such as on convertibility of shares, declaration of dividends and the like. Apart from these, certain ratios in the capital structure of the company have to be maintained. An equity-debt ratio of 1:1 is considered ideal but financing of many projects may be designed on the basis of 1:2 ratio. Between equity and preferential capital as well, certain basic ratios have to be maintained. These normally vary from 2:1 to 4:1. Incidentally, these ratios have nothing to do with return-optimality. These are matters dictated by conventions as financially sound and prudent. By cost of finance, for example, debt is normally preferable to preference capital, but one may find it imperative to resort to preference capital. Interest is allowed as a cost item for purposes of taxation, while dividend is payable out of the residue after the payment of corporate taxes.

Table 41: **WORKING CAPITAL REQUIREMENTS OF AN ASBESTOS PRESSURE PIPES PROJECT**

| COMPONENT NAMES OF WORKING CAPITAL | REQUIREMENT/ADJUSTMENT BY PERIOD | BANK MARGIN | FIRST YEAR PRODUCTION | | | CAPACITY PRODUCTION | | |
|---|---|---|---|---|---|---|---|---|
| | | | TOTAL REQUIREMENTS | BANK FINANCE | MARGIN REQUIRED | TOTAL REQUIREMENTS | BANK FINANCE | MARGIN REQUIRED |
| 1. Raw Material | | | | | | | | |
| a) Cement | 4 weeks | 30% | 2.04 | 1.43 | .61 | 5.10 | 3.57 | 1.53 |
| b) Asbestos Fibre | 5 months | 20% | 28.95 | 23.16 | 5.79 | 72.38 | 57.90 | 14.48 |
| 2. Consumable Stores | 6 months | 50% | 2.16 | 1.08 | 1.08 | 4.80 | 2.40 | 2.40 |
| 3. Wages & Salaries | 4 weeks | 100% | .56 | - | .56 | 1.68 | - | 1.68 |
| 4. Cost of fuel, light power and taxes | 4 weeks | 100% | .55 | - | .55 | .78 | - | .78 |
| 5. Repairs & Maintenance | 4 weeks | 100% | .55 | - | .55 | .85 | - | .85 |
| 6. Packing & Sales Expenses | 4 weeks | 100% | 1.86 | - | 1.86 | 4.73 | - | 4.73 |
| 7. Stock of finished goods at cost | 6 weeks | 30% | 16.24 | 11.36 | 4.88 | 42.84 | 29.99 | 12.85 |
| 8. Debtors | 3 weeks | 30% | 8.12 | 5.18 | 2.44 | 18.38 | 12.83 | 5.49 |
| 9. Contingencies | 3 weeks | 30% | 8.12 | 5.18 | 2.44 | 18.38 | 12.83 | 5.49 |
| TOTAL | | | 66.55 | 47.30 | 19.85 | 169.73 | 119.52 | 50.21 |
| 10. Less Creditors | | | - | - | - | - | - | - |
| FINAL TOTAL | | | 66.55 | 47.30 | 19.85 | 169.73 | 119.52 | 50.21 |

Supplementary notes to Table 41

1. Bank margins mean that no bank financing for these is available, and therefore fixed capital investment has to be found for the part of the working capital

2. Cement is available against government permits - due to overall shortages in the country, but the supplies are obtained from the factories in close proximity.

3. Asbestos fibre is imported Due to foreign exchange shortages, the State Trading Corporation imports the fibre and a Government agency, Directorate General of Technical Development, recommends the allocation. The inventories, therefore, have to be very large.

4. Inventories of materials and current expenses are also included in inventories of finished goods. Finished goods are to be valued on cash-cost basis. Inventories of finished goods include a small period covering goods in transit: 98% of the payment is received against the despatch document called the R/R or Railway Receipt.

5. Debtors or receivables have been provided on the basis of the payment usage of the buyers who in this case are Public Health Departments of the State Governments

6. No inventory on spare parts has been provided for since two years' requirements are included under the turn-key contract.

7. No credit for creditors has been taken since the present system of supplies of cement and asbestos fibre does not permit this facility

8. The 100% figure under bank margins means that banks do not give any credit against these components of costs. Bank margins on all items except debtors, receivables or bills are on cost basis. In the two exceptional cases, these may be on invoice value.

## Alternative modes

Financial planning has not been dealt with in great detail in this manual. It is often quite an intricate process. One must be fully aware of the local possibilities of various financing substitutes and the conditions attached thereto. The components may have to be varied when project economics are studied. The financial results of the undertaking might show that it would be more fruitful and necessary to change the proportions of the various components of capital originally estimated or provided for.

For public sector projects, a bulk of the capital requirements is provided by the Government unless the industry - as in a few exceptional cases - is established in collaboration with a foreign company, a foreign government or as a joint sector project in participation with a domestic company. The governments, however, in developing countries do resort to credit facilities internationally available either in the form of suppliers' capital or as loan from internationally operating financial institutions. External financing is required invariably for procurement of technical know-how and processes, external services and equipment.

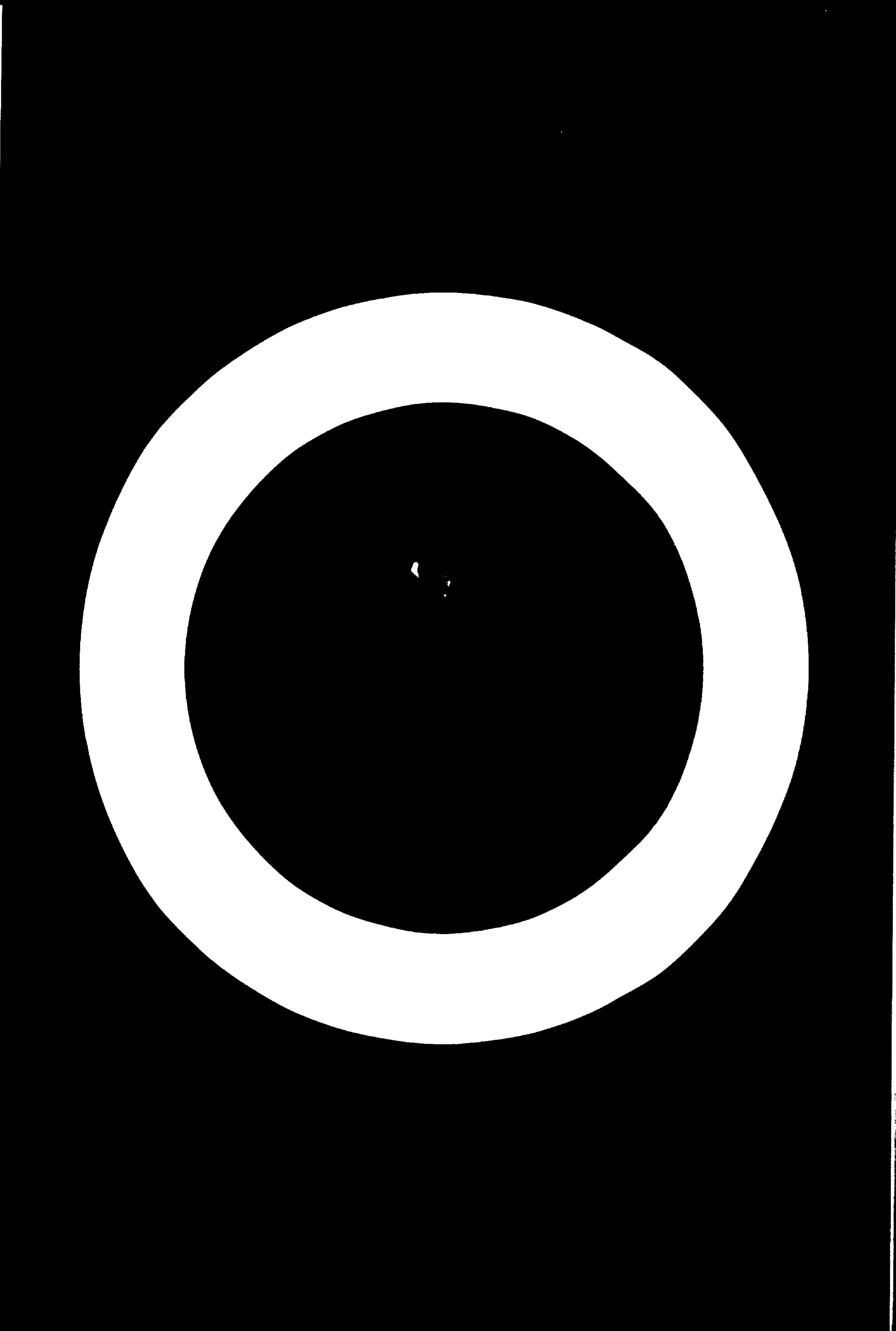
## Funds flow scheduling

An integral part of the financing plan is the scheduling of financial inflows and outflows. The two streams have to be synchronised if large losses in terms of interest (arising out of idle funds) or of delays in project implementation (as a result of financial bottlenecks) are to be avoided. These losses may be staggering in dimensions. At the pre-investment stage, however, it is sufficient to plan fund flow on quarterly or for small projects on half yearly basis.

## Cautions in financial planning

As a consequence of scarcity of capital, it is the general tendency of unenlightened or inexperienced promoters to maintain in the pre-investment studies the project outlays and financial resources as low as possible. A project analyst should resist the temptation of pleasing the sponsors of the study by the low figures. Bad financial planning in pre-investment studies will clog the progress of the project either at the stage of obtaining clearance of the financial institutions or at an even more crucial stage of project implementation.

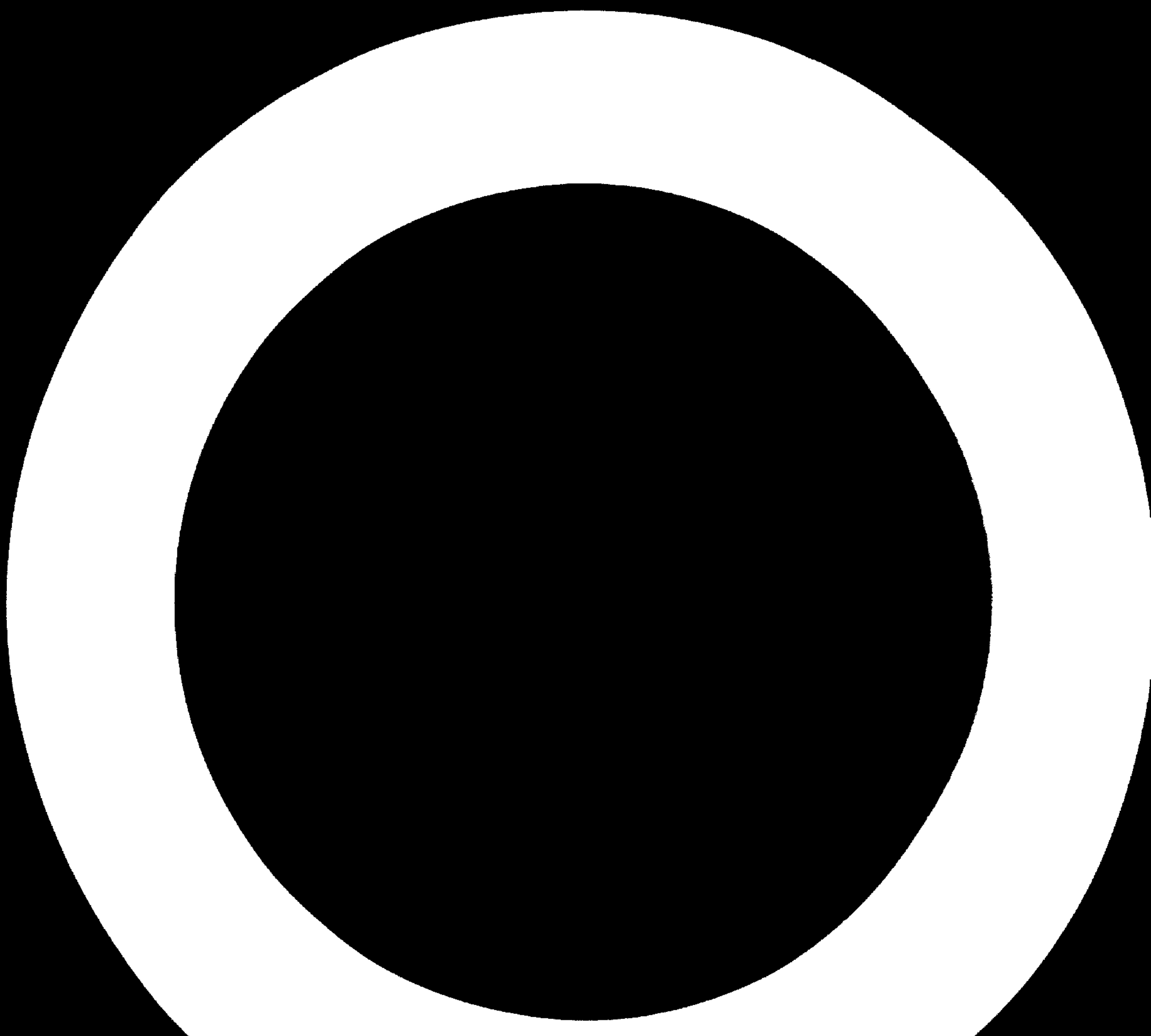
Every pre-investment study must consider and provide for alternative modes of financing and endeavour to develop contingency plans.



# PART IV. COMMERCIAL PROFITABILITY EVALUATION

## Chapter 17. Methods of commercial profitability evaluation

(Under preparation)



# A QUESTION-BASED CHECK-LIST FOR THE PREPARATION OF INDUSTRIAL TECHNO-ECONOMIC FEASIBILITY STUDIES

(NOTE: This checklist does not cover opportunity and pre-feasibility studies).

## General

G-1 Who is the sponsor of the project? What is his constitution? What are the management's industrial background and credentials?

G-2 Are the resources of the sponsor adequate for the project?

G-3 In the case of the sponsor of the project being an existing industrial establishment, what is its size? What has been its performance in the recent years?

G-4 Who has sponsored the subject techno-economic feasibility study? What shall be his role in the establishment of the project-establishment? What is his relationship with the sponsor of the project?

G-5 Who has prepared the subject techno-economic feasibility study? What are his or their technical and professional background and experience of the subject industry? Is their competence adequate for the size and complexity of the project involved?

G-6 Has the basic nature of the project been identified: (a) a new unit, (b) expansion of an existing unit, (c) diversification of product-mix, (d) modification of or switch over to a new technology or process, (e) swith over to a new raw material (e.g., from coal to naphtha for a fertilizer plant or chemical pulp to bamboo for a paper plant), (f) shift in location of an existing plant, (h) backward or forward integration, (i) rehabilitation or replacement of depreciated or obsolete machinery?

G-7 Does the product fit in with the priorities assigned and targets fixed under national, regional and sectoral plans?

G-8 Does the project fit in with the licensing and related policy considerations of Government?

G-9 Has it been examined whether the industry would be approved (or licensed) by the Government considering its size, location and other relevant factors?

Location (Chapter 5)

L-1 Is the location selected on pure techno-economic considerations? Do socio-political factors override such considerations?

L-2 Has national policy on balanced dispersal of industries been taken into account in making the locational choice?

L-3 In selection of the location, have considerations of environmental pollution and especially effluent disposal been taken into account?

L-4 If effluent disposal is a problem, has effluent treatment been provided for?

L-5 In selecting the site, have contours of the land been plotted?

L-6 If the land is not suitable for factory and related facilities, has provision been made for site development including landscaping for technical and aesthetic considerations?

L-7 Has it been examined that the land might require more than normal foundations and atmospheric control conditions?

## Transport (Chapter 5)

Tr-1 Has a thorough enquiry been made for phased availability of transportation facilities fo the movement of

(i) raw materials,
(ii) auxiliary materials,
(iii) packaging materials,
(iv) finished products,
(v) effluents,
(vi) manpower

Tr-2 Have adequate provision such as for cranes, been made for internal handling of

(i) raw materials,
(ii) work-in-process,
(iii) wastes and rejects,
(iv) products.

Tr-3 In the case of bulk materials, has provision been made for bulk handling of products?

Tr-4 If public transportation system is not adequate and if the conditions envisaged so require, has provision been made for the project's own transport fleet consisting of cars, lorries, buses, vans, tank-trucks, railway wagons?

Tr-5 Has transport equipment such as demonstration vans for product sales promotion been provided for?

Market study (Chapters 8, 9, 10)

Mk-1 Has the methodology of market and demand analysis been adequately delineated in the report? Are there any gaps or unexplained assumptions? Are the gaps and assumptions substantial? If yes, have discounts been provided for or qualifications made to the conclusions?

Mk-2 Has the nature of the candidate commodity (consumer durable or non-durable, intermediate or capital goods) defined and taken into account in developing the methodology?

Mk-3 Has the sectoral relationships of the candidate project been noted: public, private, joint or co-operative sector?

Mk-4 Have the characteristics of the market structure (such as monopolistic or monopsonic) been diagnosed? If structural market aberrations are identified, have appropriate techniques been applied and necessary adjustments made for them in market and demand analysis?

Mk-5 Have the behavioural market characteristics (such as controlled distribution) been identified? Have necessary adjustments been made for them in making the demand appraisal?

Mk-6 Were all the relevant and significant determinants of demand identified?

Mk-7 Have the correlations been established between the quantifiable determinants and the size of demand?

Mk-8 Have the growth dynamics of the market been identified - such as likely intensification of competition, diversification of product-mix, relaxation of government regulations?

Mk-9 Has it been visualized that new units might be established and especially after the candidate project becomes successful?

Mk-10 In analyzing demand trend, have distinctions been noted between
(i) consumption and demand (consumption + unsatisfied demand),
(ii) apparent consumption and consumption
(iii) demand and apparent demand,
(iv) demand and effective sales or sales potential?

Mk-11 Have adequate adjustments been made in assuming the price of the product after providing for likely changes such as inflation, changes in customs duties, injection of new competition?

Mk-12 In reckoning probable prices of the product, have adjustments for abnormal factors (such as seasonal variations) been taken into account?

Mk-13 What is the price-cost relationship?

Mk-14 In assuming export prices, have discount been made for special packaging, freight - internal and external, insurance, export and import duties, forwarding and clearing costs

Mk-15 Have market or price leaders been located? What has been their role in the past? What response does the project anticipate from them?

Mk-16 Have any reference determinants from equally placed - such as by per capita incomes - or from unevenly developed economics been simulated? If yes, were adequate discounts made?

Mk-17 Were the income and price elasticities of demand determined? If yes, have these been adequately applied in estimating the demand?

Mk-18 Have the impacts of the new entrant - the candidate project - on market and price dynamics been visualized and provided for? Has it been assessed, for example, that the existing producer or group of producers might offer resistance by way of under-cutting?

Mk-19 Has the risk of technological development in the product market been assessed and provided for?

Mk-20 In projecting the trend, has it been noted that abnormal change in size of demand might have occurred during the latest period? If such abnormality is discovered, has adjustment been made in starting from a new identified base - such as the average of the last three years?

Mk-21 Are any cyclical or other rythmical fluctuations discovered in the demand curve? If yes, have these fluctuations been duly provided for in the projection period?

Mk-22 Has the market been dissected for divisions into segments or group of segments? Have the characteristics - and aberrations - of each market segment been noted? If yes, have the characteristics and aberrations been provided for in the market analysis?

Mk-23 Were the market sensitivities in the following and other areas determined: market prices, product quality, emergence of substitutes, introduction or intensification of foreign competition, expansion of the market horison, variations in customs tariff? Has the demand analysis extended by sensitive analysis on the basis of the expected sensitivities?

Mk-24 Is the market more determined by import substitution or export promotion or both? Has the country's industrial strategy been properly considered when conceiving the project?

Mk-25 In case the product is an intermediate product or a capital good, have the appropriate methods of demand projection been used?

Technology and equipment (Chapter 11)

T-1 Were alternative processes and technologies considered?

T-2 Are the selected process and technologies commercially proven?

T-3 In cases of newer processes or technologies, is the experience of other plants known?

T-4 Are the selected process and technologies suitable for the candidate size of the plant?

T-5 Have recent/potential trends in technological developments been traced/projected?

T-6 Were the leading factors in selecting the process and technology identified:

(a) raw materials availability and their location,
(b) size,
(c) requirements of utilities,
(d) transportations costs,
(e) skill requirements,
(f) maintenance facilities,
(g) foreign exchange content of capital costs,
(h) recurring foreign exchange costs?

T-7 Were possibilities of alternative raw materials examined?

T-8 Have the raw materials been tested?

T-9 Have the technical specifications been analyzed and outlined? Have the standard specificaitons, if available, been recounted?

T-10 Do the raw materials selected conform to the process and technologies selected?

T-11 In selecting the site, were preliminary investigations made by test boring and soil tests? Were contours delineated?

T-12 Is the location selected economically and technically justifiable after examining:

(i) technical requirements of the plant,

(ii) proximity of raw material supplies,

(iii) proximity of market,

(iv) adequacy of transportation facilities,

(v) cost of transportation of raw materials and finished products,

(vi) adequacies of utility supplies.

(vii) convenience of effluent disposal?

T-13 In selecting the location, were the meteorological conditions, if relevant, taken into account?

T-14 Is the capacity adequate for packaging of materials?

T-15 Have normal spare part requirements been established realistically after examining the possibilities of their local availability and bottlenecks in their procurement from the domestic market or from abroad?

T-16 Were emergency supplies of critical spare parts required for probable breakdowns planned for?

T-17 Has an exhaustive list of spare parts been prepared and included in the report?

T-18 Has an assessment been made for the nature and scope of guarantees from:

(i) know-how and process suppliers,

(ii) process vendors,

(iii) technical collaborators,

(iv) engineering firms,

(v) machinery suppliers,

(vi) construction contractors,

(vii) erectors,

(viii) turn-key contractors,

(ix) operating collaborators?

T-19 Are the guarantees (under T-18) adequate? What are the risks involved? Have the compensations considered adequate for defaults been assessed?

T-20 Has it been examined whether the technology and process may involve acquisition of a patent or patents, know-how (requiring lump sum or royalty payments), market restriction?

T-21 Has adequate provision been made for maintenance facilities?

T-22 Has provision been made (or appraised) for ancillary production, such as of saggers for a ceramic plant, dies for metal casting and fabrication plants?

T-23 Have adequate testing and laboratory facilities been provided for?

T-24 Have adequate testing and quality control requirements been envisaged such as gauges, testing instruments?

T-25 Would the plant require outside testing facilities? If yes, are they available? Would they require special arrangements with external agencies? Have these been provided for?

T-26 If quality control inspection by bulk consumers necessary, has provision been made for it?

T-27 Has it been examined that the raw materials and components may have to conform to prescribed standard specifications?

T-28 Has it been examined that the designed products conform to the prescribed standard specifications?

T-29 Does the plant and equipment conform to safety and related regulations, factory and labour legislation and conventions?

T-30 In computing capacity, has reference been made to working hours per day and working days per year?

T-31 In fixing the working days per year, was discount made for statutory holidays, down-time requirements for preventative maintenance and breakdowns?

T-32 Has it been assessed that the selected process/technology is not too sophisticated for the selected size of the plant, the available skills, manpower and maintenance facilities?

T-33 In plants which are supposed to achieve fully the finally planned capacity over a period of time, have the acquisition of machinery and equipment and construction of buildings been rationally phased over to achieve the maximum advantage of size while making minimum investments in the initial years?

T-34 Has the optimum plant size been determined other than the process? Having established the gap in the market, one needs to fit the plant size in order to reach lowest unit production cost, sometimes providing over-capacity, to cater for a future growth in demand.

## Investment (Chapter 12)

I-1 In estimating the price of land, has the basis on which the land is to be obtained visualized: (i) freehold land available from a private owner, (ii) freehold land to be alloted by the governmental or local authorities such as a municipal corporation, (iii) leasehold land from a private owner, (iv) leasehold land from development authority, (v) rented land?

I-2 In the case of leasehold land, is the term of the lease long enough for the life-span of the project?

I-3 Are any developmental costs such as for access roads involved in siting the factory at the selected land? Have these been provided for?

I-4 In calculating land cost, have estimates of legal and related costs for transfer of land been included?

I-5 In estimating the cost of land, has a margin been provided for likely increase in price occasioned by the establishment of the candidate project itself?

I-6 Does land cost include site investigations, soil surveys, boring tests, clearing and site development, cost of demolition of old or unrequired structures existing on the land?

I-7 Do building estimates include:

(i) civil and architectural engineering fee and costs;

(ii) all required buildings, step by step and function by function, as outlined in the technical part of the report,

(iii) ancillary buildings such as laboratory, maintenance workshops, time and security office, electric substation:

(iv) fencing, internal roads, parks, parking lots;

(v) housing, staff and workers welfare and recreational facilities.

I-8 In making estimates of building costs, has reference been made to the precise specifications of different sections of the buildings?

I-9 Are foundation costs adequate considering the broad specifications of the foundations?

I-10 Do the civil works costs estimates include, besides foundations, the water storage and supply facilities, drainage and sewage, effluent disposal system?

I-11 Are the buildings and civil works costs realistic in the context of prevailing rates of construction, prices of construction materials and design specifications of the buildings?

I-12 Are the cost estimates based on some reliable quotations? Where the estimates are based on first enquiries or preliminary quotations, have these been adjusted/amended?

I-13 In preparing the building designs and layouts, has adequate provision been made for anticipated and likely expansion by way of (a) increase in capacity, (b) diversification of products, (c) vertical-backward and forward integration?

I-14 Do the buildings plans conform to considerations of technology, safety, hygiene, aesthetics, environmental purity?

I-15 Do the building plans conform to regulations under factory and labour legislation, building conventions and standard specifications, regulations of local authorities, such as of municipal corporations?

I-16 Has it been examined that raw materials or products or both may be hazardous or obnoxious materials and may require special conditions of storage?

I-17 Do building specifications conform to acceptable conditions of insurers?

I-18 Do the buildings have the necessary load bearing capacities?

I-19 Does the project require atmospheric control? If yes, has necessary provision been made for it in the design of the building?

I-20 In preparing the layout, has adequate space been provided for storage of finished products in bulk and in packages?

I-21 Does the layout envisage the minimum movement of materials?

I-22 For reason of economy in building costs, has the building been divided into sections with variable specifications?

I-23 Are the foundation designs and specification adequate for the machinery and equipment? Or are they over or under-designed?

I-24 Has water tankage been provided for?

I-25 Have adequate provisions been made for and spelt out for the following:

(i) internal roads,
(ii) drainage and sewage,
(iii) administrative offices,
(iv) security office,
(v) utilities,
(vi) housing for emergency staff,
(vii) locker , washroom and other facilities for workers,
(viii) canteens and other social welfare facilities?

I-26 In case the plant is to be located in outlying site, has adequate provision been made for social and welfare facilities such as

(i) hospital and clinic,
(ii) educational facilities,
(iii) recreational facilities such as an auditorium, swimming pool, play grounds?

I-27 What is the source of estimates of machinery and equipment? Has it been cross-checked?

I-28 Do the machinery and equipment estimates include:

(i) Overseas freight, insurance export and import customs, forwarding, clearing and handling costs, the basis varying with the types of quotations, f o b , f o b destination, c i f , delivered cost, f o r , erected cost or turn-key, (ii) internal transportation, local taxes, handling and insurance costs?

I-29 Do costs of machinery and equipment include those of essential spare parts, necessary instrumentation?

I-30 In estimating the cost of machinery, has the equipment for the following been included:

(i) utilities, including power generation (if necessary), transformers, switches gears, etc water treatment and pumping;

(ii) effluent treatment and disposal;

(iii) laboratory and testing equipment;

(iv) maintenance workshops equipment, including those for buildings, civil works, electric installations, utilities, and transport equipment

(v) fire-fighting equipment.

I-31 Have investigations been made to assess the requirement of off-plant infrastructural facilities such as (i) link or access roads, (ii) railroad lines and siding including loading and unloading facilities, (iii) harbour or dock facilities, (iv) bulk handling or pumping facilities, (v) electric power generation plants (such as in the case of aluminum plants), (vi) electric substations, (vii) link transportation lines, (viii) water pumping stations, such as from river or public supply system, (ix) effluent disposal ducts or pits. If yes, have these been provided for in the estimates of capital costs to the extent these are to be borne by the candidate establishment - (outside the responsibility of public authorities and agencies)?

I-32 Are all the requirements of transport equipment and fleet and particularly the vehicles for the movement of workers and staff, raw materials, finished products included?

I-33 Has adequate provision been made for office equipment, such as typewriters, calculators, accounting machines, computers?

I-34 Has communications equipment such as telephone, intercom facilities, short circuit TVs (if considered necessary) been incorporated in the capital cost estimates?

I-35 Are erection and installation costs adequate considering the nature of the plant facilities? Is the basis of cost calculation sound?

I-36 Does the installation cost include cost of fabrication such as of vessels and installation tools and equipment?

I-37 Do machinery and equipment require special inspection by agencies other than the staff engaged under the project? Has the cost of such inspection been provided for if such inspection is not the responsibility of one of the contractors?

I-38 Do furniture estimates include items required

(i) by office administration

(ii) for stores, especially spare parts, tools and component stores,

(iii) on the shops floor,

(iv) for housing,

(v) for staff welfare facilities including workers?

I-39 Do machinery and equipment include

(i) air conditioning and atmospheric control equipment including humidification plant within the factory, in office and other buildings,

(ii) incidental equipment, such as for the kitchen in staff and workers canteens?

I-40 Do capital outlay estimates include, if required,

(i) technical know-how, technical assistance, patent, licensing and similar other fees

(ii) cost of detailed engineering, if it is to be accomplished by contracting outside agencies

(iii) fee for conducting special tests and studies, such as pilot plant tests?

I-41 Do preliminary (pre-incorporation) and capital issue expenses include:

(i) legal, printing, fees and other expenses for the formation of the company;

(ii) printing and advertisement costs for publication of prospecti and announcements concerning the public issue of capital

(iii) brokerage and underwriting commission;

(iv) costs of processing share applications, allotment of shares and other work of corporate register?

I-42 Do the costs envisaged under I-41 conform to the corporate usage and policies of the local stock markets and company law administration?

I-43 Are costs of the following provided for under pre-production costs:

(i) project identification studies

(ii) pre-feasibility and feasibility studies

(iii) goodwill and fee for reproduction rights

(iv) all salaries, wages and social security benefits during the construction period

(v) all administrative costs, such as rental, communication and travel costs, legal costs;

(vi) costs of recruitment and training, including travel cost of trainees, training fee, if involved

(vii) consumption of raw materials, utilities and other engineering and related costs during the test and trial runs and the commissioning of the plant;

(viii) cost in arranging loan financing from public financial institutions or other sources including mortgage registration fee or stamp duties?

I-44 Has interest during construction period been calculated analytically after examining the schedule of capital disbursements, interest rates chargeable and providing for the share holders capital?

I-45 Is the interest rate calculated for interest during the construction realistic? Does it include incidental costs such as commitment charges?

I-46 In computing capital costs, has provision been made for price escalation?

(i) in line with the recent expenditure in the candidate industry and associated with the sources of supplies, and

(ii) after reckoning the timelag between the points of estimation and price fixation.

I-47 Over and above the provision for price escalation, have contingencies been provided for under items not computed on lump sum basis? If the provision has not been made on item by item basis, has a lump sum (say 10%) provision been made on total capital cost of the project except in package deal estimates, such as on turn-key basis?

I-48 Does the total capital cost include the requirements of working capital?

I-49 In computing working capital requirements, have the following been included:

(i) all components of inventories main and other raw materials, auxiliary materials, bought-out components, work-in-progress or semi-processed materials, finished materials in the factory, in transit and with trade (to be held on project-establishment account)

(ii) all working expenses not covered under unsold stocks;

(iii) payables and receivables - debtors and creditors?

I-50 Has extra provision been made under inventories for imported materials?

I-50 Do the total working capital requirements conform to the expenses of similar industrial establishment?

I-51 Have escalation (10% or as required) and contingencies (say 5%) been provided for separately under working capital?

I-52 Has the report indicated the need for making advance deposits with agencies and authorities, such as state electric supply systems, telephone exchanges? If yes, has a separate provision been made for such deposits?

I-53 (a) For building costs, first establish whether a turn-key contract will be given, or payments made at stipulated rates applied to bills of quantities?

(b) Establish procurement procedures in estimating equipment costs. Will there be:

(i) international competitive bidding?

(ii) domestic competitive bidding?

(iii) plant supplied against manufacturers' credits?

(iv) inports against bilateral aid?

Material inputs (Chapter 13)

R-1 Have all raw materials, subsidiary and auxiliary, (including process chemicals and additives) been listed and examined for their technical suitability and prices?

R-2 Are the raw materials suitable for the technologies, processes and equipment selected?

R-3 Were alternative raw materials considered in necessary depth to make a rational selection from the points of view of

(i) capital costs
(ii) production costs
(iii) transportation convenience and costs,
(iv) technical suitability,
(v) consistently regular supplies?

R-4 Have all the relevant properties (physical, chemical and others) of the raw materials been determined by dependable laboratory analysis and tests?

R-5 Has it been examined that the subject raw material might need a pilot plant test? If yes, were tests on a pilot plant organised? What were the results? Are the results fully stated with the necessary qualifications and reservations?

R-6 In estimating the supplies of raw materials from indigenous sources, were risks of rising demands from alternative sources examined (such as likely diversion of naphtha supplies from synthetic fibres to fertilizer production)?

R-7 In the case of imported raw materials, have the oscillations in international markets been anticipated, analyzed and appraised? Were possibilities of local supplies examined?

R-8 Does the material need beneficiation, sintering or pre-processing? If yes, has it been provided for?

R-9 In the case of mineral products, are the reserves proven by surveying and prospecting? Are dependable reports available? Have the sources of such reports been indicated in the feasibility report?

R-10 Are the subject mineral reserves adequate for the life-span of the project after providing for anticipated and necessary expansion?

R-11 Have necessary facilities for prospecting, exploitation and supply of the mineral products been programmed and provided for?

R-12 Has it been considered that the supplies of the raw materials may require special collection machinery? If yes, has adequate provision been made for it?

R-13 Were alternative sources of raw materials examined from the points of view of technical suitability, quantities available, prices, transportation and handling costs?

R-14 Has it been investigated that the same raw material was used in similar plants? If yes, was the experience of the other plants studied? Did the other plants have operational problems with the material? Did the material require additional processing or equipment?

R-15 Has the (locational) occurrence of the material any impact on the location of the plant?

R-16 Have the price trends of the raw materials shown any abnormal tendencies?

R-17 Have purchasing arrangements for raw materials been established?

R-18 Have raw material costs been projected?

R-19 Have inflationary factors been considered?

R-20 Are major developments in the supplies and use of the materials envisaged? Have these been provided for adequately?

R-21 In estimating quantity requirements, have discounts been made for wastage, leakage and process losses?

R-22 If the raw materials require special arrangements or investments for their extraction/exploitation, have these been provided for?

R-23 If the raw materials require special transportation and storage arrangements, have these been provided for?

R-24 Have the inventory requirements been estimated realistically keeping in view procedures and bottlenecks in regard to allocations, allotments and permits, imports and exchange controls customs, transportation?

R-25 Are the estimates of raw material requirements been made for test runs and commissioning of the plant?

<u>Material inputs - Utilities</u> (Chapter 13)

U-1 Have investigations been made if off-site facilities such as the following are required to be constructed directly as a result of the project:

(i) access or link roads,
(ii) railroads and sidings,
(iii) harbour and dock facilities,
(iv) bulk-handling facilities,
(v) electric power plants,
(vi) electric substations,
(vii) water resources and/or pumping facilities,
(viii) effluent disposal pits, ducts?

U-2 If any of the U-1 facilities are required to be undertaken, has the responsibility been allocated between the project and public authorities and agencies?

U-3 If the responsibility for U-1 facilities is to be shared or to be shouldered wholly by the project, have detailed specifications been worked out?

U-4 Has a phased power requirement schedule in conformity with capacity utilization levels drawn?

U-5 Does the maximum load take account of all equipment to be operated simultaneously if necessary?

U-6 Has the experience of power cuts, power shut-downs and voltage fluctuations taken into account in providing for power loads, transformers, stabilizers and other equipment?

U-7 Has stand-by power facility been provided for emergencies, especially for continous and process equipment?

U-8 Has the necessary provision been made for electric substation, step-down transformers and if necessary transmission lines from the electric supply station?

U-9 If electric power is a critical and significant factor, such as in the case of electrolysis plants (aluminium industry), has consideration been given to the installation of a power plant as an adjunct to the project?

U-10 Were the relative economics of power and fuel considered, as for glass industry?

U-11 Is the analysis of the fuel outlined in the report? Is the fuel selected suitable for the equipment? If not, what impacts should it have on productivity? Has provision been made for rectifying factors (for example, muffle kilns for a ceramics plant if the sulphur content is high?

U-12 Have adequate transportation, storage, handling and associated facilities such as for pumping been provided for?

U-13 Have sufficient electricity supply arrangements planned for the pre-production phase: for construction, erection, test-runs and commissioning of the plant?

U-14 Have quantities of fuel requirements for the test-runs and commissioning of the plant estimated and provided for?

U-15 In the event own power generation is planned, have the generation equipment and fuel requirements been estimated realistically and provided for?

U-16 Has adequate provision been made for internal cabling within and outside battery limits?

U-17 Do electric power requirements include those for ancillaries such as air-conditioning, maintenance shop, internal transportation system?

U-18 Is the fuel storage capacity adequate considering the apprehended bottlenecks in supplies and transportation systems?

U-19 Have the water requirements been assessed adequately?

U-20 If the public or natural supply sources are not adequate, has special provision been made for water supply facilities, such as boring a tube well, laying a pipeline, erecting a reservoir?

U-21 Has water analysis been obtained? Has it been examined that the available water would be suitable for process and production purposes?

U-22 If necessary, have water treatment facilities been provided for?

U-23 To conserve (or to economize) water resources, have facilities for recycling of water been provided for?

Manpower (Chapter 14)

Mp-1 Have the workers requirements been estimated separately for different sections of the plant, by shifts, by skills and by levels? Are these adequate?

Mp-2 Are the estimated manpower requirements for technical supervisory staff adequate considering the value of operations, wroker-strength and shift working?

Mp-3 In estimating administrative and commercial service personnel requirements, has provision been made for all necessary functions and especially sales, procurement, transportation, store control, personnel services, medical facilities?

Mp-4 Has service personnel been provided for, such as security staff and janitors, cleaners, drivers, messengers?

Mp-5 Does top management personnel include all essential functions, general management, technical management, commercial and financial management?

Mp-6 Is the apex of the organizational chart too heavy for the total manpower?

Mp-7 Has a suggested organizational chart been developed in the report?

Mp-8 Does the organization chart represent (i) too much centralization of authority, (ii) duplication of functions, (iii) conflicting or overlapping functions?

Mp-9 Is the manpower provided for not too much when compared to a similar manufacturing facility? Would the quantum of manpower planned yield attractive productivity coefficients?

Mp-10 Have necessary programmes been spelt out for pre-operational and post operational training, including on-the-job training and familiarization programmes abroad at the plants of technical collaborators or suppliers?

Mp-11 In case of complicated process plants for which no local experience or expertise is available, have provision been made for expatriate technicians and engineers for (i) engineering work, (ii) construction and erection, and (iii) operation. Are the numbers provided for adequate?

Mp-12 Has the expatriate content of skills been phased out over a period in accordance with a rational plan?

Mp-13 Have necessary adjustments been made for the phased recruitment of manpower in accordance with expected levels of capacity utilization?

Mp-14 Are the estimated manpower requirements during the construction period adequate?

Mp-15 Is the programme for recruitment and training schedule of manpower during the pre-production period consistent with construction, commissioning and operational schedules?

Production cost (Chapter 15)

Pc-1 Have capacity utilization levels been fixed realistically after providing for teething troubles, market penetration rate and such other factors?

Pc-2 Do material costs conform to bill of materials outlined in the technical part of the report?

Pc-3 In computing the quantities, has account been taken of wastages, leakages and process losses?

Pc-4 What is the source of information on prices? Has cross-checking been done in determining the prices?

Pc-5 In computing delivered prices, have all components of costs been provided for, such as freight, customs duty and clearing (in case of imported materials), insurance, handling charges?

Pc-6 In computing prices, have adjustments been made for bulk or small quantity purchases, special specifications, if any, of the materials?

Pc-7 If the materials require special packaging, has packaging cost been provided for (after adjusting it for recovery of used packages)?

Pc-8 In calculating wages and salaries, has the entire work-force requirements outlined in the report been included?

Pc-9 Are the salary/wage levels assumed in the report realistic for the candidate industry and local wage levels?

Pc-10 Has adequate provision been made in manpower planning (and operational costs) for leave reserve at all levels?

Pc-11 Has adequate provision been made for prerequisites, social insurance, social welfare and similar benefits?

**Pc-12** In computing salary-wage bill for different operational years, has an escalation for the ageing of the work force, as distinct from inflationary impact, been provided for?

**Pc-13** Has power cost been computed in accordance with the power tariff in force and related to actual power requirements? Has it been noted that power rates may involve minimum charges?

**Pc-14** Has fuel cost been calculated realistically?

**Pc-15** Has separate provision been made for all overhead cost components, apart from salaries, such as rentals, administration costs, travel, transport and communication expenses, legal expenses, fees payable to directors, auditors and consultants?

**Pc-16** Has adequate provision been made for maintenance of all fixed assets including but not limited to plant and machinery and buidlings, but including utilities, transport fleet and equipment, laboratory and maintenance equipment, office equipment, other tools and accessories?

**Pc-17** In computing maintenance costs, has full provision been made for spare parts and tooling?

**Pc-18** Has provision been made for partial replacements of certain parts of plant and machinery such as relining of furnaces?

**Pc-19** In computing costs for other than the initial years, has maintenance cost been increased over the years making the necessary adjustments for the ageing of assets and thus requiring higher maintenance costs?

**Pc-20** In computing costs, conventionally taken as variable or otherwise, has adequate adjustment been made to ensure that production levels lower than the capacity may involve proportionally higher costs?

**Pc-21** Has interest been calculated at applicable rates for different sources of borrowing (long-term institutional and non-institutional loans and current bank borrowings from commercial banks)?

Pc-22 In computing interest, have adjustments been made for repayment of loans and for the rise and fall in bank borrowing levels?

Pc-23 In addition to interest, have other bank charges as guarantee commissions been included?

Pc-24 Have all sales costs been adequately provided for: (a) packaging cost, (b) special commission to distributive channels or sales organization, (c) sales promotion and advertizing costs?

Pc-25 Has depreciation been calculated on a realistic basis in accordance with the imputed life-spans of the various items of fixed assets?

Pc-26 In computing costs, has a separate provision been included for contingencies? Has it been adjusted with the level of production and total quantum?

Pc-27 Has it been checked that no royalty payment is involved? If it is, has provision been made for it?

Pc-28 Are there any indirect taxes such as municipal rates, production taxes, payable by the candidate establishment? If yes, have they been provided for?

Pc-29 Are there any one time non-capital expenditures (such as preliminary and pre-incorporation expenses, pre-production costs) to be written off? If yes, have these been provided for?

Financial plan (Chapter 16)

F-1 In the financing plan, has the first priority been given and maximum resort proposed to borrowing from public financial institutions, domestic and international, which make available financial assistance on soft terms?

F-2 Have the bank borrowings for current working capital purposes been provided for in accordance with local commercial banking usages?

F-3 Have opportunities been explored for alternative and relatively more attractive capital sources, such as preference capital?

F-4 Have subsidies available from government - cash subsidies for capital expenditures, workers housing - been provided for?

F-5 In planning for the capital structure, have norms such as equity-debt, equity-preference ratios been ensured?

F-6 Is the planned capital structure in consonance with government regulations, company legislation and conventions and requirements of public financial institutions?

F-7 In planning participation of foreign collaborators, have equations between local and foreign participations been realistically provided for?

F-8 In providing for public participation in the shares of capital of the candidate establishments, have norms of stock exchanges, government regulations and public financial institutions been taken into account?

(i) The debt-equity ratio must be acceptable, in relation to the debt-service coverage displayed by the income projections.

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