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UNITED NATIONS INDUSTRIAL
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MANUAL FOR THE PREPARATION OF INDUSTRIAL FEASIBILITY STUDIES*

Prepared by the

International Centre for Industrial Studies

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Acknowledgement

This Manual represents the cumulative experience of UNIDO in the methodology and practice of industrial project preparation. The work on this Manual has gone through a number of stages during which its initial draft was applied in regional and national training workshops on project preparation in Ethiopia, Madagascar, etc. Based on the experience gained in preparing industrial studies and in training local cadres, the Manual gradually developed into its final form.

The Manual was prepared by Werner Behrens of the International Centre for Industrial Studies of UNIDO in close co-operation with Friedrich Giersig of Vienna. Valuable contributions were received from R.S. Mohnct of New Delhi and Rana K.D.N. Singh of Dispur-Gaumati as well as from experts and colleagues working in the field of industrial feasibility studies, for which great appreciation is expressed.

It is hoped that this Manual will serve to further standardization in feasibility studies prepared for the benefit of the developing countries.

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INTRODUCTION

With the envisaged larger share of the developing countries in world industrial output, new industrial investments will in future have to be undertaken on a massive scale. As a consequence, the number and size of industrial pre-investment studies will grow considerably. The complexity of industries to be established will increase since not only the final products are becoming more and more sophisticated but also the technological alternatives of production. Yet, in the past the quality of pre-investment studies does not appear to have kept pace with the multi-dimensional demands made on them. The standard and depth of the studies are often not of the level which may ensure rational decision-making at the various stages of the pre-investment process. This frequently encountered deficiency has resulted in mis-allocation of resources, long gestation periods, investment cost over-runs, high rates of industrial mortality or mutilated and lop-sided growth.

With the wide disparities and diversity among developing countries in respect of the stage of industrial growth as also the socio-economic policy framework governing industrial planning and decision-making, the need for pre-investment studies emanates in these countries from a number of sources. In countries with a relatively high degree of centralized planning, industrial pre-investment studies not only constitute an essential tool for investment decisions and project implementation but assist in project identification and selection in a number of other sectors of the economy. The broad indicators regarding sectoral requirements and priorities which emerge from the planning process constitute a valuable base, on which pre-investment studies can be undertaken for specific industrial projects. It is possible to derive from the broad industrial development plan in such countries fairly definitive sectoral requirements which accorded _inter se_ priorities on the basis of a country's overall objectives. These in turn get disaggregated into specific investment propositions which are then studied in depth through pre-investment studies and evaluated in terms of defined priorities.

In other countries, with comparatively less emphasis on centralized planning, the initiative for industrial promotion and development is largely left to the private sector, with state institutions and agencies initiating such activities principally in selected branches, such as petroleum and primary petrochemicals, capital goods, etc. Pre-investment activities, including market and other studies, are mainly undertaken by the entrepreneurial and corporate sector within the given policy framework of the government which influences prices and material inputs and outputs, wages and foreign exchange availability. Experience thus shows that a well-formulated industrial development plan is not necessarily a pre-requisite for industrial project identification and that the market mechanism can also bring about satisfactory industrial growth rates. A general scheme of planning and the establishment of well-defined industrial priorities would, however, undoubtedly be valuable for resource channelization in desired growth directions. Irrespective, however, of whether a detailed planning mechanism is resorted to or not, the need for pre-investment studies remains a basic pre-requisite for investment decisions. It may assume even greater significance in developing countries with less or inadequate planning as the inter-relationships between various inputs and production aspects need to be more specifically defined than in situations where the planning mechanism itself provides adequate information regarding such inputs.

Since investment decisions in industry are largely based on some form of pre-investment analysis, it needs to be considered whether there is a different significance to this question in so far as developing countries are concerned. Since such countries are in various stages of industrialization, it is obvious that industrial decision-making during these stages should be on as rational a basis as possible and should be related to the specific requirements in each stage. Actual experience in this regard has tended to be very mixed. In a number of cases, pre-investment studies have been principally motivated from the viewpoint of equipment sales or as part of a turnkey project and have not adequately highlighted the specific problems and difficulties likely to be encountered. In other cases, such studies have largely been based on experiences of similar projects in developed countries and are very inadequately oriented to the situation and conditions prevailing in particular developing countries. In a number of cases, costs of such studies have tended to be disproportionately high when compared to the financial implications of the final projects. The fact that there has been continuing dependence on foreign consultations in a number of developing countries and that national consultancy services have developed only to a limited extent in some developing countries and in certain sectors has added, in a number of cases, to the gaps in knowledge and application thereof to the specific conditions prevailing in particular countries.

Despite the wide proliferation of industrial activities and projects, the basic ingredients of various types of pre-investment studies tend to be conceptually similar and it is necessary to consider whether a format and procedures can be prescribed which can be applied to a wide spectrum of industrial projects. The basic information elements for determination of viability of, say, a cement plant would vary substantially from that of a plant to produce diesel engines which again would be quite different for a unit designed to produce simple consumer goods. Nevertheless, the essential categories of pre-investment information would tend to be similar in the above cases.

Against this background the Manual addresses itself to project planners working in developing countries. Since this activity is an inter-disciplinary task requiring a team approach of engineers, economists, social scientists, businessmen and governmental administrators, the Manual will find readers with different educational backgrounds and varying professional experiences and developed countries. The Manual tries to be practical in its approach. It aims at putting the numerous feasibility studies to be formulated in the future at a similar footing with a view to making them more comparable than in the past. Especially industrial development centres, investment promotion centres, industrial development banks and public and private consulting firms in developing countries should benefit from the Manual, but also the numerous individual experts assigned to project planning authorities in developing countries may take advantage of the Manual.

The Manual is composed of three parts: Part I concentrates on the different types of pre-investment studies which can be applied to the industrial sector as a whole, showing the actual information requirements at the various stages of decision-making in the project selection process so that the implications of under-taking one or other type of pre-investment study can be delineated fairly clearly against the need in each case. Part II is the core of the Manual and its outline corresponds to the one of a feasibility study. Chapter 1 which summarises the objectives and results is preceded by general remarks on the preparation of a feasibility study. In the principal chapters related issues are grouped in such a way that their results can serve as input for the succeeding chapters. Three chapters deal with the base of the project: its history and the overall economic context in which it will operate, the assessment of markets, the supply conditions and the resulting production and supply programmes. Jointly with the results obtained from the chapter on location and site selection, the production and supply programme serve as points of reference for the chapters on choice of technology, equipment and civil engineering, and administration and manpower requirements. Chapters on project implementation, financial analysis and issues related to project evaluation from the national economic point of view conclude the Manual. Part III contains a bibliography which is grouped by subjects.

In order to increase the transparency of Part II of the Manual, each chapter is presented in three parts: brief introductory remarks on the subject to be covered by the chapter, data and information section, detailed explanatory notes.*/

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*/ **The pattern does not apply to the "Executive Summary"** (Chapter 1) **and the "Background and History"** (Chapter 2).

The data and information section which constitute the backbone of the feasibility study are particularly highlighted in the Manual by marking them with a black line at the margin of the page. If all parts marked this way are put in sequential order according to the table of contents given in Part II.0.1, the complete feasibility study evolves (see Annex 5). When preparing the data and information section, the user of the Manual should proceed in conformity with the following black line concept:

(1) - Briefly describe the fundamental data of the chapter,
- Show their processing to derive at possible alternative solutions,
- Explain formulae used and justify their application,

(2) - Select the optimum alternative for further application in the study and describe it in detail,
- State reasons for its selection and describe how this was done,

(3) - Estimate - as far as applicable - investment and annual production costs for the duration of the project at full feasible normal capacity.

The explanatory notes serve to acquaint the reader with conceptual problems he will face when completing the study. These notes are as detailed as required in the context of a Manual dealing with the multifarious problems converged in a feasibility study. A bibliography will enable the reader to familiarise himself further with the issues raised in the Manual.

The above format has sought to follow a stage by stage analysis in which the implications and analytical data relating to various study components merge into one another at the next stage of analysis. Consequently, the various study components have been analysed in a sequential order with one aspect leading to the other and with the various sets of figures gradually converging to relevant totals in a sequential order. This format was designed keeping in mind that the evaluation of an investment proposal can only be done appropriately if the collection of information and data during the preparatory stage were done properly. Although the manual is concerned with project preparation, the admitted need to promote the wider application of fund flow analysis in project evaluation has been reason enough to broaden the manual by adding a presentation of the simple and the discounting methods applied in commercial profitability evaluation and to gear the manual accordingly. Thus, each chapter of the manual contains several pro forma schedules suitable for data collection. These schedules are designed in such a way as to correspond to the timing requirements of cash flow analysis. Furthermore, the schedules are sequential and can ultimately provide all major inflows and outflows of funds of cash flow tables needed for evaluation and financial planning. The concept used for the manual can be developed further and should be used for the design of a computer programme for project preparation, particularly with regard to facilitating the assessment of the numerous project alternatives. The manual was not written with the intention of breaking any new academic grounds. The subjects covered have been dealt with - although separately - in much greater depth in other publications than it can ever be the case in a manual of this type. All the manual intends is to put the different subjects to be covered by a feasibility study in a sequential order, pinpointing their interlinkages and the feedbacks needed to arrive at the final complete study.

For a number of reasons the manual does not address itself to problems related to industrial sector planning and social benefit-cost analysis. Firstly, both subjects would require too much space for appropriate coverage. Secondly, when preparing an investment proposal, an investor or promoter is normally not very much concerned with the costs and benefits his projects may have to the economy as a whole. His interest is focussed on commercial considerations, i.e., the rate of return to be expected from the investment involved, taking into account the prevailing market prices to be obtained for the products and to be paid for material inputs, utilities, labour, machinery and equipment and the like.

Finally, industrial sector planning and social benefit-cost analysis are not part of this manual since the UNIDO Guidelines for Project Evaluation, the Practical Guide to Project Appraisal and the Manual for Evaluation of Industrial Projects in Arab Countries covered both at great length, paying particular attention to the interaction of macro-economic planning and socio-economic project choice. Only in the final chapter of Part II the economic relevance is emphasized of subjecting any major commercially profitable investment proposals to social benefit-cost analysis in order to create a general awareness of the significance of social benefit-cost analysis for private and public investors as well.

For the time being the manual will be the final document in a series of publications dealing with project preparation and evaluation. So far, project preparation was only treated in an informal UNIDO document and to a limited extent in the Extracts of Manufacturing Establishments (4 volumes). Both the Extracts and the Profiles were however mainly conceived as a collection of reference data covering 24 feasibility studies and over 500 industrial establishments in developing and developed countries. With the present manual, the context is established between the Extracts and the Profiles, and the three UNIDO publications on project evaluation.

Part I

The pre-investment phase

Chapter 1 Basic Aspects and Categories of Pre-investment Studies

The transformation of a project idea into a factory passes through various phases during which 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.

Any significant resource allocation in the industrial field should follow the project development cycle comprising the pre-investment, the investment and the operational phases. Each of the three major phases is divisible into stages, some of which constitute important industrial activities. A few of the 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.

The pre-investment phase includes several stages: identification of investment opportunities, preliminary project selection and definition (pre-feasibility studies), detailed project formulation (feasibility studies), final evaluation and investment decision. These stages of project formulation and preparation are part of a continuous process to enable a potential investor to proceed from one stage of decision-making to another and to provide the necessary base for project decision and implementation.

Exhibit 1

PROJECT DEVELOPMENT CYCLE

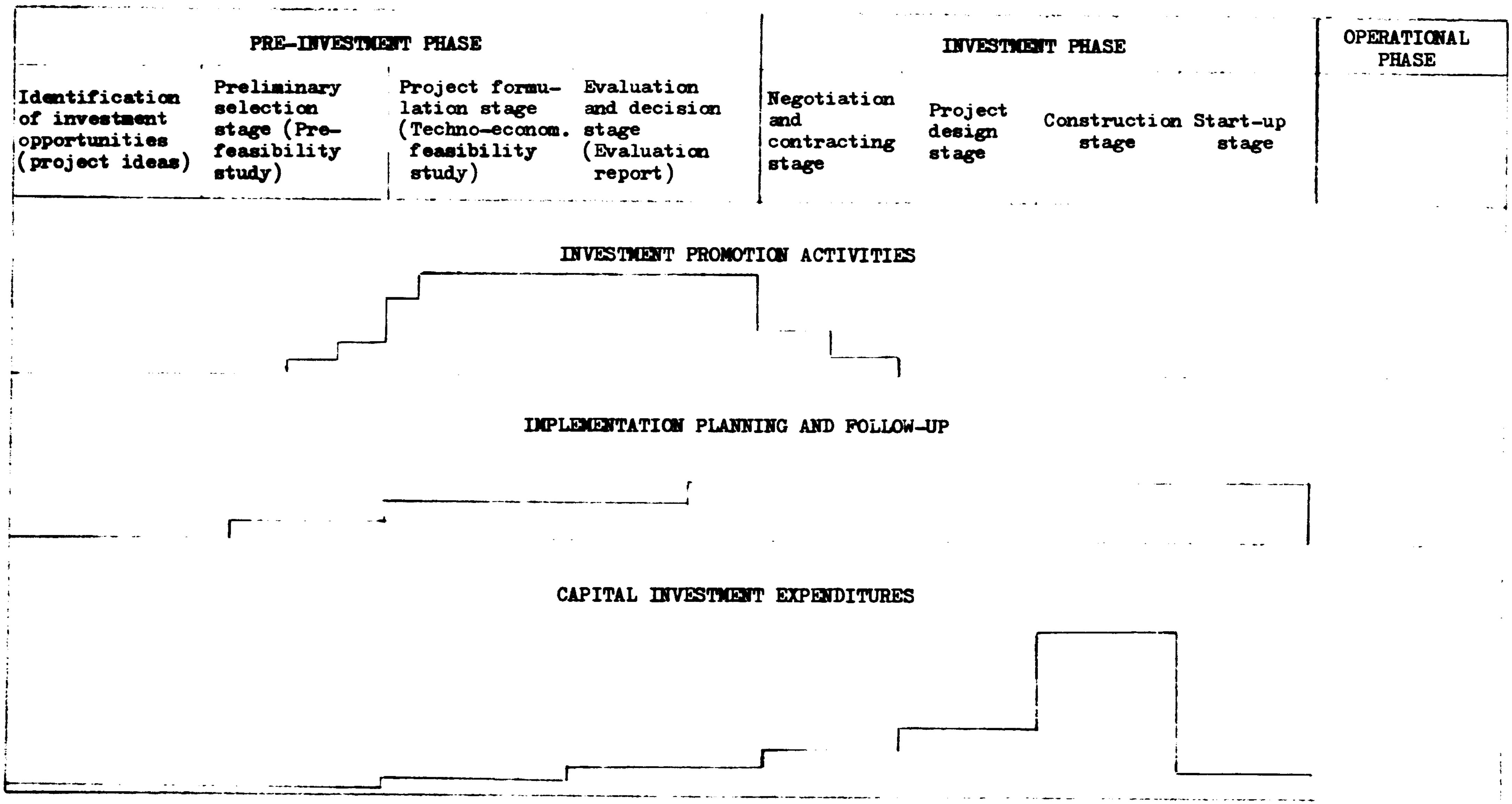

Exhibit 1 shows the entire project development cycle. Within the pre-investment phase several activities take place parallel and even reach into the succeeding investment phase. Thus, once the early stages of pre-investment studies have produced fairly dependable indications of a viable project, investment promotion and implementation planning are initiated long before the completion of the pre-investment studies leaving, however, the main thrust to the final evaluation stage and the investment phase.

Before dealing with the pre-investment phase it would be useful to briefly consider the various stages of the implementation and the operational phases as well as the promotional activities as these have a significant bearing on the nature and scope of pre-investment studies. It must be stressed that no single, uniform pattern can be defined, as industrial activities can take innumerable forms, ranging from small-scale unit producing a particular product or component to a large multi-product complex.

1. Investment Phase

The project investment or implementation phase for a large steel plant bears little relation to the setting-up of a small-scale unit for the production of castings or precision parts and components. Assuming, however, that a projected industrial activity involves the construction of a factory and the installation of machinery and equipment, the project implementation phase could be broadly divided into the stages of (i) project designs, (ii) negotiations and contracting, (iii) construction, (iv) training, and (v) plant commissioning. */

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*/ UNIDO has already covered most of these topics in a number of publications such as:

Contract Planning and Organization, New York, 1973 (Sales No. E.74.II.B.4)

Guidelines for Contracting for Industrial Projects in Developing Countries, New York, 1975 (Sales No. E.74.II.B.4)

Manual on the Establishment of Industrial Joint-Venture Agreements in Developing Countries, New York, 1971 (Sales No. E.71.II.B.23)

Programming and Control of Implementation of Industrial Projects in Developing Countries, New York, 1970 (Sales No. E.70.II.B.18)

B. Barkhoff, "Planning the Implementation of Industrial Projects" in Industrialization and Productivity Bulletin No. 17, New York, 1970 (Sales No. E.71.II.B.8; ID/SER.A/17)

M.D. Kilbridge, "Problems Often encountered in Implementing Industrial Projects in Developing Countries", ibid.

The preparation of project and engineering designs would include time-scheduling, site prospecting and probing, preparation of blueprints and plant designs, detailed plant engineering and final selection of technology and equipment. Negotiations and contracting would define the legal obligations and areas of responsibility in respect of project financing, acquisition of technology, construction of buildings and services, supply of machinery and equipment of various inputs during the operational phase. It covers the signing of contracts between the investor on the one hand, and the financial institutions, consultants, architects and contractors, equipment suppliers, patent holders and licensors, collaborators and suppliers of input materials and utilities, on the other. This stage involves a host of procedures and efforts which often present serious problems and pitfalls for developing countries. Negotiations and contracting take place at all stages of the investment phase with the exception of turn-key contracting, a relative less troublesome but a more expensive way of implementing projects. Pre-investment studies provide the base for the activities under the investment or project implementation phase. The decisions, however, at the investment phase do not necessarily follow the choices recommended in the pre-investment studies. Direct negotiations and contracting reveal the need for modifications and throw up new ideas for project improvement, however, leading to unforeseeable increases in investment costs.

The construction stage involves site preparation, construction of buildings and other civil works, together with the erection and installation of equipment in accordance with proper programming, phasing and scheduling. The training stage, which should proceed simultaneously with the construction stage may prove to be of significance regarding the rapid growth of productivity and efficiency in plant operations.

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.

The investment phase involves heavy financial commitments. There are only limited possibilities of major modifications of the project without significant financial implications. 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. Since the time factor does not play such a decisive role in the pre-investment phase, it is preferable to trade off time for the quality and dependability of the project concept; but in the investment phase, the time factor assumes critical significance.

2. Operational Phase

During the operational phase, the implications need to be considered both from a short-term and a relatively longer-term viewpoint. During the initial period after commencement of production, a number of teething problems may emerge. These may relate to aspects such as the application of production techniques or operation of equipment or inadequate labour productivity. Most of these problems should, however, be considered as extensions of the implementation phase and necessary corrective measures pertain principally to project implementation. The more long-term implications relate to production costs on the one hand and income from sales on the other and these have direct relationship with the projections made at the pre-investment phase. To the extent that such projections prove faulty, the techno-economic feasibility of an industrial activity would inevitably be jeopardised and if such shortcomings are identified only at the operational phase necessary remedial measures are not only difficult but can prove highly expensive.

The above outline of the implementation and operational phase of an industrial project would undoubtedly be an over-simplification for a large number of projects and, in fact, certain other aspects and problems can well emerge which can have even greater short-term or long-term impact. Nevertheless, the wide range of issues which need to be covered at these phases highlight the complexities of the aspects which must be assessed at the pre-investment phase which constitutes the essential base for the subsequent phases. The adequacy of pre-investment study and analysis would undoubtedly determine, in large measure, the ultimate success or failure of an industrial activity, provided serious deficiencies do not creep in at the implementation and operational phases. On the other hand, the techno-economic rectification of a project, which is wrongly conceived in the pre-investment stages in terms of basic factor ingredients is far more difficult, however well the project may be subsequently executed and operated.

3. Promotional Activities

Project promotion starts with the decision to identify potential sources of finance, marketing and other co-operant inputs that are required for successful project development. Thus, promotion may involve the search for local sponsors, private or public partners, foreign partners, various sources of finance, etc.. Project promotion should start at the earliest once the opportunity study or even better, the pre-feasibility study have demonstrated preliminary project viability as shown in figure 1. This initial evaluation of the technical, economic and financial aspects of a project is carried out in relatively broad terms, and on its outcome would depend decisions to go ahead in an integrated way with promotional activity and a full feasibility study.

In this context attention is drawn to the lack of integration of industrial financing and investment promotion activity with the other equally vital elements of the project cycle in particular with the project identification and project formulation stage. This deficiency has caused either a number of feasibility studies showing positive results to remain unimplemented projects or implemented projects to become financially and/or economically not viable ventures. With regard to the former, the lack of integration arises because serious attempts to promote and finance a project, may be delayed until the full feasibility study has been completed. The problem which arises, however, is that third parties who are vital in providing finance very often insist as a minimum on inserting their own requirements into the terms of reference for the full feasibility study. On projects in which joint financing and operating management is a requirement, the suppliers of the latter sometimes insist that their own experts be involved in the full feasibility study. If they have not been so involved, these potential partners may insist on a new round of the feasibility study exercise. The net effect of these demands is a waste of resources involved in the initial feasibility study; this difficulty may, of course, be compounded if in the repeat study there is not a preliminary agreement among the parties involved in any subsequent jointly financed/managed project.

It should be noted that one of the functions of efficient promotion is to facilitate such initial agreement.

It should be noted that while a full feasibility study may interest potential partners, progress towards project implementation may be dependent upon these parties carrying out or financing new studies, and this they may be unwilling to do. If the project had been promoted at the pre-investment phase, this difficulty can often be overcome by associating these third parties with the first full feasibility study financed or potentially financed by the government or by development agencies.

4. Categories of Pre-investment Studies

To draw an exact demarcation line between an opportunity, a pre-feasibility and a feasibility study may not be an easy task in view of the frequently encountered false application of these terms for studies where contents and title do not correspond. The Manual therefore attempts at its outset to provide definitions which are general enough to be widely accepted and applied in developing countries.

4.1 Opportunity studies

A major constraint in developing countries is the dearth of knowledge of investment opportunities that ca be developed into investment projects. Unlike the situation in developed countries where the concept of an industrial project or activity emanates from the industrial or entrepreneurial sector, the identification of industrial opportunities is a significant problem in itself in a number of developing countries, with the magnitude of the problem being accentuated in countries in earlier stages of industrial growth. With successive stages of industrialization, this function is increasingly undertaken by the entrepreneurial sector, both public and private, but there continues to be need for governmental and institutional agencies to define such opportunities as may exist at different points of time and development.

Where there is a relatively strong planning base, the task of initial identification is relatively easier as the planning mechanism provides fairly detailed economic indicators, together with sectoral priorities based on well-defined criteria. A greater degree of selectivity in defining investment opportunities can then be exercised, and industrial investments can be sought to be channelized in sectors having higher priority or where significant production gaps are likely to emerge. Even in countries where the market mechanism operates more freely, the responsible ministry frequently publishes lists of potential investment opportunities. In certain developing countries, where the entrepreneurial sector is relatively underdeveloped, mere publication of a list of potential industrial opportunities may, however, not prove adequate and has to be supported by more specific data and information before adequate entrepreneurial interest can be developed.

When reaching for investment opportunities, a number of general indicators may serve as basis such as:

(a) An analysis of natural resources which have potential for processing and manufacture, such as timber for wood-based industries;

(b) An analysis of the existing agricultural pattern which serves as a basis for agro-based industries;

(c) Projection of present demand of specific consumer goods which have adequate growth potential as a result of increased population or purchasing power or the emergence of new uses such as synthetic fabrics or domestic electrical products;

(d) An analysis of imports in order to identify obvious areas for import substitution;

(e) Identification of manufacturing sectors successfully undertaken in other countries with similar levels of development, factor endowments and economic background;

(f) Identification of possible interlinkage with other industries, indigenously or internationally;

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

(h) Identification of possibilities for diversification such as pharmaceutical industry to a petrochemical complex;

(i) Programming of expanding existing industrial capacity to attain economies of scale;

(j) Analysis of the general investment climate;

(k) Analysis of the industrial policies;

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

Accordingly an opportunity study can be defined as an exercise aiming to identify investment opportunities or project ideas which will be subject to further scrutiny once the proposition has been tentatively proven viable. Opportunity studies are rather scetchy in nature and rely more on aggregate estimates than on any detailed analysis. Cost data are usually taken from comparative existing projects and not from quotations of equipment suppliers and the like. Depending on the prevailing conditions under investigation, either general opportunity and/or specific project opportunity studies have to be undertaken.

<u>General opportunity studies</u>

General opportunity studies have been implemented in a number of developing countries through state and institutional agencies with the objective of pinpointing more specific investment proposals. Three types of studies can be differentiated:

<u>Area studies</u> - seeking to identify opportunities in a given area such as an administrative province, a backward region or the hinterland of a port;

<u>Sub-sectoral studies</u> - seeking to identify opportunities in a delimited sub-sector, such as building materials, food processing;

<u>Resource-based studies</u> - seeking to unfold opportunities based on the utilisation of a specific natural, agricultural or industrial

produce such as forest-based industries, downstream petrochemical industries, metalworking industries and the like.

Annex 1 provides a checklist for the preparation of general opportunity studies, although it may frequently occur that only the types of products to be manufactured appear in such general studies.

Specific project opportunity study

A specific project opportunity study - the more common case - may be defined as the translation of a project idea into a broad investment proposition. Since the objective is to stimulate investor response, a project opportunity study must include certain basic information. In this context, the mere listing of products which may have potential for domestic manufacture, is not adequate. While such a list, derived either from general economic indicators such as past imports or growing consumer demand or from one or other of the general opportunity studies relating to areas, sectors or resources can serve as a starting point, it is necessary, firstly, to be discriminate and selective as to the products so identified, and secondly to incorporate certain basic and essential data relating to each product so that a potential investor, either domestic or foreign, can consider whether the possibilities are initially attractive enough to proceed to the next stage of project preparation. Such basic data can also be effectively supplemented with necessary information as to basic policies and procedures which may be relevant to the production of the particular product. What would then emerge would be a broad investment profile which would be adequate for the purpose of stimulating investor response. This suggests, however, that following the initial definition of general investment opportunities in the form of products having potential for domestic manufacture, a governmental or institutional agency should undertake a specific project opportunity study and prepare an investment profile which can then be circulated to potential investors. While such a course needs to be, and is being taken, in a number of developing countries, it should not presuppose that the principal sponsoring source for such opportunity studies would not be the potential investor groups themselves. In fact, it is the prospective investor or entrepreneurial group who, in most cases, undertakes this exercise.

The nature of basic information conveyed in a project opportunity study should not be such that any substantial costs are involved in its preparation. By its very nature, it is intended primarily to highlight the principal investment aspects of a possible industrial proposition. The basic purpose of such a study is to arrive at a quick and inexpensive determination of the salient facts and aspects of an investment possibility. Where a project opportunity study is undertaken to develop entrepreneurial interest, the following pre-feasibility study has to be taken into consideration as and when entrepreneurial response is forthcoming.

4.2 Pre-feasibility study

The project idea conceived must, of course, be elaborated in a more detailed study. However, formulation of a techno-economic feasibility study which enables a definite decision on the project is a costly and time-consuming task. Therefore, before assigning funds for such study, a preliminary view of the feasibility of the idea must be obtained.

The principal objective of a pre-feasibility study is to determine:

(a) whether the investment opportunity is so promising that an investment decision can be taken on the basis of the information elaborated at the pre-feasibility stage itself; or

(b) whether the project concept justifies a detailed analysis through a feasibility study; or

(c) whether any aspects of the project are particularly critical to its feasibility and necessitate in-depth investigation through functional or support studies such as market surveys, laboratory tests, pilot plant tests, and the like; or

(d) the information is adequate to decide that the project idea either is not a viable proposition, per se, or is not attractive enough for a particular investor or investor group.

Though a pre-feasibility study should be viewed as an intermediate stage between a project opportunity study and the detailed feasibility study, the difference primarily lies in the detail of the information secured rather than on the pattern of its contents. Accordingly, it is necessary even at the pre-feasibility stage to examine, perhaps broadly, the relative alternative economics of:

(i) Demand and markets
- market sizes
- degree of integration
- product mix
- size of capacity

(ii) Material inputs
Substitute fead stocks or raw materials

(iii) Plant location

(iv) Project engineering
- technologies and equipment
- civil engineering works

(v) Overheads (factory, administrative and sales)

(vi) Manpower

(vii) Project implementation

(viii) Financial analysis
- investment costs
- project financing
- production costs
- commercial profitability

The structure of a pre-feasibility study should be the same as the one of a detailed feasibility study. An outline of a pre-feasibility study is given in Annex 2.

When a project opportunity study is conducted in respect of an investment possibility, the pre-feasibility stage should often be able to be dispensed with. The pre-feasibility stage is also occasionally by-passed when a sector or resource opportunity study contains project data adequate enough to proceed to the feasibility stage or determine its discontinuance. A pre-feasibility study is, however, conducted if it is apprehended that the economics of the project are doubtful, unless a certain aspect of the study has been investigated in depth by a detailed field market survey or some other functional study to determine the basic viability. Short-cut methods may be used to determine a number of minor components of investment outlay and production costs, however not for major, significant or critical cost components. These must be estimated for the project as a part of the pre-feasibility study, but it is not necessary to depend solely on firm quotations.*/

The increasing precision to be reached while proceeding from a project opportunity study to a pre-feasibility study is demonstrated in Annex 3, which contains the example of a paper mill project.

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*/ Short-cut methods: For working capital, for example, one of the methods would be to assume operational cash outflows (for raw materials, manpower, utilities, overhead 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-months period for this purpose. In other words, if the total annual cash outflows aggregate to $12 million, the working capital requirements may be placed 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 transporation 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 rate would be approximately 3 per cent, for an asbestos pressure pipes plant 7 per cent, for a ceramics plant 10 per cent. 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-metre or per-cubic-metre cost may be applied. These costs, however, would vary from country to country, and in fact, from area to area. Prudence is needed when applying them.

4.3 Partial support or functional studies

Support and functional pre-investment studies may be defined as exercises in industrial programming which cover one or more but not all aspects of an investment project and which are required as prerequisites of or in support of pre-feasibility and full feasibility studies, particularly for large-scale investment proposals.

Classification:

(a) Market surveys of the products to be manufactured, including demand projections in the market to be served together with anticipated market penetration;

(b) Raw material and input studies, covering present and projected availability of raw materials and inputs basic to the project and the present and projected price trends of such materials and inputs;

(c) Laboratory and pilot plant tests to the extent necessary to determine the suitability of particular raw materials, such as the quality of limestone for a cement factory or that of various types of clay for a porcelain insulator plant;

(d) Locational studies, particularly for potential projects where transport costs of raw materials, inputs or principal markets would constitute a major determinant factor;

(e) The studies on economies of scale 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 economies of scale and do not extent to the intricacies of technology. The principal task of these studies is to evaluate the most economically-sized plant after considering alternative technologies, investment costs, production costs and prices. The studies normally take several capacities for analysis and develop the broad characteristics of the project, computing results for each capacity size.

(f) 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. 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 investments 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 operation 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 contents of the functional or support study would vary, depending on the nature of the study and the projects contemplated. Since, however, they relate to a specific aspect considered vital for the project, the conclusions should be unequivocal and unambiguous enough to give a clear direction to the subsequent stage of project preparation.

A frequent reason why support or functional studies are separately conducted is that the agency carrying out the feasibility does not have the requisite manpower or expertise to conduct studies in the areas concerned. 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 synchronized manner with them. 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.

Obviously the cost of a supporting study must bear relation to the cost of the feasibility study keeping in mind that the purpose of undertaking such studies is also to economize later on during the feasibility stage. It may be assumed, for example, that a pre-feasibility study has been completed at a cost of $20,000 for a projected plant for production of electric motors and that the likely cost of a detailed feasibility study for this project would be $100,000. It would obviously make little sense to commission also a market survey for around $100,000. In this case, it ould be better to proceed directly to the feasibility stage. On the other hand, if a market study could be undertaken for, say $20,000, it may be more desirable to take up the support study in the first instance and proceed to the feasibility study only if the market survey was conclusive and positive. It is necessary to emphasize the cost aspect of such supplementary studies, as a number of such studies have been undertaken in developing countries at high cost, only to be followed by feasibility studies at even higher expense.

Support or functional studies are carried out <u>before</u> commissioning a pre-feasibility or a full-scale feasibility study when it is felt that a basic characteristic and input, for example, may be a decisive factor in determining the viability of a project, and the support study may show negative results. Support and functional studies are commissioned separately but <u>simultaneously</u> 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 support or functional study is undertaken <u>after</u> completion of a feasibility study when it is discovered in the course of the 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.

4.4. Feasibility study

A feasibility study is a document which must provide a concrete and dependable base - technical, economic and commercial - on which an investment decision can be taken for an industrial project. It should consequently define and analyze all the critical elements which relate to the production of a given product or products together with alternative approaches that can be considered in respect of such production. What should emerge from such a study is a project of a defined production capacity at a selected location, using a particular technology or technologies in relation to defined materials and inputs, at identified investment and production costs, and sales revenues yielding a defined return on investment. At the same time, alternative possibilities pertaining to the project should also be highlighted so that the project can be suitably adjusted and tailored in the course of investment decision-making, should this become necessary. Such a wide coverage is inevitably a complex exercise as it does not only need to put together a number of components into one whole but also to define other possible combinations of such components.

To achieve this objective, a cycle of feedbacks and inter-linkages has to be established covering possible alternative solutions for production programmes, locations, sites, technology, plant, mechanical electrical and civil engineering and organizational set-up which have to be harmonized and optimized in order to minimize investment and production costs. The final result of this process should be a project, well defined as to its physical and organizational extent. The feasibility study should describe this optimization process, justify the assumptions made and the solutions selected and define the scope of the project as the integrated and co-ordinated sum of all finally-selected partial alternatives.

All final estimates on investment and production costs based on the detailed engineering and the following estimates and calculations of commercial and national economic profitability are only meaningful if the scope of the project is defined unequivocally in order not to forget or lose any essential part and its pertaining cost. This scope should be laid down in drawings and schedules to serve as supporting structure during further project work.

Most feasibility studies have the same or similar scope of coverage, though, in orientation and emphasis, there may be considerable differences, depending on the nature of the industry, the magnitude and complexity of the production unit contemplated, the investment and other costs involved and other such factors. By and large, however, a satisfactory feasibility study must necessarily analyze all the basic elements and implications of an industrial project and to the extent of any shortfall in this regard, the utility of the study becomes limited and restricted.

The term "feasibility study" is often misunderstood in developing countries and misconstrued, often deliberately, by suppliers of equipment or technology. Often, a skeleton outline of a project, oriented primarily towards supply of equipment or choice of particular proprietary techniques is characterized as a feasibility study. In other cases, production or sales estimates are reproduced directly from experience in one or other industrialized country and bears little relation to the conditions within which a project has to operate in a developing country. To the extent that these studies are unrelated or not adapted to local factor endowments, these can be misleading and can result in misapplication of resources, as has often occurred in developing countries. A feasibility study has necessarily to be related to particular factor situations and to local market and production conditions and the establishment of such a relationship involves a degree and analysis which, in turn, has to be translated into costs and income.

A feasibility study is not an end in itself, but is only a means to arrive at an investment decision which need not necessarily coincide with the conclusions of the study. In fact, it would be relatively rare to find investor response so flexible as to fully conform to the results of such a study. */

*/ An example would make this aspect clearer. A feasibility study for the production of transformers identifies a large potential domestic market, which can be served with an initial capital investment of about $15 million. The actual investment decision, however, may be to limit the capital investment to only $5 million and to revise the feasibility study to this figure. From a national point of view, this would result in inadequate market coverage, a lower level of domestic integration and possible continuance of imports to cover the demand balance. From a commercial viewpoint, however, such an investment decision may make good sense in that the over-all financial outlay would be reduced, the size of the market would be much larger than contemplated production, which could result in higher prices and profitability and the extent of local integration would be reduced, consequently decreasing the responsibilities at the plant level. In such a case, a revised feasibility study would need to be commissioned for the lower investment outlay. The revision would not entail the same volume of work as the original study, as many of the parameters would be adopted from the former, but it is obvious that the final investment would differ substantially from the one envimaged in the initial feasibility study. It appears that variations occur to a lesser extent in the case of process industries (sugar, pulp and paper, or cement) as the function of plant size lends itself more to scale economies. It must be recognised that also there may exist divergences between the conclusions of the feasiblity study and the investment decision, which may seam substantial revision of the feasiblity study. To an extent, such revision can be minimised if the feasibility study can test the "sensitivity" of various factors, including the volume of capital investment. In summary it may be said that investment decisions do not flow pari passu from feasibility studies and that the latter represent only a stage, though a critical stage, in investment decision-making.

Investment decisions have to be taken while proceeding through various pre-investment stages. It is, of course, axiomatic that the implications of a particular investment must be analyzed with great care prior to such a decision being taken, but it may be incorrect and unduly expensive to assume that an industrial project should necessarily pass through all stages outlined above, particularly if such services are provided by outside agencies. Investment decisions should be taken at whatever stage the implications of such decisions can be adequately assessed. Annex 4 summarizes the categories of pre-investment studies and the objectives of the decisions to be taken.

It is obvious that, with the enormous range of industrial activities, no uniform approach or pattern can be adopted in respect of all types of industrial projects. These can be of various categories and magnitudes and the emphasis and detailed consideration of different components would vary from project to project. At the same time, a broad format can be prescribed for most industrial projects within the framework of which a feasibility study needs to be prepared. The purpose of Part II of the Manual is to define such a format and to highlight the critical components of a feasibility study that need detailed analysis in determining the viability of a project and in defining its scope and magnitude.

It must be emphasized that the collection and analysis of data for a feasibility study extends considerably beyond static extrapolations of costs and sales and the determination of commercial profitability based on simple evaluation techniques. An industrial project must be viewed in dynamic terms and must take account of the interactions between its components over a reasonable period of the life of the project. These interactions need to be reflected in the resource inflows and outflows projected over a number of years and are to be subjected to discounting methods in order to assess the over-all profitability of the project. It is only then that a comprehensive in-depth analysis is possible for an industrial project over a period of time and that the full techno-economic implications of a project can be adequately determined.

5. Cost of studies

Every pre-investment study involves an element of cost, and consequently the scope and analysis of each such study has to be directly related to the objectives of pre-investment analysis, on the one hand, and the nature and magnitude of the investment contemplated, on the other. The relatively simple identification of certain consumer goods products having a growing market in an economy in the process of industrialization obviously bears little relations to the determination of viability or otherwise of a textile mill or a sugar plant. Similarly, the techno-economic feasibility of setting-up a small manufacturing enterprise producing, for example, plastic toys or ready-made garments is hardly comparable with the determination of feasibility of a large engineering workshop or an oil refinery. The inter-relationship of costs to the nature and category of pre-investment study to be undertaken for any particular project is a vital aspect. While a substantial outlay on pre-investment studies through various stages of such analysis may not only be justified but be wholly essential for large and complex projects such as a steel or a fertilizer plant, even a relatively small outlay may prove to be disproportionately high in other cases where the objectives may be limited or where a relatively small investment is contemplated.

There are no established norms governing the costs of pre-investment studies, and these differ from project to project and from one study to another. Such costs are a function of several factors, such as the magnitude and nature of the project, the type of pre-investment study, its scope and depth, the agencies commissioning and undertaking the study and the time and effort required to collect and assess the material required. Generally, however, the costs of studies are sought to be related to the man-months estimated to be put in the exercise. The period required may range from one month for a relatively simple opportunity study to one or two years for a detailed feasibility study of a complex project.

Since the cost element is a vital determinant aspect of various types of pre-investment analysis, it would be appropriate to, at least, indicate orders of magnitude regarding such costs, if such studies are undertaken by outside agencies. It must be stressed, however, that these figures are cited on general rule-of-thumb basis and should not be considered as being other than order-of-magnitude estimates.

For opportunity studies, the order of cost as related to the magnitude of projected capital outlay may be approximately as follows:

(a)	For one specific branch, such as newsprint paper, rayon, grade pulp, aluminium (The cost would be 25 per cent to 100 per cent more if raw material analysis or tests by pilot plants are involved.)	0.1 to 0.5%
(b)	For a group of opportunities for associated industrial branches, e.g. based on date palm cultivation, or on limestone, or metalworking industries	0.1 to 0.3%
(c)	For subsector opportunities, such as building materials industries, machine building industries, agricultural implements industries	0.1 to 0.2%

The costs of pre-feasibility studies are approximately 20 to 50 per cent higher than for similar opportunity studies. In some developing countries, pre-feasibility studies have, however, been undertaken by government organizations for small and medium-sized industries, with very low cost involvement for the investor.

The spread of costs in the case of feasibility studies is limited and may be related to projected capital outlays. The sophistication of the industry, technology and the agency which conducts the study, however, have significant bearing on total costs. Related to magnitude 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%

It may be necessary for support and functional studies to commission either the services of outside agencies or to organise a full team working for several months. The costs of such studies may sometimes be very substantial, though it should be significantly less than that of a complete feasibility study. Each case has necessarily to be evaluated on its own merits and involves the assessment of man-months necessary and levels, background and specialisation of the personnel involved, the use of equipment, and incidental costs, such as travel and living allowances, cost of drawings and mapping, etc.

6. Accuracy of cost estimates

The accuracy of estimates of investment and production costs rises while the project progresses from one stage to the other.

If compared with the respective ideal average value, which changes from stage to stage, the range of accuracy may be given for

- an opportunity study with appr. ± 30%,
- a pre-feasibility study with appr. ± 20% and
- a feasibility study with appr. ± 10%.

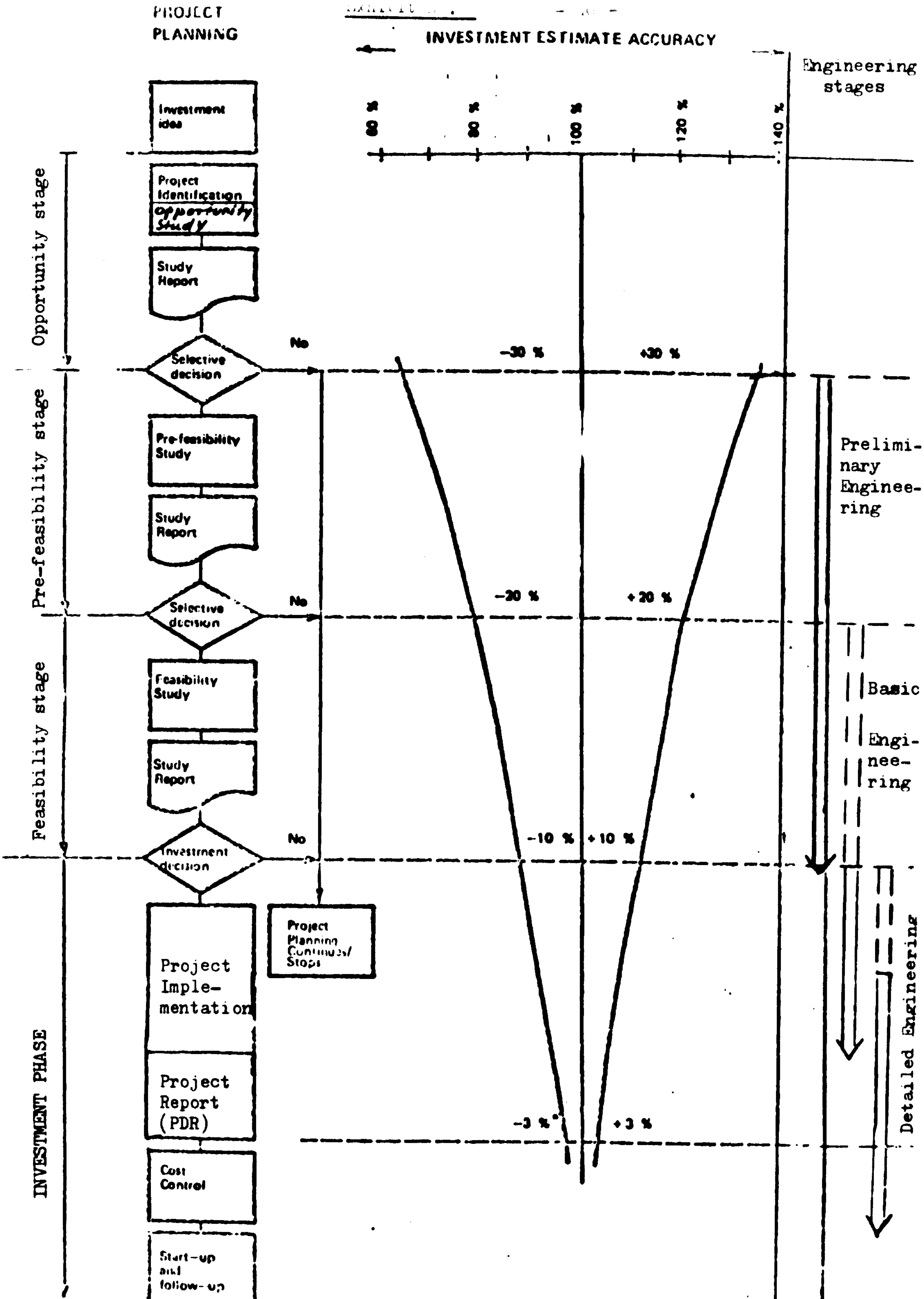
All these values are empirical averages which may differ from project to project and according to the applied method of cost estimate. Exhibit No. 2 gives a graphical presentation of these values as they arise as the projects develop.

For an opportunity study and for a pre-feasibility study this ideal average value is based partially on secured and partially on non-secured facts which are preliminary assumed as being secured ones. Thus, the ideal average can change essentially from one stage to the other and may even prove that the profitability of the project is no longer given.

Only at the stage of the feasibility study all relevant facts which may essentially influence the project are checked and their impact on the project and on costs is secured. Thus, the ideal average value will not differ very much from the actual one.

The accuracy of cost estimates is not only determined by the ratio of secured and non-secured facts but also by the methods applied which may range from global lump sum estimates to detailed offers and calculations. Further details on these methods are given in Part II-0.4.

In view of the above remarks it is conceptually wrong to decide to invest in a project based on an opportunity study by adding 30% to the estimated cost values without checking whether all relevant facts have been secured and taken into consideration.



Precision of economic analysis in investment planning

rce: Jaako Pöyry + Co OY, Consulting Engineers, Helsinki, Finland

7. Agencies commissioning and conducting pre-investment studies

Pre-investment studies of one or other category are commissioned by various agencies. As discussed earlier, project opportunity studies are often commissioned in developing countries by governmental institutions with a view to attracting investments, either domestic or foreign or in the form of a joint venture. In certain cases, pre-feasibility studies have also been commissioned by public bodies, including investment promotion organizations and industrial development banks. A large number of opportunity and pre-feasibility studies have also been conducted by private companies.

As for feasibility studies, however, these are generally commissioned by the organization, domestic or foreign, which is directly interested in the investment itself. This can be a domestic industrial enterprise interested in expansion or diversification or an industrial development bank. But also government departments and institutions can and have sponsored feasibility studies, particularly in countries where industrial development is mainly to be accomplished through public enterprises as a matter of policy.

Pre-investment studies are prepared by various types of organisations such as governmental and institutional agencies dealing with industrial development, industrial enterprises, consulting firms, turn-key contractors and equipment suppliers. Since the project opportunity study is often an industrial promotion measure, semi-governmental institutions are performing this task in a number of developing countries, particularly for small-scale industries and medium-scale enterprises, not involving sophisticated and complex technology. Industrial companies themselves provide an adequate repository of knowledge and skills to cover the various stages of pre-investment analysis, especially when expansions in the same or allied lines of manufacture are required. Generally they cover the opportunity or pre-feasibility stages also in the case of diversification proposals. At the stage of the feasibility study, however, specialised expertise is called for, mostly in the form of foreign or local consultancy services.*/

*/ Manual on the Use of Consultants in Developing Countries, New York, 1972 (Sales No.:E.72.II.B.10).

Part II

The feasibility study

0. General remarks on the preparation of a feasibility study

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0.2 Project team

0.3 Scope of the project - how to calculate a project?

0.4 How to obtain data?

0.5 Justification of alternatives and assumptions

0.6 Proposed cost structure

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0.8 Local and foreign exchanges

0.9 Inflation and contingencies

0. 1 **Table of Contents**

The ultimate objective of any full-fledged feasibility study is to prepare for an investment decision. To facilitate this decision, the study should be clearly arranged and easily comprehensible despite the fact that the final version of the study is the result of an optimization process taking into account many data, alternatives, partial solutions and feed-backs within the project and parts of it.

The following proposal for a table of contents takes these conditions into account. It is generally applicable to all feasibility studies. However, its elements will not necessarily have to be studied in the sequence given in the table of contents.

Chapter 1 contains a synopsis on all essential data and findings to enable the reader's quick familiarization with the study. In all other chapters it was attempted to group related topics in such a way that their solutions and findings constitute the basis for the following chapters.

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	3.3	Production programme
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6		Project engineering
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	10.1	Total investment outlay
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	10.5	National economic evaluation
		Annexes

0.2 The project team

It is advisable to have a feasibility study conducted by a team of experts, although, it frequently occurs under extreme conditions that a single expert has to carry out a study. This may be due to certain constraints such as paucity of funds and non-availability of expertise at the right level and time. Yet, an economist unaided by an engineer may have difficulties with the assimilation of technological and engineering problems and an engineer, left alone, will require an undue amount of time to familiarize himself with demand analysis, financial analysis or tax laws.

As a general rule, the members of the project team should be selected to cover all major substantive fields touched upon by the project. Depending on the actual situation and the requirements of the project, the team may at least consist of:

- one demand analyst
- one (or more) technologists/engineers specialized in the candidate industry and/or special branches
- one mechanical engineer
- one civil engineer, if needed
- one industrial management/accounting expert
- one industrial economist (preferably as team leader)

This team should be assisted by short-term experts such as land surveyors, soil experts, laboratory experts, etc.

The team leader's responsibility would be, besides his own role as specialist, to plan, organize, direct and supervise all actions of the team until the study is finalized.

The team leader will also be the counterpart of the investor who is playing an important role during the preparation of the study. In many cases the project is initiated by the investor who frequently has also made the primary investigations on its opportunity and can therefore be considered as major source of information on the background and history of the project. During the preparation of the study many entrepreneurial decisions have already to be taken preferably by the investor e.g. on marketing and production programmes, the selection of alternatives etc.

0.3 Scope of the project

A pre-condition for improving the accuracy of investment and production cost forecasting is a clear comprehension of the scope of the project. Since industrial projects extend frequently beyond the boundaries of the production plant site, it is necessary to define the project widely and to cover also investment and production costs related to the supply of inputs, the delivery of outputs and ancillary investments. Therefore the term scope of the project should embrace all activities scheduled to take place at the plant site as well as auxiliary operations related to the production, extraction, off-site transport and storage of inputs, the off-site transport and storage of outputs (e.g. final products, by-products, wastes and emissions) as well as to ancillary facilities off the plant site such as housing schemes, educational, training or recreational facilities.

The main objective of grouping the project this way is to force the project planner not only to look at the material and product flow during the processing stage but at the preceding and succeeding stages as well. In addition, decisions can be prepared whether storage and off-site transport of inputs and outputs and the corresponding investments are to be provided by the project or third parties such as the suppliers of inputs or the distributors of the final product.

In order to obtain a better comprehension of the structure of the project and to facilitate the calculation of investment and production costs, the next step of the project planner should be to divide the entire project into functional, easily calculable components such as production sheds, storage buildings, administrative buildings and auxiliary facilities such as supply net works for water, gas and electricity, sewage system, telephone, internal connecting roads etc. Occasionally even major equipment (e.g. rotary kiln of a cement factory or a large vertical turrent boring machine of a heavy engineering firm) could be considered as components.

To facilitate the calculation of equipment costs and production costs it may frequently be necessary to further subdivide such components since they may cover several departments (cost centres). The division into project components should be based on the physical lay-out drawing which shows the arrangement of the project and the dimensions of its components. To facilitate the computation of the project costs it is recommended to treat the components as "sub-projects" which, once added up, will yield the investment and production costs.

0.4 How to obtain data for a feasibility study

Investment and production costs should be estimated as accurately as possible keeping, however, in mind that the costs and time involved to obtain the needed data should merit the results achieved. It may therefore be necessary for the project team sometimes to accept data of lower accuracy and to rely on assumption not properly justified. If this is the case it should be indicated in the study.

Investment cost estimates can be ranked according to their accuracy and the costs and time required to obtain them:

(1) Calling for tenders based on specifications and bills of quantities is the most accurate but also most expensive and time consuming method.

(2) Using prices from similar projects to calculate costs based on specifications and bills of quantities.

(3) Using cost parameters derived from comparable already operational projects, e.g. measured in m^3 of space enclosed or m^2 of built-up area or similar.

(4) Estimate lump sums for groups of equipment or functional project parts based on costs of comparable, already existing projects. The degree of accuracy decreases and the possibility of omitting essential project parts increases with the growth of coverage of the lump sums.

Investment cost estimates based on cost parameters and on lump sums have to be adjusted taking into account:

- annual inflation rates,
- changes in foreign exchange rates,
- differences in local conditions (e.g. climate , which may cause additional costs for air conditioning),
- different laws and regulations e.g. on security,
- accessability of the construction site.
- others

The accuracy of production cost estimates depends on the availability of data on input requirements such as for material, manpower and overheads. The latter are difficult to estimate particularly at the feasibility stage.

Quotations for material and labour costs can be obtained locally or in case of imports through tenders from suppliers abroad. In the case of labour inputs the prevailing labour legislation, the local labour productivity etc. have to be accounted for. When estimating input requirements use should be made of the

- production programme,
- work programme (number of shifts, working days/year etc.),
- type of technology and equipment,
- skills of labour and staff,
- quality of inputs.

One important data source for feasibility studies are reference data published by industrial associations, equipment manufacturers, development banks and international organizations. */ They have to be applied

*/ Two UNIDO publications, the Profiles of Manufacturing Establishments and the Extracts of Feasibility Studies were prepared with the objective to provide planers in developing countries with reference data. The Profiles Series (4 volumes) provide an international collection of industrial establishments, each being depicted at one step more detailed level than the conventional industrial surveys thus showing the functional relationship between key variables of the establishment covered. The complication of the Profiles can procedurally be linked to the effort of conducting diagnostic studies on existing industries which is itself a pre-requisite for industrial development planning. The Extracts give neutralized summaries of techno-economic parameters of general reference value taken from well-documented feasibility studies. The cost price information is more explicitly structured for analytical purposes than the information normally available from the accounting records of operating enterprises like in the case of the Profiles.

carefully, taking into account their data of collection, plant size and possible economies of scale, country of origin and applied technical and economic conversion factors.

A large number of data are collected in the field e.g. on location and site, locational conditions and civil engineering. For these types of data it is recommended to identify the sources of data or groups of related data in order to enable their later verification or completion. Additional information should be made available as to the data of collection, the person or team in charge of the collection of data and/or samples and the method used. If laboratory tests or pilot plant processing were required, both should be briefly described and the results be communicated.

0.5 Verification of alternatives and assumptions

The preparation of a feasibility study is often aggrevated by the number of available alternatives (e.g. regarding the choice of technology equipment, capacity, location and financing) and the assumptions frequently underlying the decision-making process.

If a choice exists among alternatives, the feasibility study should

- outline the existing alternatives for solving a particular problem at hand,
- select an alternative and give reasons for its selection,
- indicate the methods and formulas used for the selection, and
- describe the selection process.

Similarly, underlying assumptions should be justified stating

- why an assumption had to be made,
- the assumption itself, and
- other assumptions, if existing.

0.6 Proposed cost structure

A. Definitions of terms used

Expenditures represent an outflow of cash within a given period.

Costs are not related to an outflow of funds during a certain period but represent the total amount of expenditures required to produce a certain good or service.

Incomes are an inflow of cash and originate from the sales of products or services within a given period. Incomes and expenditures comply with eachother.

Revenues, on the other hand, comply with costs and originate from the sales of a good or service disregarding the period of the actual cash inflow.

Therefore, a distinction has to be made between investment and production expenditures if the timely occurence of the financial outflows is to be considered, and investment and production costs if the total costs of the investment and the total costs required to produce a defined amount of goods are to be calculated.

The difference between the terms costs and expenditures and revenues and incomes becomes clearer if the monetary occurence of expenditures and the actual utilization of values (e.g. costs of raw material) to produce a good is compared within a defined period (e.g. one year). With regard to raw materials the difference lies between the purchase and processing which occur at different moments or which overlaps; with regard to equipment the difference between expenditures and costs is taken care of by depreciating the investment expenditures within a certain period (determined mainly by tax laws) in order to apportion investment costs through annual depreciation charges in line with the timely utilization of the equipment.

The application of these terms is as follows:

For financial calculations (e.g. project financing, liquidity) the terms expenditures and incomes should be used. The same applies for cash flow analysis and related discounting methods (internal rate of return) with the implication that depreciation charges should not be included as expenditures since the entire investment sum is already inserted into the cash flow table at the time when the investment occures.

The term costs should only be used in the context of unit cost calculation.

When calculating the internal rate of return or the present value, a simplification is frequently introduced regarding the terms expenditures/incomes and costs/revenues based on the assumption that the annual difference between expenditures and incomes is on the average the same as between costs and revenues. Since it is too difficult to apportion expenditures and incomes exactly to the period of occurence, calculations of internal rates of return are frequently based on annual average revenues and costs (minus depreciation).

B. Total investment costs

Investment costs for land and site preparations, pre-production capital costs and working capital concern the entire project and do not have to be calculated separately by project components as mentioned under chapter 0.4. Only investment costs for technology, equipment and civil works have to be computed by components/project department/sections (= cost centres).

1. Total investment

			see chapter
1.1	Fixed investment		
	Land and site preparation		5 and 6
	Technology		6
	Equipment	- production equipment	6
		- auxiliary equipment	
		- service equipment	
		- spare parts, wear and tear parts, tools	
	Civil works	- site preparation and development	6
		- buildings	
		- outdoor works	
1.2	Pre-production capital costs		2 and 10
	- preliminary and capital issue expenses		
	- pre-production expenses		
	- trial runs, start-up and commissioning costs		
1.3	Working capital		10
	Evolution of investment expenditures (cash flow)		10

C. Total production or manufacturing costs

Production cost estimates should be based on the requirements of the feasible normal capacity which is achievable under normal working conditions taking into account not only the capacity of installed equipment and technical conditions of the plant such as normal stoppages, downtime, holidays, maintenance, tool changes, desired shift patterns and indivisibilities of major machines to be combined but also the management system applied. Thus, the feasible normal capacity is the amount of units produced during one year under the above conditions and which are available for sales. These figures should correspond to those derived from the market study.

Contrariwise, the nominal maximum capacity is the technically feasible capacity and frequently corresponds to the installed capacity as guaranteed by the supplier of the plant. To reach maximum output figures, overtime as well as excessive consumption of factory supplies, utilities, spare parts and tear and wear parts will inflate the normal level of production costs.

		see chapter
1.	Factory costs	
1.1	Material inputs (variable costs)	4
1.2	Manpower (variable)	8
1.3	Factory overheads (fixed)	7
2.	Administrative overheads (fixed)	7
3.	Financial costs (fixed)	10.C
4.	Sales and distribution costs (variable)	3
	Evolution of production expenditures (cash flow)	10

0.7 Schedules

Each chapter contains several schedules for the calculation of investment and production costs. In most chapters it will be necessary to disaggregate the project into its components (e.g. cost or profit centres) in order to arrive at the investment and production costs. In these cases summary sheets are provided to sum up all cost items. All schedules and summary sheets are geared towards chapter 10 which sums up the total investment and production costs and projects the timely evolution as investment and production expenditures. Cross references are provided for all schedules.

0.8 Local and foreign exchange

In order to provide for the appropriate financing it has to be decided during the preparation of the project which parts of the investment and production costs will have to be paid in local and foreign exchange. When inserting these amounts into the relevant schedules the foreign exchange requirements should be converted into local exchange. The kind of foreign exchange and the exchange rate used should be indicated.

0.9 Contingencies and inflation

When planning an investment project, two types of contingencies are usually encountered: physical and financial contingencies.

Physical contingencies concern the precision of planning activities related to sales, engineering, material and other inputs. Thus, it may not be possible to exactly determine the amount of raw materials, utilities in particular energy requirements, manpower needs etc. In order to make up for this deficiency, recourse may simply be taken to adding a certain percentage (e.g. 5 - 10 per cent) on the physical volumes. Since the errors of estimation vary probably from item to item, it should be refrained from applying a standard across the board rate. In addition, it is felt that this would only encourage sloppy planning since it may be hoped that mistakes would be evened out this way. Therefore, it is proposed to estimate all items as precisely as possible and to indicate the degree of reliability. For this reason no provision for contingencies was made in any of the schedules and pro formas.

A much greater impact on the financial viability of the project is of course exercised by the financial contingencies (inflation) which may occur during the life of the project and which influence the magnitudes of fixed investments, working capital and production costs but also of sales. The liklihood that all four components would have the same inflation rate is minimal, on the contrary, wages, salaries, equipment, utility and sales prices will change at different rates. Such growth rates may remain contant or change abruptly over time, e.g. exchange rate corrections.

Looking at prices for items of fixed investment, e.g. for equipment and civil engineering works it is obvious that price forecasts for mainly imported equipment will be rather difficult and that it should be made by country of origin. Prices of locally produced equipment and of civil engineering works may be easier to project but care should be attached to the import content of local equipment and buildings which may have a detrimental impact on the rate of price increases. Therefore, equipment and civil works should be inflated seperately and where possible, account should be taken of imported inflation.

A similar approach should be taken with regard to costs of material and labour inputs. Labour costs with change at different rates than costs of materials and utilities. Account should however be taken of increases in labour productivity.

A further aspect which is frequently overlooked in feasibility studies is the charge of fixed costs as production increases. Better utilization of machine capacity through the introduction of shift work requires more maintenance and supporting administration.

Working capital requirements need not only to be checked in view of the gradual attainment of full capacity but also in view of the increased cost of the items to be financed from working capital. Consequently, appropriate different inflation rates should be applied for local and imported materials, utilities, labour, etc. when projecting the working capital.

As far as forecasts are concerned it will not be sufficient just to project the quantities of sales but to anticipate price changes as well.

Obviously it will be very difficult to arrive at reasonably valid projections since the margins of error are rather wide. In any case it is recommended to subject these projections to sensitivity analysis and to calculate the errors of projections.

To summarise, it is recommended to apply different inflation rates by countries for the component constituting production costs, fixed investments, working capital and sales, a method which is also applied by the World Bank. In view of the large amount of oomputations required to prepare the cash flow table net income statement and projected balance sheet based on these different inflation rates, it is suggested to apply computerised investment evaluation programmes such as the one developed by the Oesterreichische Industrie Verwaltungs AG (OIAG) for large-scale projects.

0.10 Case study

To facilitate the application of the Manual, the following case study has been worked out. As of Chapter 10 of Part II all schedules and calculations will contain data taken from this case. Particularly when calculating fixed and working capital and when preparing cash flow tables for financial planning and commercial profitability evaluation, the availability of case material will facilitate the presentation of the concepts. In order not to overload the Manual with statistics, it was refrained from putting data into the schedules attached to Chapters 1 - 9.

Product ISIC: 3220, clothing of textile fabric (not knitted or crocheted)

(000)$

a) Fixed investment — 8,300
- land 300
- buildings 1800
- equipment 5200 (incl. 500 for pre-prod. capital costs)
- cars 1000
- replacement of cars in year 8: (1,000)

b) Working capital — 2,000

c) Other current assets (2 + 3 = current assets) — 400

d) Sources of financing: total — 10,700
- current liabilities (accounts payable) 400
- supplier's credit (terms: repayment of credit over 5 years in equal instalments plus 8% interest) 3,000
- bank overdraft to cover 75% of working capital, interest 9% — 1,500
- equity capital — 5,800

e) Sales revenue: 2,000,000 units x $6.25 = $12,500,000

f) Production costs in year 8: variable 6,500 and fixed 3,280 — 9,780
of which depreciation (linear) = 780 calculated as follows: buildings 30 years; equipment 10, cars 5 years.
For an exact breakdown see Schedule XC_1.

g) Construction time: 2 years

h) Corporate tax: 50% of the profit net of interest:
Tax holiday during the first five years of operation

i) 4% divided on equity capital

j) Start-up schedule of production:

Year	Capacity utilisation	Sales revenue	Factory costs
1	55%	6,875	6,000
2	75%	9,375	7,350
3	80%	10,000	7,670
4-10	100%	12,500	9,000

Chapter 1 EXECUTIVE SUMMARY

A feasibility study should arrive at definitive conclusions with regard to all basic issues pertaining to a project after consideration of various alternatives. For convenience of presentation, these conclusions and recommendations should be summarized in the "Executive Summary" which should briefly cover all critical aspects of the study.

1.1 Project promoter (see chapter 2)

State: name and address of project promoter

1.2 General project indicators (see chapter 2)

State: project orientation: Market or raw material oriented

- market orientation: domestic or export
- economic and industrial policies supporting the project
- project background

1.3 Market and plant capacity (see chapter 3)

List annual dates on:

- demand
- projected sales
- production programme
- plant capacity

1.4 Material inputs (see chapter 4)

Describe general availability of:

- raw materials
- auxiliary materials
- factory supplies and
- utilities

List annual supply requirements of material inputs.

1.5 Location and site (see chapter 5)

Describe location and state plant site

1.6 Project engineering (see chapter 6)

Describe the layout and scope of the project

State finally selected technology

Summarize the selected equipment

Describe required civil engineering works

1.7 Administrative set-up and overhead costs (see chapter 7)

1.8 Manpower (see chapter 8)

State:
- selected type and size of labour force
- selected type and size of staff

1.9 Project implementation (see chapter 9)

State duration of:
- plant erection and installation
- production start-up and running-in period

1.10 Financial Analysis (see chapter 10)

1.10.1 Total investment outlay

List major investment data in local and foreign exchange as needed for

land and site preparation
+ civil engineering works
+ technology and equipment
+ pre-production capital costs
+ working capital

= total investment outlay

1.10.2 Project financing

State:
- sources of financing
- financial institutions
- conditions of financing
- financial ratios

1.10.3 Production or manufacturing costs

List annual data for

factory costs
+ administrative overheads
+ financial costs
+ sales and distribution costs

= production costs

1.10.4 Commercial profitability criteria

List:

- pay back period
- simple rate of return
- net present value
- internal rate of return
- break-even point

1.11 Other essential information on the project

National economic evaluation (see chapter 10.E)

Appraise project proposal from national economic point of view applying e.g.

- UNIDO Guidelines on Project Evaluation
- UNIDO/IDCAS Manual for the Evaluation of Industrial Projects in Arab Countries
- others

Chapter 2 Background and history

In order to ensure that the numerous external conditions which can effect the project during its operation are well taken care of in the feasibility study, it is important to have a clear understanding of how the general project idea fits into the framework marked by the economic conditions, the general development and the industrial development of the country.

The product should be described in detail. The sponsors of the feasibility study should also be identified, together with the reasons for their interest in the project.

2.1 Background of the project

Describe the project idea and

- list the major project parameters which served as guiding principle during the preparation of the study: product and product mix, plant capacity and location, market or raw material orientation of project, implementation schedule and others;
- outline the economic, industrial, financial, social, and other related policies;
- show different geographical levels, such as international, regional, national, areal and local and
- highlight the economic, sectoral and sub-sectoral project coverage.

2.2 Project promoter and/or initiator

State:

- name(s) and adress(es)
- financial possibilities
- role within the project
- other relevant information

2.3 Project history

Describe:

- historical development of the project (state: dates of essential events in project history);
- studies and investigations already performed (state: title, author, completion date, ordering party);
- conclusions and decisions taker from these former studies and investigations for further use within this study).

2.4 The feasibility study

State:

- author, title;
- ordering party.

2.5 Cost of preparatory studies and related investigations, provided that they form part of the project's pre-production expenses (see Schedule 10-2/1), i.e. that they are to be borne by the project and not by third parties.

State cost for:

- pre-investment studies, such as
  . opportunity studies
  . pre-feasibility studies
  . feasibility study
  . partial studies
  . experts, consultant and engineering fees
- preparatory investigations, such as
  . land surveys
  . quantity surveys (market, raw materials etc.)
  . quality (= laboratory) tests
  . other investigations and tests
- others

For calculation use attached Schedule 2-1 and insert total in Schedule 10-2/1.

Schedule 2 - 1

Estimate of Investment - Cost : PRE - INVESTMENT STUDIES AND PREPARATORY INVESTIGATIONS

ESTIMATE OF INVESTMENT COST

PRE - INVESTMENT STUDIES AND PREPARATORY INVESTIGATIONS

Item						Unit Cost	Cost		
[illegible]	[illegible]	[illegible]	Description	[illegible]	[illegible]		foreign	local	total
(1)			Pre - investment studies						
			. . . . .						
			. . . . .						
			. . . . .						
(2)			Preparatory investigations						
			. . . . .						
			. . . . .						
			. . . . .						
Total									

Insert TOTAL in Schedule 1o - 2/1

Chapter 3: Market and Plant Capacity

Pre-condition for the commercial production is the existence of a market for the product. Demand analysis is therefore a prerequisite for project formulation. The size and composition of the present effective demand of the over-all market and by segments should be determined prior to projecting the domestic and external demand during the life of the project. An essential feature of demand projections is an estimation as to the degree of market penetration that may be possible for a particular product.

As an extension of demand analysis, income projections from sales should be undertaken as an iterative process taking into account technology, plant capacity, production programme and marketing strategy. The latter has to be set up during the feasibility study stage giving due consideration to product pricing, promotional measures, distribution systems and costs.

Once the sales projections are available, a detailed production programme should be determined showing the various production activities and their timing. The final step at this stage of a feasibility study is to determine the plant capacity taking into account alternative levels of production, investment outlay and sales revenues.

3 Market and plant capacity

3.1 Demand and market study

3.1.1 Fundamental data and alternative projection methods

- List and describe fundamental data needed for the demand and market study
- List and describe possible alternative methods of data evaluation and determination of present and future demand
- Select and describe in detail the methods of data evaluation and demand determination to be used for the project under consideration
- State reasons for selection

3.1.2 Determination of demand and market size for products (by-products)

Evaluate data and present final results showing the

- size and composition of present effective demand (total and by market segments)
- demand projections for the total market and by segments for the lifetime of the project expected
- expected market penetration by product

3.2 Sales forecast and marketing of products and by-products

3.2.1 Fundamantal data and alternatives

- Describe fundamental data required in addition to the results of the demand and market study
- List and describe possible alternative sales and marketing programmes

3.2.2 Selection of sales programmes and marketing strategy

(1) Select and describe in detail the final sales programme

- state reasons for selection

- presentation of the programme:
  descriptively, tables, graphs and maps as appropriate showing the development throughout the life of the project

(2) Select and describe in detail the adopted marketing strategy

- state reasons for selection

presentation of the marketing strategy:
- . product pricing
- . promotional efforts during the pre-production and production stages
- . organizational set-up of distribution and sales
- . commissions or discounts on sales
- . after-sales facilities and services

3.2.3 Estimate of sales revenues

Estimate annual sales revenues based on the sales programme and the marketing strategy

Use schedule 3-1 and insert totals in schedules 10-8/3, line A.2, 10-13, line A.1 and 10-14, line A.1.

3.2.4 Estimate of sales and distribution costs

- Estimate of sales costs
- Estimate of distribution costs

Use schedule 3-2 and insert totals in schedule 10-11 (10-3/1).

3.3 Production programme

3.3.1 Fundamental data and alternatives

- Describe fundamental data required to set-up a production programme
- List and describe possible alternative production programmes

When preparing the production programme, keep in mind <u>inter alia</u>:

- anticipated sales
- minimium storage requirements
- expected wastage
- parameters of plant capacity
- after-sales requirements
- reserves due to operational reasons

3.3.2 Selection of production programme

- Select and describe in detail the production programme
- State reasons for selection

The production programme should define

(1) for each product (and by-product)

- quality specifications
- quantities produced annually

- time schedule of production (start-up, trial runs, full capacity production)

  Use schedule 3-3 and insert estimated rate of capacity utilization in schedules 10-8/3, 10-13 and 10-14.

(2) for emissions such as:

- . wastes and efluents (to be treated or not) dust, fumes, noise etc.
- . quality of emissions
- . quantities of emissions
- . time schedule
- . means of treatment

3.3.3 Estimate costs of emissions disposal.

Estimate annual costs of emission disposal such as:

- treatment (as far as not yet covered under equipment and civil works)
- disposal in dumps and/or sewage system
- compensation payments to neighbours for damage caused by emissions

Use schedule 3-4 and insert total in schedule 10-11 (10-3/1).

3.4 Plant capacity

3.4.1 Fundamentral data and alternatives

- Describe fundamental data for the determination of plant capacity (feasible normal vs. nominal maximum capacity)
- List possible alternatives on plant capacity

3.4.2 Determination of feasible normal plant capacity

- Select and describe in detail the feasible normal plant capacity
- State reasons for selection
- Describe nominal maximum capacity

The selection of the feasible normal plant capacity should be based on:

- parameters of the production programme
- parameters of minimum economic equipment size

Plant capacity should be determined as feasible normal capacity for:

- . the entire plant and
- . main departments (semi-finished products)

Schedule 3 - 1

Estimate of sales revenues

PRODUCTS BY-PRODUCTS			YEAR 1						YEAR 2						YEAR 3						YEAR 4					
DESIGNATION	UNIT PRICE		QUANTITIES TO BE SOLD			SALES REVENUES INCLUDING SALES TAX			QUANTITIES TO BE SOLD			SALES REVENUES INCLUDING SALES TAX			QUANTITIES TO BE SOLD			SALES REVENUES INCLUDING SALES TAX			QUANTITIES TO BE SOLD			SALES REVENUES INCLUDING SALES TAX		
	exp	loc	exp.	loc	total	exp.	loc.	total	exp	loc	total	exp	loc	total	exp	loc	total	exp	loc	total	exp	loc	total	exp	loc.	total
GRAND TOTAL																										

exp = export, loc = local

Sales revenues should be stated net of discounts.

In the case presented in chapter 10 provision is made for a construction period of two years. Accordingly, the first year of sales would be year "3" as indicated on the cash flow tables to which the sales data have to be transfered (Schedules 10-8/3, line A.2; 10-13, line A.1; 10-14, line A.1).

Schedule 3-2

Estimate of Production - Cost : Sales and distribution Costs

ESTIMATE OF PRODUCTION COST

SALES AND DISTRIBUTION COSTS

Item						Unit Cost	Cost		
[illegible]	[illegible]	[illegible]	Description	[illegible]	[illegible]		foreign	local	total
(1)			Sales costs						
			Training of salesmen and merchants						
			Advertising						
			Travel expenses						
			After sales services						
			Sales tax						
			Communication						
(2)			Distribution costs						
			Containers and packaging						
			Freight						
			Commissions						
			....						
			....						
Total									

Insert TOTAL in schedule 10-11 (10-3/1).

Schedule 3 - 3

Production programme

PRODUCTS BY-PRODUCTS WASTES	Units at 100 % capacity	YEAR 1 capacity %	YEAR 1 units	YEAR 2 capacity %	YEAR 2 units	YEAR 3 capacity %	YEAR 3 units	YEAR n capacity %	YEAR n units

Insert in Schedules 1o - 8/3, 1o - 13, 1o - 14

Schedule 3-4

Estimate of Production - Cost - EMISSIUNS BISPOSAL

Item						Unit Cost	Cost		
ESTIMATE OF PRODUCTION COST									
EMISSIONS DISPOSAL									
[illegible]	[illegible]	[illegible]	Description	[illegible]	[illegible]		foreign	local	total
(1)			Emissions treatment (as far as not covered under equipment and civil works)						
			. . . . .						
			. . . . .						
			. . . . .						
(2)			Disposal in dumps and sewage system						
			. . . . .						
			. . . . .						
			. . . . .						
(3)			Payments to neighbours						
			. . . . .						
			. . . . .						
			. . . . .						
Total									

Insert TOTAL in Schedule 10-11.

Explanatory notes to Chapter 3: Market and plant capacity

A. Demand and market

Effective demand represents the total quantity of a defined product which would be purchased at a given price in a particular market over a given period of time. A market can be viewed in narrow terms as the set of consumers, existing and potential, willing to buy a product or can be conceived in broad terms as representing the total environment in which transactions relating to a particular product take place and to which the proposed project must necessarily be adapted. In this manual, the broader view of the market has been adopted. Thus, while an assessment of effective demand relates primarily to variations in the extent of purchases by consumers, following on price fluctuations, a market study takes account of much broader elements and factors relating to a particular country or region where such transactions take place. In developing countries the role of governmental institutions and policies is of particular significance in the context of demand and market considerations which are closely inter-linked in these countries and need to be viewed in terms of their combined and total impact. Consequently, no clear and sharp distinction has been maintained between these categories in this manual and demand and market aspects have, by and large, been considered together.

Nature of demand analysis

The first step in project analysis is in most cases related to a detailed estimation of the size, structure and basic characteristics of demand for the product to be manufactured. In almost all cases, a certain amount of primary data has to be generated since secondary data in requisite detail is not available, and when such data exists, it is often not published or accessible. There is also great reluctance on the part of producers to reveal information on operational aspects of industry and of consumers on family budgets, personal incomes, consumer habits, preferences and responses. This fact and frequent changes in socio-economic living patterns often render available historical data largely irrelevant for the purposes of industrial programming. These difficulties are encountered specially when a new product, not domestically produced or imported in large quantities, is to be introduced. On the other hand, in many cases, the market and demand analysis in developing countries may present an easier task during earlier stages of development since the majority of industrial projects in such countries is in the beginning geared to import substitution, and the extent of imports constitutes an indicative parameter. Often, the initial entrepreneurs, particularly as far as consumer goods are concerned, are former importers of such products and are fairly well acquainted with existing market conditions. Import figures of varying degrees of accuracy can also generally be obtained by other potential entrepreneurs.

Certain products and projects may also constitute exceptions to the general convention of initiating feasibility studies with estimates and analysis of domestic demand though certain special aspects of demand would need nevertheless to be studied in such cases. There may exist a large and obvious effective demand in a country which may not warrant a detailed study to establish the justification for substantial production capacity, and only some aspects of demand growth and market absorption would require analysis. For example, in a large agricultural country, a broad market analysis may not be necessary for a fertilizer plant for which there would obviously be sizable unsatisfied efffective demand, but the pattern of demand growth for different types of fertilizers and implications of market absorption in each case would require to be studied. A detailed analysis of domestic demand need not be the initial step in project formulation if a project is to be based on an abundantly available natural resource, and it is obvious that international markets exist.

The critical question in demand and market analysis is to estimate the demand for a defined product during the life span of a proposed project keeping in mind that the financial and commercial viability of the project is <u>inter alia</u> dependent on the projected sales or income. The size of demand at any given time is a function or several variable factors such as the composition of the market, the degrees and extent of competition from other sources of supplies of the same product and substitutes, income and price elasticity of demand, market responses to socio-economic patterns, distributive channels, and consumption growth levels. The problem of demand appraisal is consequently a more complex exercise than is commonly assumed. The problem gets accentuated because, while the primary task of analysis is to estimate the size of demand for a particular product, it is also necessary to identify its components (product-mix) and segments or consumer groups, its characteristics, social and institutional constraints and restrictions and its growth dynamics and sensitivity. Inadequate or inaccurate analysis of the demand growth pattern and degree of market penetration usually results either in the establishment of excess production capacity and poor capacity utilization as is often the case in developing countries or in insufficient plant capacity which is unable to meet market needs and cannot take adequate advantage of the economies of scale.

1. Contents of demand analysis

A demand and market study should aim at providing certain basic information on a product whose broad technical specifications and characteristics have to be given at the outset. The basic information to be ascertained could be summarized as follows:

(i) size and composition of present demand in a market whose geographical limits should be defined;

(ii) the composition of the market by segments which may be:

- (a) geographical such as regional, national and export markets;
- (b) by end-uses, such as different consuming branches of industry; or
- (c) by economic segments such as different income levels of consumers;

(iii) the demand projections of the over-all market and of the segments over a period of time preferably for the first ten years of the operational life of the project;

(iv) the market penetration ratio which the proposed project is expected to achieve over the projected period in the context of developing domestic and international competition and changing consumer preferences and responses and;

(v) the broad pricing structure on the basis of which projections of growth and market penetration are made.

The conditions of sales promotion including where necessary the type of after-sales services and the packaging standards contemplated as well as the sales organization to be established are normally also part of the demand and market study. They are dealt with in the succeding subchapter B.

The factors governing export markets tend to be more complex than those of domestic markets, and the techniques of estimation and forecasting need to be considered separately.

Though a study should usually have a defined product with definitive characteristics as a starting point, it may be necessary, in the course of such analysis, to identify the important details and modifications which may be necessary in the specifications and detailed characteristics of the product in order to suit local, national or export markets to be served. Such changes should not be of so fundamental a nature as to change the basic character of the product itself but should highlight such features as need to be elaborated and as can be covered or adjusted in the course of project formulation. Depending on the nature of the product, such modifications may concern a number of aspects such as detailed categorization of products, design and specifications, performance, consumer preferences, packaging and the like.*/

*/ In the case of engineering goods industries, including machinery products, it would be necessary to determine the categories of the product in greater detail. Thus, in the case of a machine-tool project, a specific break-up of the market should be provided for different types of lathes or milling machines or other machine-tool category. For the production of refrigerators or electric fans, the market analysis should relate to different sizes of refrigerators and different categories of electric fans, such as ceiling, table or pedestal fans. In respect of product design, specification and performance, specific market requirements may take the form of certain approved standards as for boilers, pipes and other engineering goods. Such requirements need to be defined so that the product can be suitably adjusted to such needs. In the case of consumer goods products, as also for various engineering goods, the question of consumer preference for certain brands and makes or the type of packaging to which consumers may be accustomed in particular markets, need to be identified.

2. Size and composition of present effective demand

The initial objective of market and demand analysis for a feasibility study is the determination of current or present effective demand.*/ The base point for estimation is the actual consumption figure in the relevant period. It may, however, also not be easy to obtain consumption figures of most products. A short cut, or at any rate, a beginning has to be made with "apparent consumption" of a product which in a domestic market is arrived at for a given period by aggregating its production, and deducting or adding the changes in the balance of trade and in inventories. Thus apparent consumption (C_o) is:

$$C_o = P + (I - E) + (S_o - S_c), \quad \text{where}$$

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.

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*/ Current effective demand generally refers to 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 adopt the year in which the project is expected to commence commercial production as the base. This should generally be avoided as most of the data is available for past years and the base year itself would then need projection. Moreover, for certain projects, the commencement of a feasibility study is too early a point in time to be able to project with any precision the completion date of the project. Whether the year selected is a fiscal 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 publishes such data on a fiscal year basis, such as April to March, the fiscal year should be adopted.

Adjustments should be made for captive consumption of the product by the producers. Provision should also be made for abnormal factors to the extent that these can be gauged at all by escalating or deflating the final figures. Where such factors cannot be identified, it may 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.

In a competitive market current consumption may be equated with current effective demand. Current consumption, however, cannot be equated with current demand or requirements*/ in most developing countries, as there are various restrictions on consumption and imports of manufactured goods. In estimating the demand for a product, it is necessary to provide for 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 product, the nature of the market and the size and structure of the industry. A further significant factor would be the existence of monopolistic or oligopolistic imperfections. Domestic production itself may have remained restricted because of plan targets or as a result of non-availability of inputs, domestic or imported.

Apparent consumption must be recognized as being indicative only, and it is necessary to check apparent consumption of the base year and the trend with other subsidiary or secondary data. In demand studies, the factors not quantifiable have necessarily to be provided for on the basis of assumed discounts and

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*/ It is often erroneously assumed that demand analysis and forecasting is easier if a particular product is fully imported. Imports, however, are very illusory indicators of aggregate demand as they are subject to severe restrictions by quotas, exchange allocations or tariffs in most developing countries.

escalators. When such factors are not of significant magnitudes, there is no need for inflating or deflating the demand estimates, but nevertheless, this needs to be clearly brought out in the study.

3. Analysis by segments

Demand analysis, 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 analysis may commence for one segment and end with another segment. 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.

Market segments can be identified by nature of the product (qualities and end-uses), by consumer groups, or by geographical division of the market. The rationale for dissecting a market into segments by consumer characteristics is based on the fact that demand varies from one segment to another. Variations occur as a result of a number of conditions. Consumer habits in one case may change more rapidly than in another, and a high income segment may, for instance, show greater response in accepting a higher priced product. The impact of price variations on demand will be further discussed in part D on demand projections of this chapter. Some segments may even structurally grow at a faster rate than others. Segmentation of the market may facilitate the planning of marketing strategies for the project as considerable gains are possible by gearing promotional strategies to the characteristics of different market segments. One overriding consideration, however, is that in most cases the appraisal and projection of market size can be made only by separately analysing each market segment in line with a broad or detailed classification.

Since geographical, end-use and consumer group segmentation of markets differ from product to product, it is not possible to design guidelines on their nature and structure, but it is necessary to define such segments in a feasibility study for a particular product. In one case, such as dairy products, a large national market may be regionally divided; in other cases, such as steel, aluminium or paper, the market limits may extend beyond national frontiers. Even for the same industry or product, the segments may differ for different countries, and whereas territorial segments may be critical for a product in one country, the end-use aspect would need to be concentrated on in another case.

4. Demand projections (domestic and exports)

The projection of market demand constitutes, perhaps, the most significant and certainly the most complex element of market and demand analysis, since it is the critical factor for determining both the viability of a project and appropriate plant capacity. Essentially, such projections need to cover:

(i) the forecast of potential demand for the subject product or prodcuts;

(ii) estimates of potential supplies;

(iii) an estimate of the degree of market penetration that the proposed project is likely to secure; and

(iv) the characteristics and features of potential demand spread over a period of time. Quantitative and qualitative figures need to be provided on these various aspects.

The first task is to project the potential demand for a product over a reasonable period of time. Except for products, which are wholly or substantially export-oriented, such projections need to deal with national markets in the first instance. Export possibilities also need to be assesed but the nature of projections required tend to be somewhat different in emphasis and detail and have consequently been dealt with separately in the manual. The basic steps necessary for projections of national demand are to:

(i) define, assemble and analyse available data regarding existing consumption and rates of change over a period of time;

(ii) classify such consumption data by market segments;

(iii) identify the indicators or factors which have been principal determinants of past demand and the relationships between such factors and past demand;

(iv) project future development of the factors and their relationship with demand; and

(v) forecast demand through extrapolation of the factors by one or other method or a combination of such techniques.

In the case of new products, this task is more difficult and may have to be viewed against demand growth trends in other countries at the related level of product development, together with economic and other indicators. In the case, for example, of TV sets in a particular country or region, where television is initially introduced, the projected demand for sets may need to be related to experience in other countries during such stage but a more important determinant factor would be the general income levels and living standards in the area in question.

The determinants of future demand would naturally depend a great deal on the type of product and its end-uses. The determinant elements would tend to differ widely between non-durable and durable consumer goods and between intermediate products and capital goods and also as between single-use and multi-use products in each of these sectors. Certain products, principally consumer goods, can be directly related to general economic indicators such as size of population and its structure, income levels, growth and distribution, urbanization coefficients and the like. In other cases, demand growth is complementary such as the demand for electric lamps and appliances which is related to the growth in power generation and distribution or the demand for capital goods products which are directly related to growth rates in the principle machinery-consuming branches. In the case of consumer durables and capital goods, an important element may be the replacement factor. The demand for certain products may be linked to certain distinctive phenomena related to end-uses. The demand for newsprint, for example, grows with newspaper and magazine circulation which, in turn, is related to growth of literacy and education. Products such as asbestos pressure pipes would be related to investments in community health engineering and water supply programmes. The demand for petrol pumps at service stations would depend on the vehicular population and to the number of service stations. It is not, therefore, possible to generalize as to the factor determinants for demand growth and there is no alternative but to specifically identify the major growth determinants in relation to the product under consideration.

Forecasting techniques

There are various methods employed for forecasting effective demand, ranging from relatively simple techniques to sophisticated mathematical processes, some of which have to use computer facilities. The technique to be utilized in a particular case depends on the type of the product, the nature of the market it is intended to serve and the principal determinants of demand growth. It is not the intention in this manual to elaborate the various forecasting techniques in any detail since considerable literature is available. It is, however, necessary to define and outline some of the principles underlying these techniques so that, both in the preparation and evaluation of feasibility studies, it is possible to asses the appropriateness of the method used and the qualifiying aspects which may need to be borne in mind. The following techniques may be used for demand forecasting:

(i) trend (extrapolation) method;

(ii) consumption level method (including income and price elasticcities of demand);

(iii) end-use or consumption coefficient method;

(iv) regression models;

(v) leading indicator method.

For further details about forecasting methods see Annex 6.

Market survey

A market survey in relation to demand forecasting for a particular product would be an expensive and time-consuming exercise. In its nature, it involves extensive field work, the extent of field investigation depending on how detailed the survey needs to be. Market surveys can either cover a broad field of inquiry or can be related to a specific product. The procedure followed in both cases is fairly similar though it would differ widely in detail. A note outlining the general features of a market survey is appended as Annex 7. Usually, limited market surveys are undertaken as part of demand and market analysis insofar as specific products are concerned, to cross-check the results of forecasts arrived at on the basis of one or other of the forecasting techniques outlined. Thus, if by use of the trend line or end-use technique, the market for electrical motors in the higher ranges is defined over a period of time, the results can be cross-checked through a survey of the principal industrial sectors which would be purchasing such motors. Or, the demand for steel over a period of time may justify a field market survey to test the hypothesis and results or forecasting through one or other of the above techniques.

Competition from domestic and foreign suppliers

Against the background of the various alternatives and combinations of techniques that can be adopted for forecasting demand, projections of supply of a product have to be a matter of judgement as this depends on the availability of a product through increased domestic production or through imports. Domestic production can take the form of expansion of existing enterprises or the establishment of new industrial units in the same field production. Existing domestic enterprises have an obvious advantage in that production capacity can be increased with relatively less capital outlay. In countries, where a formal or informal system of industrial licensing or governmental approval is operating, it is possible to project estimates of manufacturing capacity to a reasonable degree. In other cases, however, an independent assessment of domestic manufacture of a particular product would have to be made. The availability of a product in a particular market would, of course, also be determined by governmental policies relating to imports.

Export projections

The possibility of extending the market to other countries needs to be explored for most projects of any significance, as this has to be taken into consideration in determining plant capacity. It may be possible, through expansion of plant capacity to cater to a much larger market than the home country. Though a project may be conceived primarily as an import-substitution measure, it nevertheless may have export capability, either immediately on commencement of production or within a reasonable period of time, during which productive skills may need to be developed in order to be able to offer a product of international quality standards at a competitive price. Thus, a petrochemical or fertilizer plant can enter export markets much easier after commencement but the export of heavy electrical equipment, for example, may take some years till plant capability is adequately established and products are fully proved. In all such cases, export capability needs to be assessed, and this necessitates the determination of possible export markets as an essential feature of demand forecasts.

The evaluation of export markets has a somewhat different emphasis and orientation than forecasting domestic demand.

For products, which have a history of past exports or which are being exported currently, the starting point is already established with the collection and evaluation of data relating to quantities exported in value and units, unit price for exports, countries to which exports took place or are taking place at present and any special characteristics of the products exported, such as quality specifications or use of a particular brand name, either foreign or domestic, or use of a particular foreign selling agency. In certain countries, particular specifications need to be adhered to for engineering goods and other products and these need to be identified insofar as a particular product is concerned. Such information can generally be obtained either from the exporting enterprises or in the importing countries and has then to be related to the products to be manufactured and the nature of the enterprise proposed to be set up. A further survey has then to be undertaken of the size of the market in the countries already importing the product in mind and in other countries which can be considered to be in a similar category in terms of stage of development, import policies, shipping costs and other externalities.

In the case of new products, and this would be the much larger number of goods and services from developing countries, the starting point has to be an analysis of past imports into the home country, the unit cost of such imports, the countries from which such imports are taking place and the special characteristics of the imported product. Such information is, in any case, necessary, even from the viewpoint of domestic production.*/ In the first

*/ Except for relatively small projects, designed solely for local markets, there is close relationship between the domestic manufacture of a product and its production in other countries. Projects may be principally tailored to a domestic market but there is considerable interaction and interplay between the products of such enterprises and equivalent or similar products which can be obtained through imports. Such interaction may take the form of competition within the country or in external markets. Except in countries imposing severe import controls, domestic products have frequently to face competition with imported products but even in the former, the value, quality and delivery of equivalent imported products has considerable impact on the quality and price of domestic products. In some countries, a direct relationship is established in the matter of pricing, and domestically-manufactured products have to sell within a certain percentage under equivalent imported products (such percentage tending to be around 20-25 %). Even in the case of public sector projects, product pricing is sought to be related to the prices of comparable imported products. Thus, knowledge and awareness of the prices and quality of equivalent imported products is, in any case, necessary when formulating a project proposal.

instance, it is necessary to define the price and quality of the product in the international market. This is not particularly difficult. When related to export incentives and facilities provided by the home country, the pricing parameters can be identified.

The next stage is to define the geographical parameters of possible exports in the context of a particular product. While there is a global market for most products, some products have necessarily to be viewed as less global than others and various obvious constraints have to be taken into account. The market for certain consumer products such as cameras, colour TV sets, stereo equipment, electronic calculaters and the like is global but, at the same time, highly competitive. However, if a proposed product is considered to be internationally competitive in terms of quality and technological inputs, the global market can be considered in various stages of market penetration. There is no reason why such products, if produced in Latin America, should not be able to enter markets in Asia, provided the products are competitive in terms of technology, quality and price. In such cases, no detailed survey of all the countries is necessary and the export market survey may be initially confined to certain principal markets which should be sought to be penetrated initially and then gradually extended to other countries, as plant capacity is expanded to meet such increased market demand. For some products, scale economies may prove a determining factor in defining export markets. A plant contemplating production of 30,000 to 50,000 automobiles annually in a country in Asia cannot expect to compete effectively in external markets with other automobile manufacturers producing more than 300,000 automobiles. However, the export possibility of trucks is much greater as adequate scale economies operate at a much lower level of production and an export market survey could be undertaken, to cover neighbouring markets to start with and gradually penetrating into other markets. In the case of intermediate products and products of process industries, export could be determined by transport costs, assuming that such products are comparable in quality, which should normally be the case. For capital goods products, export markets have to be gauged in terms of possible acceptability of particular products to principal users. The number of such users is relatively much fewer than in the case of consumer goods products and greater stress is normally laid on quality and reliability as related to prices, together with aspects such as availability of spares and after-sale services. Machine tools produced in India are presently being exported to the USA in small quantities, but to set up a full-scale machine-tool assembly plant oriented solely to such exports may not prove appropriate, despite the fact that the US market for machine tools is very large. On the other hand other countries which are geographically contiguous to major markets should take export possibilities into full account for such a project. Projections of exports have to be related to the degree of penetration considered reasonable and practicable in any particular market.

After delineation of the geographical parameters of possible exports on the basis of reasonable projections as to the degree of penetration, a market survey may need to be undertaken in selected countries. The scope of such survey would vary from case to case and would depend on the degree of export orientation contemplated for a project. Thus, export surveys could range from projections of past imports in an external market with general projections for the future to a detailed demand forecast in any particular external market, using the forecasting techniques described earlier. The latter should, however, be undertaken only rarely and only when export prospects of a particular product are of such an order as to justify such an expensive course.

General information as to imports and sources of imports into developed countries can generally be obtained without too much difficulty. In the case of developing countries, suc information may be more difficult to obtain from published sources and visits to selected countries may be necessary. Most industrially-advanced countries have institutional agencies to collect and collate economic data pertaining to possible export markets and similar steps may have to be undertaken by developing countries contemplating significant exports of new and non-traditional products to a much greater extent than hitherto.

While an assessment as to possible exports is an essential feature of demand forecasts, it is necessary to sound a word of caution both as to the scope of such studies and their reliability over a period of time. With rapid, technological development, the market prospects in industrially advanced countries, as also in developing countries, tend to alter rapidly in a few years. It is far more difficult to anticipate such development accurately in a number of other countries than it is in respect of national markets.

Total demand

Total demand, present and projected, should therefore, cover both the national and export markets and relate to the degree of phasing of market penetration for a particular product. The demand or market study should, at the same time, highlight broad implications of penetrating such markets in terms of product pricing, quality, technology and special characteristics such as consumer reference for particular makes or brand-names. The marketing strategy which may need to be followed for one or other of these markets also needs to be broadly defined. It is only then that the demand study can serve a really effective purpose in determining plant capacity and the strategy to be followed in project formulation and implementation.

5. Market penetration

An essential feature of demand projections is an estimation as to the degree of market penetration that may be possible for a particular product. This would be related to (i) the degree of competitiveness, either domestic or foreign, (ii) consumer response, and (iii) the degree of substitutability. These aspects have to be considered for the product to be manufactured and an assessment made as to the share of the market that can reasonably be assumed. The conditions of market penetration also need to be defined, such as product quality, packaging, marketing and distribution arrangements, after sales services for machinery and other products, etc., as part of the over-all marketing strategy to achieve a targetted level of sales and income. Where a particular product is to be manufactured for the first time in a country and a system of licensing and of import controls is operating, consumer reaction and substitutability would be the determinant factors. The market penetration of the first synthetic fabric plant in a country would depend on the substitutability of such fabrics to cotton textiles. As second and successive units come up, however, the competitive element would be the principal determinant factor and price considerations would become dominant, though other aspects would still operate to a lesser extent such as quality, brand-name and the like.

6. Uncertainty - sensitivity analysis

The projections of demand for any product, which is inherently dependent on a number of variables, inevitably involves an element of subjective analysis as also of uncertainty. Whatever method or combination of methods is used, projections have necessarily to be related to various assumptions and probabilistic estimates. A number of factors relating to demand do not often appear on the surface and can never be fully accounted for. Unpredictable events such as the energy crisis alter the demand pattern for a wide range of products. Even excluding such factors, the problem of uncertainty extends to that of errors in estimation.

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 supressed 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 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 cost;

(x) Changes in tariff barriers;

(xi) Inflationary price rises (or declines) distributed unevenly over different commoditites; and increase in input costs;

(xii) 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. 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 10%, 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 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 1.0 and 1.5. The process of estimating alternatives 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. 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 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.

In making the sensitivity analysis, it is not sufficient to measure the effect by a single change (in a factor or 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 considerable arithmetical work and may necessitate the use of computer facilities but would yield a wide range of possibilities, which may fall under the categories of optimistic, pessimistic or realistic forecasts. The latter forecast could then constitute the basis for determination of market size over a period of time.

The degree of sensitivity to be applied to export surveys should be greater than in the case of national markets since some difficult items such as changes in tariff rates or in foreign exchange rates of domestic and competitive currencies have to be taken into account. From the viewpoint of determination of plant capacity, it would be more prudent to err on the side of pessimism than undue optimism insofar as export prospects are concerned.

The most common way of applying sensitivity analysis is the break-even analysis which is described in detail in Chapter 10.4 of part II.

Precaution for statistical analysis

The collection, analysis and application of demand analysis 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 analysing 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, a fairly large number of observations amenable to statistical tests of significance, should be taken into account. Trend established over a four year period howsoever marked 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) 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.

(vii) The dynamics of data and coefficients should be recognized. The price elasticity coefficient at $10 per unit cannot be used if the price rises to $20 per piece. The price elasticity may be 1.2 in accounting for demand for printing paper in 1960, it may be only 0.8 in 1975.

(viii) In identifying trends, coefficients and relationships, abnormal or extraordinary cases should be eliminated.

(ix) Simple averages should be avoided in preference to weighted averages.

(x) 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 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 analyse and process what does exist. There is, therefore, no justification for making rough, subjective estimates without statistical support.

The degree of precision required in demand analysis - which is correlated with time, effort and cost involved - should be determined by a reference to the basic criteria relating to the manufacture of the product, such as size, sensitivity of production to factor variations, vulnerability of the products to substitutes, etc. The criteria may include operational economics of the industry itself. An initial sales forecast, for example, may indicate that between 900,000, and 1,000,000 units of a product would be demanded by a given year. With greater precision, the forecast of sales may be estimated at 970,000 units, but such a degree of precision may not be necessary. Too much concern for precision and predilection for advanced econometric models and techniques may also not be justified, particularly if the source of data is of doubtful validity. To apply statistical measures of confidence (or probable errors) in analysing such data may be a wasteful exercise. The margin of error may be too great at the base for a precise statistical appraisal.

7. Information and Data

It is necessary to consider the information and material required for demand and market analysis and the extent to which these are readily available in many developing countries. Such information can be considered under two categories, basic data and specific market data for a particular product. The basic information required for most market studies covers aspects such as:

(i) general economic indicators having a bearing on product demand such as population, per capita income, growth of GDP, income distribution and the like;

(ii) governmental policies, practices and legislation directly related to consumption of the product in question, such as import restrictions, import duties, sales and other taxes, subsidies or incentives for industrial enterprises, credit controls, foreign exchange regulations, etc.

(iii) existing level of domestic production by volume and value over a period of 3 to 5 years including captive production of the product which is not placed on the market;

(iv) magnitude of imports of the product in value and volume for a similar period;

(v) existing production and imports of substitutes or near-substitutes;

(vi) data on major or critical inputs and complementary products;

(vii) production targets under national targets, where these are defined, together with that of substitute or near-substitute products;

(viii) volume of exports, if any;

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

(x) legal information.

The range of depth of specific statistical and background material that may be required in respect of a particular product depends on the nature of the product and the type and degree of market research that it may involve. It is not practicable to define any classification or prescribe any guidelines in this regard. In one case, past production figures may assume a position of decisive significance, in another case, the production data may be misleading. The same holds true for statistical information on imports, past consumption and prices. It is necessary to consider the determinant elements in each case as, in most developing countries free market forces are hardly operative and varying degrees of restrictions and controls can result in considerable distortion of data. The demand for a product may have been suppressed by the levy of a high import tariff, which would not be payable on products of a domestic enterprise. Or, an artificially high domestic price may be prevailing for certain products whose imports are severely restricted, but the pattern of demand and consequently of product pricing would change materially once the product became available in large quantities. It is, however, necessary to identify specific demand and market data considered necessary in respect of a particular product, the extent to which such data is available and could be utilized in the feasibility study or the alternative data on which the conclusions of the study have to be based.

The period to be covered by a market or demand study cannot be related to any standard pattern. In one case, a ten-year data may be barely adequate 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. It is also difficult to classify products for the purpose of fixing time periods for data collection. By and large, mass consumption products such as food items, bicycles, radio, TV sets and the like should be based on long-term series while, for intermediate and capital goods, a relatively short-term series may be adequate. It is necessary to define the period in each case with explanation as to why a particular time-span has been adopted.

Sources of information have to be identified and located in each case. Considerable information may be available from official published data, including statistical handbooks, census reports, resource, area or sectoral opportunity studies conducted by governmental and institutional agencies, publications of chambers of commerce and the like. Such data is seldom complete for the purpose of a market or demand study but constitutes an effective starting point. It is common, in many developing countries, that, while data is usually available on general economic indicators, such material is not adequately or readily available in respect of existing production figures. In some developing countries, such information is considered confidential insofar as production in particular industrial enterprises is concerned. Import data is, of course, available with governmental agencies, but is not always accessible. In most cases, a number of items may be lumped together, and disaggregation is difficult, and figures cannot be identified for detailed product classifications and sub-classifications. Data on inventories is difficult to obtain, except for certain products in respect of which there are official publications. Even to obtain basic information and data, considerable field research may be necessary.

B. Sales forecast and marketing

An analysis of sales and income from sales is essentially an extension of the initial demand analysis on the basis of which a project is developed. The parameters of market size and anticipated market penetration, which would be defined in the demand study, need to be further refined and have to be projected in terms of specific sales volume during different periods after a project goes into production. Estimating sales income is an iterative process which should not be based alone on a further detailed analysis of market and demand data, but which should also take into account technology, plant capacity, production programme and marketing strategies. The final determination of sales income may therefore only be possible once technology and plant capacity are more clearly known. The project planner has consequently to feed the technological concept into the sales and marketing programme in order to harmonize both and to lay down the production programme. Without such a cycle of feedbacks it would not be possible to cope with the complex matter of project planning.

In certain projects, where effective demand will exceed the envisaged production capacity, the volume of sales would tend to equate with the quantities produced at various production levels. Thus, the sales volume for a 600 t/d cement factory in an area where cement is in short supply would be between 180,000 to 200,000 tons annually depending on the number of days of operation. In terms of product pricing, the producing enterprise would be in an advantageous position though this would still be governed by the price elasticity of demand for the product on the one hand and production costs and distribution facilities on the other. Since the demand for cement is relatively inelastic up to a certain price level, sales may not be affected by the price, except if such price was so high as to result in construction activities being postponed. The extent of marketing research and strategy that may be required would be somewhat limited, though adequate distributive outlets would have to be provided and promotional activity undertaken to a limited extent.

The situation would be different in the case of a product where there is considerable competition or where substitutes may exist or where the demand elasticity may be high. In such cases, market research and strategies assume considerable significance. A suitable marketing strategy would have to be developed covering various market aspects, of which the most essential would be (i) product pricing, (ii) promotional measures including advertising, and (iii) the distributive system, including sales and distribution channels, sales commissions and discounts as well as costs of distribution.

The impact of these measures and of the marketing strategy as a whole would, however, emerge only considerably after a project is implemented and most of the measures themselves would be taken up in the post-implementation stage. The degree of detail in respect of marketing strategy that can be covered in the feasibility study stage is difficult to define and would necessarily vary from product to product but it must be recognized that in most cases it is possible to highlight and define only the basic aspects of such a strategy, leaving the details to be worked out during the post-implementation stage.

Before describing some aspects of the outlined marketing strategy, attention is drawn to the required market data of a feasibility study. As mentioned before, it is intended to use cash flow analysis as the major technique for project evaluation which in terms of sales and marketing data means that two distinct types of data have to evolve at the end of this chapter: the estimated sales revenue and the related sales and distribution costs. Both types of information should be kept separately and not be deducted from each other, since both enter into the cash flow table with different signs: the former as a cash inflow, the latter as a cash outflow.

1. Production costs and product price relationship

Product pricing has a significant impact in terms of both the volume of sales and income from sale of a particular quantity. The initial base in respect of any pricing policy should be the production costs and the market

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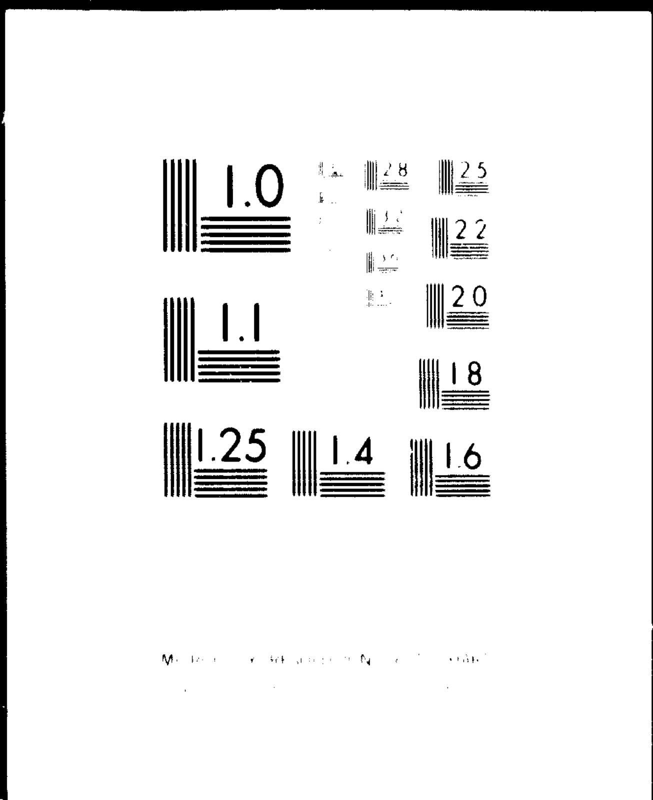

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structure for a particular product. From the viewpoint of the enterprise, the appropriate price for a product would be such price as would yield maximum income in relation to a given level of production. A monopolistic enterprise could perhaps sell its product at the maximum prices the market would be willing to absorb, subject to any regulatory action that the concerned governmental authorities may take in this regard. For an enterprise facing a high degree of competition on the other hand, constant adjustment becomes necessary between the maximum prices that can be obtained for a product and the production costs accruing against such enterprise. In respect of enterprises envisaging an expansion of an existing operation, the production-cost and product-price relationship can be determined fairly accurately. In the case of new projects, however, costs have to be anticipated or certain standard costs have to be assumed. The determination of standard costs for direct-cost items such as materials or labour may not be unduly problematic. The projection of overhead costs is more difficult since this could vary considerably with different levels of capacity utilization.

Direct or partial costing

It would be necessary for the feasibility study, however, to analyse the implications of product pricing in terms of projected sales so that income from sales can be determined. This can be a difficult exercise as a number of alternative situations can develop. Where production costs are estimated to be unduly high during initial production years or even over a fairly sustained period of time and full absorption of such costs in product pricing may have serious repercussions on the volume of sales, the implications need to be carefully assessed. It may not be possible for products in such cases to be initially priced at levels where all production costs are covered and an adequate profit margin is also maintained. In many cases, product pricing would have to be so adjusted to market responses that only the variable (direct) costs plus a part of the fixed cost or only just the variable costs can be covered for some time to come. This course may have to be adopted for a number of projects where long gestation periods are involved. In the manufacture of high-voltage electrical equipment or heavy and sophisticated mechanical equipment, domestic production costs in developing countries may be much higher for many years as compared to production costs in other countries where much older manufacturing plants are operating, with little or no depreciation liabilities and much higher productivity. Product prices in the former countries may have to be so determined that they are at least broadly comparable to international prices of such products and within a differential of 20 to 25 %. This would, however, inevitably mean that production costs may not be able to be absorbed in such cases for a number of years. If such plants are established, they may consequently have to face financial losses for relatively longer periods, unless wholly protected markets enable them to charge the required prices necessary to fully absorb such costs or such costs are subsidized. Even where markets are fully protected, it may not be practicable to charge prices disproportionately higher than international prices of such products as the costs of some other essential product or services such as cost of electric power may have to be raised. In many such cases, part of production costs may have to be absorbed by the enterprise and estimated as losses. The financial difficulties faced by certain public sector projects in developing countries producing capital goods and equipment may be partially due to this factor. The implications in this regard should be fully brought out in the feasibility study.*/ A more detailed description of product costing is given in chapter 10.C of part II.

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*/ The example may be quoted in this connexion of an electric equipment plant in a developing country in respect of which the feasibility study envisaged a continuing annual loss for over 12 years on the basis of competitive product pricing. The project was nevertheless undertaken as a measure of public policy. The actual losses on the basis of pricing which was more or less competitive were even higher than had been earlier estimated but, in recent years, the project has made sizable profits and, over a long period, must be considered as being quite viable.

Products may have to be priced below total production costs for certain periods not only because initial production costs may be unduly high but because only such lower prices would enable entry into a particular market. In the case of new products, a particular market or markets may have to be nursed through initially lower prices or this may be necessary because of the existence of a lower-priced substitute or because of the element of competition in the same product. In all these cases, there may be an initial period when product pricing would not be able to provide a profit element and may not be able to cover even total production cost. Such product pricing must, however, essentially be limited to a period of time. It would obviously not be commercially viable to undertake the manufacture of a project where product pricing would remain below total production costs plus profits over an indefinite period. Such a situation may, however, have to be allowed for in respect of a number of products over a short-term period and particularly during initial production years. The feasibility study should seek to define such a period on the basis of reasonable assumptions.

Product pricing may also be considered in the context of a monopoly or semi-monopoly situation. In such cases also, the implications of charging unduly high prices need to be assessed. Despite various degrees of control on industrial production in many developing countries, new projects would inevitably be attracted in production sectors where high profits are being made, except in fields where technology cannot be obtained because of its exclusive nature. Where there are such controls a monopolistic or semi-monopolistic situation may not be allowed to develop at all and where it occurs, it would be short-lived. It may in any case be more prudent to price a new product at a level which allows a reasonable profit to the initial enterprise and which discourages other entrants in that field of production than fix a price which is high and consequently yields greater profits but which invites a greater degree of competition.

The reaction from competitors producing the same product or a similar or a substitute product would also be very pertinent. The entry of a new manufacturing enterprise is naturally resisted, generally through a reduction in product pricing by competitors. Current product prices would not then provide an adequate basis for projecting sales income and the marketing strategy has necessarily to be evolved in the context of a qualitative appraisal of the nature of competition and its likely responses. The likely consumer response has also to be assessed. A product which is in substitution of an imported item would probably command a lower price because of consumer preference for imported items or particular brand names. In such cases, where imports would not be curtailed, a lower product price may have to be assessed, even though production costs may well be higher than for the imported product.

2. Promotional measures

The type of sales promotion efforts required and targetted market penetration should be broadly defined. Sales promotion through various forms of advertizing, consumer advisory services and the like is an expensive process and the extent to which such promotional activities must be resorted to should be identified and expressed in cost terms.

3. Distribution system

The sales and distribution organization for marketing a particular product needs to be broadly defined and its costs of operation be estimated. The sale and distribution of most products requires a marketing organization within the enterprise, which is responsible for such sales and which organises, supervises and reviews the sales and distribution network. In some cases, such as for highly sophisticated machinery, all sales are handled by the manufacturing enterprise itself or by a subsidiary marketing company. The size of the sales and marketing organization is then very large and can be spread over a number of countries in the case of products having an international market. In most cases, however, actual sales and distribution are handled through agents either within a country or in a number of countries who are paid a specific commission on the sales effected in their respective area. The appropriate marketing structure should be defined in the feasibility study. In some cases, it may be useful to utilize the distribution outlets which may be provided by a foreign partner or a foreign technology licensor, particularly in potential external markets. In other cases, it may be necessary to set up distribution agencies directly or jointly with some other complementary products. A feasibility study can, however, only suggest the broad pattern that should be followed in this regard and estimate the costs involved. Details regarding marketing and distribution arrangements have, however, to be worked out during the post-implementation stage.

A significant aspect of product marketing is in respect of after-sale facilities and services which many products require. After-sale services and facilities are required for a wide range of industrial products and can extend from supply of simple wear and tear parts to provision of extensive servicing, maintenance and repair facilitites, and stocking of a large volume of spares in different locations. The nature of after-sale facilities and services in respect of a particular product should invariably be defined in a feasibility study.

Sales promotion, the design and creation of a distribution system and the related costs are an important aspect of product marketing. However, they concern more the institutionalization of marketing in a company than the actual distribution of the final products. Therefore, provision has also to be made to estimate the costs connected with packaging, shipping, selling and billing of products. A rather exact estimation of freight costs is of great significance since excessive shipping costs may reduce the profitability of the project. Schedule summarizes all pertinent sales and distribution costs to be covered by a feasibility study. It should be noted, that sales costs connected with promotional efforts might already occur during the pre-productin stage. Where this is the case, separate accounts have to be kept since such costs will have to be capitalized as pre-production expenses (Schedule 10-2/1 and chapter 10.A). Otherwise, sales and distribution costs will become part of the total production costs (Schedule 10-3/1 and chapter 10.C).

4. Sales revenue

Projections of sales can only be made in the light of the market structure, market requirements and the marketing strategies that are followed. Such strategies have necessarily to be defined and an assessment made of the implications in terms of product pricing, production programme, promotional efforts and the sale and distribution mechanism. It is only then that a reasonable projection can be made of the likely annual sales and the income from such sales. Such projections need to cover a relatively long-term period, the actual period depending on the nature and type of the product. For a machinery product, projections should be for a period of 15 to 20 years and reasonable hypothesis regarding demand and sales growth and production costs have to be assumed. For products having a short life-span, such as certain pharmaceuticals, etc., the period should be much shorter and can be limited to 5 to 10 years. The forecasts of annual sales in terms of quantities or volume and the anticipated income from sales should be projected as outlined in Schedule 3.1.

When estimating the development of sales revenues it must be decided in advance whether to include the sales tax or not. This distinction is needed in the context of cash flow analysis and in view of the fact, that the sales tax (e.g. value added tax) can become a rather important cost item. If the sales tax is included in the sales revenue like in the Manual, it has also to be incorporated in the production costs (Schedules 10-3/1 and 10-11 in chapter 10).

This way it is ensured that the sales tax is both counted as cash inflow (as part of the sales revenue) and as cash outflow (as part of the production costs) and that it cancels out this way.

Discounts, on the other hand, result in a real reduction of the sales revenue but do not constitute a cost item. Thus, if discounts are granted, they have to be deducted from the sales revenue.

C. The production programme

Following specific projections of sales during different stages of production growth, a feasibility study should define the detailed production programme. A production programme needs basically to define the levels of output to be achieved during specified periods of time and, from this viewpoint, has to be directly related to specific sales forecasts. To design such a programme, it is necessary to consider the various production stages in detail, both in terms of production activities and timing. Within the framework of over-all plant capacity, there can be various levels of production activities during different periods and stages, such levels being determined by various factors in different projects. It would be prudent to recognize that full production may not be practicable for most projects during initial production operations. Owing to various technological, production and commerical difficulties, most projects have to undergo certain initial problems which can take the form of slow and gradual growth of sales and market penetration on the one hand and a wide range of production problems on the other such as the adjustment of feedstocks, manpower and equipment to the technology selected. In most cases, full production capacity can only be achieved over a period of time. However, even if full production were to be achieved in the first year, marketing and sales may prove a significant bottleneck. Depending on the nature of the industry and local factor situations, a production and sales target of 40-50 % of over-all capacity should not be considered as being unreasonably low during the first year. It is usually only towards the third or fourth year that full production levels can be achieved and operating ratios can be effectively determined and be adequately planned for. Even in certain process industries, where rated plant capacity is capable of being achieved within a relatively short period after commencement of production, production may be programmed at well below such capacity during initial years in order to adjust to gradual growth of demand for a particular product. Growth of skills in operations can also be a limiting factor in a number of industries, particularly the engineering-goods sectors, and production has to be tailored to the development of such skills and productivity. Full production capacity may be achieved in such cases only after some years, and it may be unrealistic to plan on any basis other than fairly gradual growth of production and output. In the case of assembly-type industries, the degree of manufacturing integration has to be determined over a period of time and production programming has to determine the extent of such production integration which may initially be relatively low and extended only gradually. Production programming can take various forms and alternatives and it is necessary to determine what production pattern would be most suitable in relation to projected sales and growth of production, particularly for the initial years of the project in question.

The production programme should also determine the operating ratios of different production lines during the initial years of production. As regular production, in accordance with over-all plant capacity, is achieved over a period of time, the operating ratios will get stabilized at different levels of production but, in the initial period, this needs to be carefully programmed and reviewed from time to time. The operating ratio is dependant on several factors ranging from the sophistication of the end-product and the complexity of the technological and production operation to the skills and experience of plant personnel and maintenance of equipment, besides of course, the regular flow of material and input requirements.

The characteristics and determinant factors of a production programme during initial production years would vary considerably from project to project. This can be illustrated by the different approach that would have to be adopted for four different types of industries such as (i) single-product, continuous process manufacture as in cement production, (ii) multiple-product, continuous process production as in an oil refinery, (iii) batch/job order production such as in an engineering workshop and (iv) assembly/mass manufacture as for production of automobiles. The determinant factors and the nature of production programming would be very different in these cases. In the first case, the growth of sales may not be a significant problem unless production capacity is in excess of local demand but production problems may be more critical. In the second case both production and sales problems may arise. In the third case, though production aspects may present difficulties, obtaining a satisfactory order-book would be critical. The sales aspect in relation to price would of course be dominant in the case of automobile production.

Once a production programme defines the levels of outputs in terms of end-products, and possibly of intermediate products and the operating ratio between various production lines and processes, the specific requirements of materials and labour need to be quantified for each stage. For this purpose, it is necessary to prepare a material flow diagram, showing the materials and utilities balances at various stages of production. The nature and general requirements of materials and labour would already have been identified prior to determination of plant capacity but, at this stage, a more detailed exercise would be necessary to determine the specific quantities and numbers that would be needed for each stage of the production programme and the costs that these would entail. The input requirements and costs would necessarily have to be assessed for (i) basic materials such as raw materials, intermediates, bought-out items, etc. (ii) auxiliary materials and factory supplies, (iii) major utilities, and (iv) direct labour requirements for various categories of personnel. Detailed estimates in this regard would need to be prepared for the stage of initial production and for the stage of full production, together with one or more intermediate stages if these can be clearly identified. It would also be necessary to provide for wastage, damage or rejection elements in preparing the material consumption estimates and for leave reserves, etc. in the case of labour needs as outlined in Chapters 4 and 8 which deal with material and labour requirements. In cases where such a minute procedure cannot be applied to calculate the material and labour costs at different production stages until full capacity is reached, recourse should be made to the fact that material and labour costs are variable and that consequently apportioned material and labour costs can easily be calculated for the initial stage based on the cost level at full capacity production. This procedure is applied in Schedule 10-3/1 "Annual production cost estimate" in chapter 10.A as well an in Schedule 10-12 "Production Cost Schedule" in chapter 10.C.

An example of a production programme is provided in Schedule 3-3. It should serve as planning base for scheduling the cash flow table. For this purpose the different envisaged capacity utilization rates should be inserted as first line e.g. into the cost flow table for financial planning (Schedule 10-8/3) of chapter 10.B. This way it will be easily possible to programme the development of variable production costs as production/sales increase.

D. Determination of plant capacity

1. Capacity definitions

Generally speaking, the term "production capacity" can be defined as the volume or number of product units, that can be produced during a given period of time. This definition implies the output expectations from the production of a plant. Its meaning has to be seen in a dynamic way, since production and product-mix change during the life of a plant. For a short period of the life of a plant the capacity figure can be considered as being constant keeping in mind that adjustments have to be made in view of changing circumstances.

Several capacity terms are being used and need to be defined:

Feasible normal capacity

This capacity is achievable under normal working conditions taking into account not only the installed equipment and technical conditions of the plant such as normal stoppages, downtime, holidays, maintenance, tool changes, desired shift patterns and indivisibilities of major machines to be combined but also the management system applied. Thus, the feasible normal capacity is the amount of units produced during one year under the above conditions. This capacity figure should correspond to the demand figure derived from the market study. If not indicated otherwise, the Manual will refer to this definition.

Nominal maximum capacity

Contrariwise, the nominal maximum capacity is the technically feasible capacity and frequently corresponds to the installed capacity as guaranteed by the supplier of the plant. To reach maximum output figures, overtime as well as excessive consumption of factory supplies, utilities, spare parts and tear and wear parts will inflate the normal level of production costs.

2. Determination of the feasible normal plant capacity

A critical exercise in a feasibility study is the determination of the appropriate plant capacity. While forecasts of demand and market penetration in respect of a particular product constitute the starting point and the limited availability of basic materials and inputs or of resources may be a constraint for certain projects, these parameters would still be wide enough, in most cases, to require evaluation of various alternative possibilities in respect of plant size and capacity. Such alternatives have to be related to various levels of production that may correspond to varying degrees of investment outlay on the one hand and different levels of sales and profitability on the other. Once the over-all constraints and limitations of demand and market forecasts are defined, other components of the feasibility study have to be assessed in determining the feasible normal plant capacity. This capacity should, in fact, represent the optimum level of production as may be determined by the relative interaction of various study components such as technological and equipment considerations, availability of resources, investment and production costs and sales and market coverage. Though one or other of these components will be the critical one for determining the feasible normal plant capacity in respect of a particular project, it is necessary that the implications of all these aspects should be taken into consideration.

While detailed technology and equipment considerations should normally be taken into account after the feasible normal plant capacity is determined, two issues which need to be considered prior to the capacity determination are those of minimum economic size and availability of production technology and equipment as related to various production levels.

Minimum economic size and equipment constraints

The concept of minimum economic size is applicable to most industrial branches and projects but assumes varying degrees of significance for different types of industries. In the case of a number of process-type industries, a minimum production size can generally be defined. A cement plant of less than 300 t/d is not usually considered to be economic as this may necessitate vertical shaft kilns, the production from which would not be able to compete with that of rotary kilns in a competitive market. Ammonia plants need to be of a certain minimum size if the costs of ammonia to user-plants is not to be unduly high, as compared with ammonia supplies obtained by other users. This is true of a large range of chemical industries, including primary and secondary petrochemicals where the economic size is increasing rapidly for most products. In the case of certain basic industries also, such as steel and aluminium, certain levels of capacity have been established below which adequate economies of scale would not be generated.

The economic size of production is a dynamic concept and production capacities have tended to increase rapidly in industrialized countries in a number of sectors to take greater advantage of economies of scale. Increased capacities involve investment outlays which, however, are proportionately much lower than the increased output, resulting in lower unit production costs. When determining the minimum economic size of a project it might be useful to apply the experience gained in the country or elsewhere with the understanding that some relationship exists between the production cost of the project under study and such costs in the same field of production in other projects. The capacity of the proposed project should then be related to such size. If however, this is not practicable because of constraints in resources of input availability, or size of foreseeable demand, the implications in terms of higher production costs and prices, inability to compete in external markets and the degree of protection required, should be fully brought out.

Another important fact which should be known when determining the feasible normal plant capacity is that the available process technology and equipment are often standardized at specific capacities in different production sectors. While these can be adapted to lower production scales, costs of such adaptation may be disproportionately high. On this account also, projects in certain industrial branches need to conform to a minimum economic size and should this not be possible, the implication must be highlighted. This concept is operative in the case of assembly-type industries also, particularly when series production is involved, as such series must be related to reasonable levels of continuous or semi-continuous production. However, in certain engineering-goods industries, involving multi-product manufacture, a much greater degree of flexibility is available, as production capacity can be distributed between a number of products during different periods. Nevertheless, an appropriate economic size can generally be defined in most such cases also in terms of equipment needs and technological application, though various combinations are possible in this regard.

Resource and input constraints

The availablility of resources, domestic, external or both and the availability of basic production inputs may constitute significant constraints for a number of projects in developing countries. This can take the form of shortage of foreign exchange for import of equipment, components or intermediate products or of domestic resources, either from private, institutional or public sources for projects of major magnitude and involving large investment outlays. The availability of basic production inputs may also be limited, either in the form of raw materials or intermediate products. While a minimum economic size should, as far as possible, be conformed to, it may not be practicable to go beyond such level in the event of such constraints. Where effective demand and the possible extent of market penetration are much larger, plant capacity would then only cover a part of the demand projections, leaving the balance to other projects, imports or subsequent expansions of proposed plant capacity. Even at a minimum economic size, unit production costs are bound to be fairly high as compared with production costs in other firms in the same production field, and scale economies would operate to the least extent consistent with project viability.

If the feasible normal plant capacity for the proposed project is to be below such economic size because of one or other constraint, the implications in terms of production costs, product prices and policy aspects such as the degree of protection required, should be fully brought out in the feasibility study.

Investment and operating costs

The level of investment and operating costs would be an increasingly significant determinant element if there were no serious resource or material and input constraints. As mentioned above, the volume of investment cost tends to decrease with increased magnitude of plant capacity. In the chemical industry, this capacity-cost relationship is sometimes referred to as the 6/10th factor rule.

Costs do not usually rise in strict proportion to size. This relationship can be expressed in the form:*/

$$C_2 = C_1 \cdot \left(\frac{Q_2}{Q_1}\right)^x$$

where C_2 = derived cost of capacity Q_2

C_1 = known cost of capacity Q_1

x = cost-capacity factor. On the average $x = 0.6$.

Q can be in any consistent units as it enters only as a ratio.

The cost-capacity ratio differs of course from industry to industry and can, in fact, range from 0.2. to 0.9. In general, however, and particularly for process industries, scale economies may prove to be very significant in respect of investment costs for higher plant capacities. Together with investment

*/ Bertil Hedberg: Factors influencing process selection, plant size and license fees in petrochemical and fertilizer industry. UNIDO ID/WG.129 - 7 Oct. 1975. Quoted from Prof. C. Jelen, Lamar College of Technology, Texas Unty. McGraw Hill Book Co.

outlay, it is equally necessary to evaluate production costs at higher capacities. Obviously, certain scale economies would operate to an increasing extent up to a point beyond which management capacity, labour aspects, resource, input and market penetration considerations and other study components would become critical constraints. It is necessary to assess the cost-capacity relationship insofar as the proposed project is concerned, both in terms of investment outlay and production costs and to define the parameters in this regard in relation to the other study components of the project in question.

3. Projected sales and plant capacity

The relationship of projected sales to plant feasible normal capacity also needs to be carefully assessed for alternative plant capacities. For certain products, which are either new or where new markets have to be developed, initial production capacity should be higher than initial demand and sales so that demand growth can be covered by plant capacity for some years. However, this planned under-utilization of capacity should not go below the point where sales equal production cost and as demand and sales grow, plant capacity may be outstripped by such growth and there would be an increasing gap between demand and production, which may justify plant expansion in due course. In respect of most products, the general practice is to fix the feasible normal plant capacity at a level higher than existing demand, so that demand growth can be absorbed by such production capacity for some time. To the extent that expansions can be speedily introduced and implemented, it may be desirable to fix the feasible normal plant capacity above estimated market penetration within a defined period of time only to a limited degree and to relate future sales growth to subsequent plant expansions. What particular relationship is adopted between sales projections and plant capacity depends on a number of factors such as the dependability of market forecast, of price elasticity demand or the cost-capacity ratio.

In the light of the above considerations, the appropriate feasible normal production capacity of the plant needs to be defined. For this purpose, the impact of relevant components of the feasibility study at various levels of production needs to be quantified and alternative cash flows may need to be constructed, so that a really meaningful evaluation can be made of the implications of different production capacities as against the feasible normal plant capacity determined as being most appropriate. On the one hand, investment and production costs need to be assessed at two or three alternative production levels with consequent impact on product pricing while, on the other, sales projections have to be made for the corresponding levels of production at anticipated product prices at each level. The feasible normal plant capacity selected as most appropriate should constitute the optimum relationship between the various study components in terms of commerical profitability.

In some projects, it may be economic to provide for higher surplus capacity in certain production stages where the cost-capacity ratio is more in favour of such higher capacity, and increase capacities at other stages proportionably, by and large, to growth of demand. Various combinations are possible in this regard and the appropriate combination for the project under consideration needs to be selected.

The concept of plant capacity assumes a different orientation in the case of a number of engineering-goods products where it relates to the degree of manufacturing integration proposed to be achieved in a particular project. Investment costs would be directly related to such integration and the less the integration, the less would be the investment outlay. The purchase of intermediate products, components and parts from other manufacturers through subcontracting may be far more economic than producing such intermediate products and parts in the proposed project. The degree of subcontracting and purchase of bought-out components and parts that may be possible depends, however, on the state of the component-production sector in a particular economy or on the extent of imports that may be practicable. In the case of domestically-produced components, the quality and costs are important. In most cases, such production follows that of the finished product except for standard and common-use parts and such intermediate products and components may be initially inferior in quality and higher in price. The import of components has its own set of considerations in terms of national policy, foreign exchange availability and the like. The determination of the feasible normal capacity in such cases has to take all such factors into consideration and define the appropriate phasing of manufacturing integration in respect of a particular product and the consequent investment outlay and plant capacity, spread over a period of time, that this may involve.

It is not practicable to prescribe any specific formula for determining plant capacity. Over a wide range of industries, different components of a feasibility study exercise varying degrees of influence. What is necessary, however, is that a feasibility study should take adequate account of these study components that may pertain to a particular case so that initial production capacity and any subsequent phasing thereof is realistic and corresponds to the relative weightage of such study components and considerations.

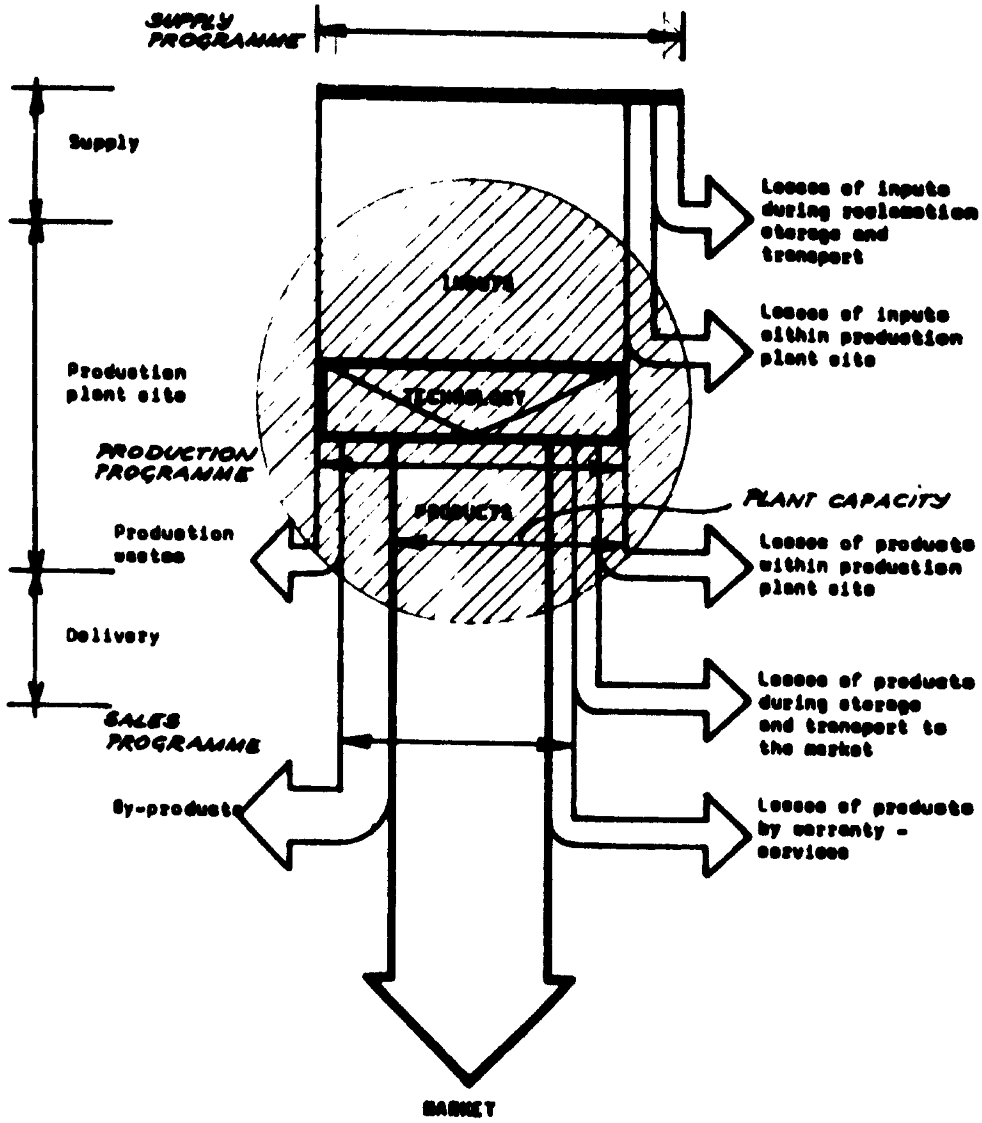
In the light of the feasible normal capacity determined, it would be necessary to quantify the various input requirements in greater detail, as also to determine the total costs of such inputs. It is also necessary to estimate the manpower requirements for a project though this may need to be defined in greater detail after selection of technology and equipment. However, production techniques may, in turn, be related to availability of skilled personnel and a general determination of manpower needs could usefully be made for most projects with the determination of feasible normal plant capacity.

4. Quantitative relationship between sales, plant capacity and material inputs

The quantitative relationship between sales, plant capacity and material inputs is determined by the basic condition, that the sum of inputs into the factory has to correspond to the sum of its outputs:

<u>Exhibit 3</u>

Flow Scheme of Plant Inputs and Outputs



(i) Q intputs ——> Q outputs

Exhibit 3 shows the flow of material inputs into the factory, their transformation into products, by-products and production wastes and the distribution of products and by-products to the market. During all stages of this flow losses of inputs, products and by-products may occur. Such losses maybe caused by inappropriate handling, treatment and storage, breakage, decay, theft, warranty services, etc. When preparing a feasibility study, realistic estimates of losses should be introduced especially for the initial years of plant operation.

The sales programme, derived from the market study, defines the timely, local and quantitative distribution of the products to be sold.

The production programme defines the quantities of products, by-products and production wastes to be produced annually (feasible normal capacity).

The quantitative relationship between these two programmes is as follows:

(ii) Q production programme = Q sales + Q losses +
+ Q warranty services +
+ Q by-products +
+ Q production wastes

and

(iii) Q plant capacity = Q sales + Q losses + Q warranty services.

In order to meet the requirements of the production programme, a number of inputs are needed as stipulated by the applied technology.

The supply programme defines the quantitative and timely supply with the required inputs:

(iv) Q supply programme = Q factory inputs + Q losses

With a view to estimating the cost of anticipated losses it is necessary to define the point of take over of inputs and the point of sales of products and by-products, i.e. to determine where inputs/outputs enter or leave the responsibility and risk of the producer.

For inputs purchased free plant site and for products sold ex works the risks and the cost of losses outside the plant site are to be borne by the supplier and the buyer respectively. For perishable goods such risks may become quite essential and should, therefore, be taken well into consideration.

To summarize, it should be noted that at the stage of the feasibility study the determination of the production programme, plant capacity and supply programme should take account of the above-mentioned quantity balances.

Chapter 4: Materials and Inputs

The selection and description of materials and inputs which are required for the manufacture of the defined products as well as the definition of the supply programme and the computation of material costs are the subject of this chapter.

There is a close relationship between the defining of input requirements and other project formulation stages, such as definition of plant capacity, location and selection of technology and equipment as these inevitably interact on one another. The main basis for the selection of materials and inputs are the demand analysis and the production programme and plant capacity derived therefrom.

The following issues relating to material and input requirements need to be covered in the feasibility study.

4. Materials and Inputs

4.1 Characteristics of materials and inputs

Materials and inputs should be classified as to

(1) Raw materials
- unprocessed
- semi-processed

(2) Processed industrial materials (intermediates)

(3) Manufactures (subassemblies)

(4) Auxiliary materials

(5) Factory supplies

(6) Utilities

A detailed classification is given in the explanatory notes.

4.1.1 Fundamental data and alternatives

- Describe fundamental data for the selection of materials and inputs
- List all required materials and inputs and show alternatives.

4.1.2 Selection of materials and inputs

Select and describe in detail the chosen materials and inputs

- State reasons for selection
- Describe materials and inputs, stating
  - . qualitative properties
  - . quantities available
  - . sources, supplies
  - . timely availability
  - . unit costs

4.2 Supply programme

4.2.1 Fundamental data and alternatives

- Describe fundamental data for the preparation of the supply programme
- Prepare supply programme, show alternatives

When setting up the supply programme, consider the

- Production programme
- Availability of supplies
- Characteristics of supplies
- Technology and equipment
- Losses of raw material inputs due to transport and storage
- Losses of semi-finished and finished products due to processing, distribution and storage
- Replacement due to customer complaints
- Local conditions and
- Others

4.2.2 Selection of the supply programme

Select and describe in detail the optimum supply programme

- State reasons for selection
- Describe supply programme, stating for each input:
  - quantitative supply programme
  - sources of supply
  - timely delivery (schedule)
  - storage measures and capacities (if necessary)

4.2.3 Cost estimate

Estimate annual costs of materials and inputs.

(1) Raw materials

(2) Processed industrial materials

(3) Manufactures

(4) Auxiliary materials

(5) Factory supplies

(6) Utilities

Use schedules 4-1 and 4-2 and insert totals in schedule 10-11.

Schedule 4 - 1

Estimate of Production - Cost - MATERIALS AND INPUTS

ESTIMATE OF PRODUCTION COST									
MATERIALS AND INPUT									
PROJECT COMPONENT No ___ DESCRIPTION ___________									
Item						Unit Cost	Cost		
No	Quantity	Unit	Description	[illegible]	[illegible]		foreign	local	total
(1)			Unprocessed and semi-processed raw materials						
			. . . . .						
			. . . . .						
			. . . . .						
(2)			Processed industrial materials						
			. . . . .						
			. . . . .						
			. . . . .						
(3)			Manufactures						
			. . . . .						
			. . . . .						
			. . . . .						
(4)			Auxiliary materials						
			. . . . .						
			. . . . .						
			. . . . .						
(5)			Factory supplies						
			. . . . .						
			. . . . .						
			. . . . .						
(6)			Utilities						
			. . . . .						
			. . . . .						
			. . . . .						
Total									

Carry over TOTAL of project component to Summary sheet (Schedule 4-2)

Schedule 4-2

Summary Sheet
Production - Cost : MATERIALS AND INPUTS

SUMMARY SHEET : PRODUCTION COST				
MATERIALS AND INPUTS				
PROJECT COMPONENT		PRODUCTION COST CARRIED OVER		
Nº	DESCRIPTION	foreign	local	TOTAL
TOTAL				

Insert TOTAL in Schedule 10-11.

Explanatory notes to Chapter 4: Materials and inputs

A. Classification of material and inputs

1. Raw materials (unprocessed and/or semi-processed)

Agricultural products: If the basic material is an agricultural product, it is invariably necessary to identity 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 determine if the material from any specific areas has been used for the product in question in the past. Certain woods may be 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. In food-processing industries, only the marketable surpluses of agricultural produce should be viewed as basic raw materials, such term referring to the residue remaining after the quantities required for consumption and sowing by producers have been subtracted from total crop. In the case of commercial crops, the marketable surplus is the total production minus sowing requirements. If the project involves relatively large quantities, the production of the agricultural input may have to be increased. This may need extension of the area under cultivation and may often require substitution of another crop.

In the case of sugar cane, for example, it would be necessary to increase the area under cane cultivation in the same region since cane cannot be transported over long distances without involving prohibitive transportation costs or loss of sucrose content or both. In order to estimate the supplies and availability of agricultural products, it may be necessary to collect data on past crops and their distribution by market segments, geographical or by end-uses. Storage and transportation costs often assume major significance and need to be assessed. 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 may need detailed analysis. Projects based on agricultural produce to be grown in future may 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. A project should not be based on an entirely new crop to be grown in the area unless the tests, based on actual produce from the area, have established the validity and viability of the raw material for the project in question.

Livestock and forest products: In most cases of livestock produce and forest resources, specific surveys are called for to establish the viability 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 more dependable and precise data-base is required and this can be built only by specific surveys, however expensive these may tend to be.

Marine products: In regard to marine-based raw materials, the major problem is to assess the potential of availability, the yields and the cost of collection. The facilities required for marine operations have often to be provided for, under the industrial project.

Mineral products (metallic and non-metallic including clays). For minerals, detailed information on the proposed exploitable deposits are indispensable for feasibility 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 very extensive, on location of deposits, size and depth of deposits, the viability of open-case or under-ground mining, the quality of deposits and 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 would rarely be uniform and 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 incorporated in the feasibility report. 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.

2. Processed industrial materials and manufactures: They constitute an increasingly expanding category of basic inputs for various industries in developing countries. Such inputs can be generally classified under base metals, process intermediates relating to a wide variety of industries in different sectors, and manufactured parts, components and subassemblies for assembly-type industries, including a number of durable consumer goods and the engineering-goods sector. In all these cases, it is necessary to define requirements, availability and cost in some detail as also to ensure that the specifications in the case of the two latter categories suit the production programme envisaged in the project. In the case of base metals, availability and prices during any particular time-span tend to operate at an international level. The extent of substitutability of such metals, to the extent feasible, should be examined such as the replacement of copper elements in electrical power distribution by aluminium products if these are available at lesser cost.

By and large, however, where such substitution is not practicable beyond a point, the pricing of products can be adjusted to fluctuations in the cost of the metals. Their availability at defined international prices is not generally a problem except for overall foreign exchange constraints. In the case of process intermediates, particularly for the chemical and petrochemical sector careful analysis is necessary of availability and cost from external sources, as also the implications of domestic manufacture of such inputs. Since backward linkages for the production of such basic inputs involve large capital outlays, this has to be considered independently and is not usually related to the manufacture of the final product. Thus, polyester fibre production has to be based on caprolactum, which would either need to be imported or produced in another plant. In some countries the manufacture of basic petrochemicals is restricted to the public sector and this factor also has to be taken into consideration in assessing the time-span by when such basic inputs would be domestically available and the pricing considerations likely. In respect of assembly-type industries, ranging from durable consumer goods to heavy plant and machinery, the basic input, apart from steel, would be a large conglomeration of parts, components and subassemblies. While similar considerations would prevail in respect of domestic and imported inputs, a different emphasis is given by the fact that the nature of input may be changed by a project through higher backward linkages. Thus, a plant to produce diesel engines can either start with a foundry and go on to the final product, with outside supplies being limited to electrical parts only or can have a high degree of bought-out parts and components, limiting itself primarily to the final assembly operation. This aspect is also dealt with in the chapter on Project Engineering and constitutes an essential element of plant-capacity determination but the alternatives to be considered are whether such items should be bought out or produced in the proposed project itself. This aspect needs to be determined in the feasibility study.

3. Auxiliary materials and factory supplies: Apart from basic raw materials and inputs, all manufacturing projects require various auxiliary materials and factory supplies. It is sometimes not easy to distinguish between auxiliary materials such as chemicals, additives, packaging materials, paints, varnishes etc., and factory supplies such as maintenance materials, oils, grease, cleaning material etc. since these terms are often used interchangeably. The current consumption of tear and wear parts as well as of tools should also be projected.

However, it is necessary that the requirements of such auxiliary materials and supplies should be defined and accounted for in the feasibility study.

4. Utilities: A detailed assessment of the required utilities can only be made after analysis and selection of location, technology and plant capacity, but a general analysis of these aspects is also necessary as part of the input study. Such utilities include electricity, water, steam, compressed air, air conditioning, fuel and effluent disposal. Frequently, input studies do not cover this aspect and even the overall feasibility study tends to underestimate the requirements of utilities resulting, in many instances, in miscalculation of investment and production costs. A precise estimate of the consumption of utilities is essential for identifying the existing sources of supply and possible bottlenecks and shortages that may exist or are likely to develop so that appropriate measures can be taken to provide for either internal or external additional supplies in good time. Such identification is particularly important since it may materially affect the investments to be made in the form of buildings, machinery and equipment, and other installations, if such major utilities are in short supply and need to be provided internally in the plant.

Electricity

An analysis of the electric energy situation must specify the requirements and the sources and availability of supply as well as the costs of electric power. It is, therefore, necessary 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 possible standby requirements, and daily and annual consumption both by shifts and in total. Inadequate availability of electric power has caused severe problems in many developing countries. The input study has therefore to ensure that the necessary infrastructure exists or that it will be provided either by public utility companies or needs to be provided by the project itself. The need for transmission lines from electric power sources to the construction and production site, including substantions, transformers etc., or the erection of an independent power station have to be considered and identified in this context.

Water

A general estimate of water supply requirements should also be covered in the study. For this purpose, the broad requirements of water for the production process, for auxiliary purposes such as cooling or steam generation and for other general purposes should be estimated, so that these can be taken into account in locational decisions, at which stage the cost calculations of such utilities can be specifically defined.

Others

The input study should also determine the broad requirements of various fuels and identify sources of supply and unit costs. Similarly, general requirements of other utilities such as steam, compressed air, air conditioning, effluent disposal and the like also need to be identified so that these can be analysed in greater detail in the course of selection of location.

5. Input alternatives: In many projects, it is possible to use different raw materials for the same production. In these cases it would be necessary to investigate and determine which raw material would be most suitable, taking all relevant aspects into consideration. A nitrogenous fertilizer plant, for example, may be based on coal, naphtha, fuel oil, crude, natural gas, or on electrolytic process. In the last case, large quantities of power are needed and the two principal raw materials would be 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 economics of the project. In a particular project, naphtha would be available in required quantities and at economic prices and would not be subject to any critical constraints. 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 issue. 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, detailed investigations may have to be undertaken; or if these have already been made, they have to be scanned and evaluated.

6. Planning of overhead materials and inputs

When estimating materials and inputs requirements by project components, the project planner will not only have to plan at the level of production cost centres but equally inportant at the level of service, administration and sales cost centres. A check-list of the usually encountered cost centres of the latter types is provided in chapter 7 "Plant Organization and Overhead Costs". Once the material overhead costs are computed it is left to the discretion of the user of the Manual whether to

Alternative 1: transfer the respective sums directly to the Total Production Cost Schedule (No. 10-11) in chapter 10.C, or to

Alternative 2: transfer the material overhead costs to the Overhead Cost Schedule (7-1) and shift afterwards the total overhead costs to Schedule 10-11.

In order to avoid any unnecessary burden on the proposed *pro forma* system, it is suggested to use Alternative 1.

B. Characteristics of materials and inputs

1. Qualitative properties

The type of analysis required to identify the characteristics of materials and inputs depends on the nature of the inputs and its usage in the particular project. Such an analysis may need to cover various features and characteristics such as:

Physical properties:

- size, dimension, form (plate, rod, etc.)
- density, viscosity, porosity
- consistence (gaseous, vapor, liquid, solid)
- melting and boiling point
- others

Mechanical properties:

- formability, machinability
- tensile, compressive and shearing strength
- elasticity, stiffness, response to fatigue
- hardening and annealing properties
- others

Chemical properties:

- grades (emulsion, suspension, low monomer)
- chemical consistence
- purity (hardness of water etc.)
- exidising and reduction properties
- flammability and self-distinguishing properties
- others

Electrical properties:

- magnetic properties
- resistance, conductance
- dielectric properties

In some cases, there may be no or inadequate experience in the use of a particular material input. In such cases, where adequate use-history has to be developed, it may be necessary to take recourse to pilot plant and other relevant tests. A related question to that of input characteristics is that of establishing organic consistency among the materials used. For example, for paper production, the mixture of bamboos with bagasse and other raw materials should be defined.

2. Sources and quantities available

The sources and the continous availability of basic production materials is a crucial element for the determination of the technical and economic viability as well as the size of most industrial projects. In many industries, the selection of technology, process equipment and the product-mix itself depend substantially on the specifications of the basic materials, while in others, the potential quantities available determine the size of the project. The prices at which such materials are available is a determinant factor of the commercial and financial viability of most industrial projects. In fact, a number of projects are conceived either for exploitation of available raw materials or for utilisation of basic materials which become available from other production processes.

At the initial stage of the study the quantities of basic material inputs which may be required need to be generally assessed principally for the purpose of determining availability and sources for immediate and long-term needs. A final and definitive assessment of input requirements can be made only after plant capacity and the technology and equipment to be used is defined.

If a basic input is available within a country the location of such availability, together with the concentration or dispersal of the areas of supplies, should be defined. It is also necessary to assess the substitute uses and alternative demands likely to be made on such materials and the consequent impact on availability for the project in question.

For example, natural gas may be available in a relatively remote area where it may be economic to use it for electric power generation in the absence of other demands. However, if the gas is piped to major consumption centres or if the area is opened up through better communications, it would be in much greater demand for other products such as fertiliser or petrochemicals and it may not be economic to use it for power generation.

The question of transportability and transport costs needs to be carefully analyzed. The distances over which basic material inputs have to be transported and the available and proposed means of transportation need to be defined, together with possible bottlenecks that may develop.

Where the basic material has to be imported either in whole or in part, the implications of such import need to be fully brought out. Firstly, the sources of imported inputs have to be defined. Certain materials such as intermediates and common-use products (springs, bearings etc.)are available from various external sources. These sources, however, may become greatly restricted in certain cases. Foreign exchange constraints may necessitate imports only from particular currency areas. Restrictive clauses in technology-supply agreements may bind licensees to obtain basic inputs particularly parts, components and other intermediate products, from licensors. Subsidiaries and affiliates of foreign-controlled companies tend to purchase such materials only from their parent companies. In many cases, there may also be lack of knowledge regarding alternative external sources for basic inputs. This would be more particularly in the case of intermediate and manufactured inputs. Secondly, the degree of uncertainty that may relate to imported inputs need to be defined. There have been cases where projects have been set up in developing countries based on imported raw materials from particular sources and such sources have ceased to produce the material in question. Such cases also primarily relate to processed materials and manufactured parts and components. Thirdly, the implications of domestic production of a basic material which was being imported, need to be analyzed. In most developing countries, such production would be accompanied by varying degrees of import control and user industries have necessarily to adjust to domestic supplies of basic materials.

This may involve some adjustments to the quality and specifications of such materials or to their price. While these aspects cannot be anticipated in any great detail, it is necessary to recognize that when a project is based on imported basic materials, a number of external and internal forces can significantly affect availability. If such forces cannot be assessed in any detail, they should at least be identified and the general implications highlighted.

3. Unit costs

Together with availability, the unit cost of basic materials and inputs has to be analyzed in detail, as this would be a critical factor for determining project economies. In the case of domestic materials, present prices have to be viewed in the context of past trends and future projections, on the one hand, and elasticity of supply on the other. The higher the degree of inelasticity, the higher would be the price as related to growing demand for a particular material. For domestic inputs transport costs by alternative means of transportation should be included. In the case of imported materials, the c.i.f. cost should invariably be adopted, together with clearing charges (including loading and unloading), port charges, tariffs, local insurance and taxes, and internal transport to the plant. The cost factor in the case of imported inputs would be less subject to fluctuations except where (i) international prices are themselves subject to considerable fluctuations such as for copper or tin, or (ii) moncpoly or oligopolistic conditions are prevailing, or (iii) supplies are linked contractually to a particular source such as between a foreign subsidiary and parent or licensee and licensor, or (iv) there is governmental action by way of tariff or duties or major changes therein.

The impact of domestic manufacture of a material which is a basic input for an industrial project may have significant implications. In most cases, domestic production costs and consequently prices of such inputs are significantly higher than prices of imported inputs, particularly during initial production years and this can have a substantial effect on production costs of user industries. The extent to which consequent price adjustments in the final product would affect demand for the product needs to be assessed.

C. Supply programme

In establishing the supply programme, the information collected on material and input requirements, their general availability and anticipated unit costs is tied in with other elements of the feasibility study. Thus, the production programme serves as basis to calculate the magnitudes and types of inputs as well as the timely delivery requirements during the year. Any supply programme is influenced by the selected technology and equipment since both determine the technical specifications of the inputs needed.

The size of the supply programme is an indicator of required storage facilities particularly if continuous supply cannot be guaranteed e.g. due to the locational separation of plant and origin of inputs or probable transportation difficulties. The cost for additional warehousing and stock-piling have to be incorporated into the investment and production cost computations.

Yet, the major objective of the supply programme is to determine the annual costs of material and other inputs which constitute a major portion of the annual production costs. The results thus obtained have to be carried forward to Chapter 10, Financial Analysis, 10.3 Production Costs, in order to be entered later on into the cash flow table.

The relationship between sales programme, plant capacity and supply programme is explained in Chapter 3.D.

Chapter 5: Location and Site

A feasibility study has to define the location and site suitable for the industrial project under consideration. The choice of location should be related to the delineation of a fairly wide geographical area, within which several alternative sites may have to be considered. Once the site has been selected, the impacts of erecting and operating the industrial plant on its environment have to be studied and shown.

5. Location and site

5.1 Location

5.1.1 Fundamental data and alternatives

- Describe fundamental data and requirements on locations for plant operation

- List possible locations, describe and show them on maps of appropriate scale

5.1.2 Choice of location

Select and describe in detail the selected optimum location

- state reasons for selection

- describe location, state:

  country
  geographical location
  district
  town, etc.

For the choice of location, inter alia, the following aspects should be taken into consideration:

- public policies

- material versus market orientation

- local conditions: infrastructure and socio-economic environment

5.2 Site

5.2.1 Fundamental data and alternatives

- describe fundamental data and requirements on site for plant erection and operation

- list possible site alternatives, describe and show them on maps of appropriate scale

5.2.2 Site selection

Select and describe in detail the selected optimum site

- state reasons for selection

- describe site, state:

    location (town, street, number, etc.)
    geographical and geodetical conditions
    use maps of appropriate scale, showing:

        orientation
        boundaries
        neighbours
        contour lines
        roads and other traffic connexions
        utility connexions, next points of tie-in
        existing obstacles and structures
        underground conditions

    existing rights of way, easements, etc.

For the selection of the plant site, inter alia, the following aspects should be taken into consideration:

- cost of land

- local conditions: infrastructure and socio-economic environment

- public policies versus private interests

- site preparation and development

- site properties and conditions

5.2.3 Cost estimate

Estimate cost of land as to

1. Investment cost, such as:

    - land
    - taxes
    - legal expenses
    - payments to neighbours
    - rights of way (one time payments)
    - others

    Use schedule 5-1 and insert total in schedule 10-1/1.

2. Production cost, such as annual payments for:

    - rights of way
    - easements
    - rents
    - others

    Use schedule 5-2 and insert total in schedule 10-11.

5.3 Local conditions

list and describe in detail local conditions of the selected site

5.3.1 Climate and weather

5.3.2 Transport facilities

5.3.3 Waste disposal

5.3.4 Manpower

5.3.5 Fiscal and legal regulations

5.3.6 Construction, erection and maintenance facilities

A general check-list of local conditions is annexed to the explanatory notes of this chapter

5.4 Environmental impacts

Describe environmental impacts to be expected due to erection and operation of plant

Such impacts may be on:

- population (increase of employment, etc.)
- infrastructure (development of trafic network, public utilities, etc.)
- ecology (water, air, soil, plants, animals, etc.)
- landscape
- others

Schedule 5-1

Estimate of Investment - Cost - LAND

ESTIMATE OF INVESTMENT COST

LAND

Item						Unit Cost	Cost		
[illegible]	[illegible]	[illegible]	Description	[illegible]	[illegible]		foreign	local	total
			Land						
			Taxes						
			legal expenses						
			Payments to neighbours						
			Rights of way						
			. . . . .						
			. . . . .						
			. . . . .						
Total									

Insert TOTAL in Schedule 10-1/1.

Schedule 5-2

Estimate of Production - Cost - LAND

ESTIMATE OF PRODUCTION COST									
LAND									
Item						Unit Cost	Cost		
No.	[illegible]	Unit	Description	[illegible]	[illegible]		foreign	local	total
			Annual payments for:						
			Rights of way						
			Easements						
			Rents						
			. . . . .						
			. . . . .						
			. . . . .						
Total									

Insert TOTAL in Schedule 7-1.

Explanatory notes to Chapter 5: Location and Site

A. Choice of location

Following the assessment of demand, capacity, production programme and input requirements, a feasibility study needs to define the location and site suitable for an industrial project. These two terms are often used synonimously but a distinction needs to be made. The selection of location should be related to the delineation of a fairly wide geographical area, within which several alternative sites can be considered. An appropriate location could well extend over a considerable area, such as a 10-mile radius around a particular urban area or along a river bank in a particular geographical district. Site selection should, however, determine the specific site where the project should be set up and consequently needs to be a more detailed exercise.

The determination of industrial location should be viewed against three principal considerations viz public policies, the relative weightage and interaction between various factors (e.g. inputs and markets) pertaining to a particular project and general locational considerations. While the traditional approach to industrial location was confined to the question of proximity of raw materials on the one hand and nearness to markets on the other, with the element of transport costs assuming major significance, certain other considerations have assumed increased importance in recent years and need to be taken into consideration.

1. The role of public policies

The impact of public policies has increased considerably in recent years and the extent to which such policies are applicable to a particular investment proposal need to be clearly defined. In a number of developed and developing countries, there is considerable pressure for decentralisation of industries from areas of heavy industrial concentration. In industrialized countries, such industrial dispersal is sought principally on environmental grounds and in view of the need to reduce industrial pollution in areas of heavy industrial concentration. While environmental considerations are increasingly being emphasized in many developing countries also, the main objective of greater decentralization still continues to be the need for reducing the external diseconomies of urban industrial concentration.

Even where public policies do not take the form of restrictions on industrial growth in particular areas or regions, knowledge and awareness of locational policies is necessary so that adequate consideration can be given to various policy concessions and incentives which may be featured as part of such policies. In some countries specific geographical zones have been set up and varying patterns of financial incentives and concessions have been prescribed for them. In other developing countries, a direct subsidy is given to industries located in particular areas or regions. A similar pattern has emerged in a number of industrially-advanced countries where significant financial and other incentives are being given to industrial projects located in under-developed regions of such countries. It is necessary that the impact of such incentives on the economics of a proposed project should be analyzed. For a number of large and medium projects, the direct incidence of such concessions may be of a marginal nature and may not affect project economics to any critical extent. However, where other considerations do not exercise undue pulls in one or other locational direction, such incentives may assume much greater significance for individual projects.

Apart from the element of dissuasion or persuasion, public policies may have a directly determinant role in industrial locations in cases where there is majority or substantial involvement of public funds or institutional finance. The growth of public sector enterprises has constituted a significant feature in the industrial growth of a number of developing countries. In the case of such public-sector projects, wider policy considerations such as regional industrial dispersal tend to play a vital part in locational decisions. If feasibility studies are sponsored for such projects, however, it would be desirable for the project sponsors to indicate a specific project location or possible alternatives which should then be evaluated in technical, financial and economic terms.

2. Material vs. market orientation

A critical aspect of location selection still continues to be the degree of impact on a particular project of one or other or a number of factors such as the availability of raw materials and inputs, the proximity of centres of consumption and the existence of basic infrastructure facilities.

The simplest locational model would therefore be to calculate the transport, production and distribution costs at alternative locations determined principally by the availability of raw materials and principal markets. In projects where the relative pulls of these factors is very high, such an approach continues to be necessary. A resource-based unit such as, for example, a cement factory, should be located near limestone availability as the transport cot of limestone is very high. Copper or nitrate deposits can be most economically processed near the location of the ores. Projects based on imported materials to a substantial extent may need to be located at ports or in proximity to terminals. On the other hand, perishable products or agro-processing industries are very market-oriented and it is far more advantageous to locate such production near the principal consumption centres. To the extent that a product can be determined as resource-oriented, or substantially market-oriented, project locations would largely follow the location of resources or consumption centres as the case may be.

A very large number of industrial products, however, are in intermediate situations in so far as the relative pulls of one or other of these factor is concerned. Petroleum products and petrochemicals, for example, can be located either at source or near consumption centres or even at some intermediate point. A wide range of consumer-goods industries and intermediates can be located at various distances from materials and markets without unduly distorting project economics. Even in the case of the engineering-goods sector, including machine-building, assembly and subassembly plants, other locational factor considerations tend to exercise considerable influence, though the products, in terms of bulk and transport costs, can be said to be primarily market-oriented.

With the ever-widening scope of industrial activities, the incidence of transport costs of materials vs products, though still of vital significance for certain projects, has to be viewed in conjunction with certain other aspects such as factor substitution, demand elasticity and the possibilities of alternative pricing formula, all of which could materially affect the incidence and weightness of the raw material or market factors.

3. Local conditions: infrastructure and socio-economic environment

Infrastructure

The availability of infrastructural investments is of vital importance for the operations of any project. It is therefore required to assess the implications which electric power, energy, transport, water supply and communications have on the project proposal. For this purpose it is necessary to have already an understanding of the capacity to be installed and the technology to be applied. Since the latter has not yet been covered by the Manual, the project planner might have to return to this sub-chapter once he has a better knowledge about the selected technology.

The non-availability of adequate electrical power or the high unit cost of power in a particular area, can constitute a major constraint, either for a project such as an alumina plant or for a particular technological process such as electrical smelting. Where the location of a resource-based project cannot be adjusted, the project has to provide its own power source. The power requirements can be defined in relation to plant capacity and its supply and cost implications at various locations would need to be studied. For determining the locational impact of power and energy factors, however, it may be necessary to collect and compare considerable detailed data for alternative locations. In respect of power, such data would need to cover (i) quantities available, (ii) whether high-tension or low-tension current, (iii) stability of network, (iv) point of tie-in for a particular area, and (v) price at different consumption levels. For coal, coke, fuel oil or gas where available, such data would need to cover, for each item, the quantities normally available, quality, calorific value and chemical composition, source, distance to different locations, transport facilities and cost at alternative locations.

Transport facilities need to be available for inflow of various inputs and marketing of products. They can take the form of railways, highways, water transport and, for small and expensive products, air transport. The transport implications, in terms of availability and cost, will need to be set out in detail for the total volume of inputs coming into the proposed plant and the total output leaving the plant withcomparisons being made for various alternative locations. The extent of details that would need to be gone into would depend on the nature and extent of transportation that would be involved.

Where shipping of inputs or finished products is involved, details as to port facilities would be necessary , including the depth of the harbour basin in the port concerned, the crane capacity, the size of ships which could use the port, port warehousing facilities and charges. Where extensive road transportation may have to be undertaken, it may be necessary to define the width of roads and bridges, clearance and bearing capacities of bridges, category of road and the maintenance obligations that may devolve on the project, apart from the cost of such transport. If a road has to be constructed to a particular location, estimates would have to be prepared and detailed aspects of construction would have to be taken into account. If rail facilities are to be extensively used, an assessment would be necessary as to capacity of rolling stock, loading and unloading facilities, ware-housing and storage facilities and any seasonal or other bottlenecks that may develop, apart from the cost of rail transportation to the principal movement points to and from possible plant locations. Water transport may also be feasible and in such cases, the width and depth of rivers and canals, the capacity of barges or other vessels that can be used and other related aspects will need to be considered. In each case, it is necessary to estimate the likely cost elements of transportations, apart from other implications.

The facilities of water supply, apart from projects such as brewery where it is a raw material also, need to be identified, as this may be necessary for various purposes. The requirements of water for processes and uses in a project would emerge from the determination of plant capacity and technology. Firstly, it would be necessary to determine the availability of water to the required extent and the costs that supplies may entail. This would need determination of (a) whether requisite quantities could be obtained from public utilities, together with conditions of supply and price, or (b) separate facilities would need to be provided by the project and water supply be arranged from surface sources such as a river or sub-surface viz groundwater. The cost of such facilities would need to be estimated. Secondly, qualitative assessment would be necessary regarding water requirements for different purposes in the project, such as drinking water supplies, use as coolants and for steam generation etc. The latter aspects may necessitate a qualitative survey of water at different locations.

The availability of good communication facilities including telex and telephone facilities also need to be defined for alternative locations.

Socio-economic environment

In respect of general community aspects, it would be necessary for the locational study to assess the implications of (i) waste disposal, (ii) availability of labour, (iii) construction and maintenance facilities, (iv) fiscal and legal regulations and climatic and weather conditions.

The problem of waste disposal may constitute a critical factor. Most industrial plants produce waste material or emissions which may have significant implications in a number of cases. The emissions may be classified as (a) gaseous, such as smoke, fumes, etc. which are generally processed till the concentration is reduced to safe proportions, (b) physical, such as noise, heat, vibrations and the like, which are also reduced to tolerable levels, through use of special equipment in many cases, and (c) liquid or solid, which are discharged through pumps and sewers over considerable distances in some cases or are settled in tanks or mounds, or incinerated or specially treated for further use or disposal.

Certain problem effluents, which are noxious or unpleasant or even dangerous require special treatment in any case. It is necessary that the location study should determine the extent of effluent and the possible manner of the disposal at alternative locations. For this purpose, it may be necessary to take into account any general and local ordinances on emission treatment and which may prescribe the specific steps and levels of treatment and disposal that may be necessary. In such cases, the cost of required effluent treatment or pumping and piping facilities or the cost of establishing and maintaining effluent dumps have to be taken into consideration. It would also be necessary to determine the likely impact of waste disposal from a project on a community and, for this purpose, more details may need to be collected regarding climatic and environmental factors. This would be particularly applicable in the case of waste material discharged into the atmosphere or liquids discharged into rivers and seas. A steel plant or a cement factory, if located near major urban centres, may constitute serious environmental problems and locational studies may have to take certain aspects such as rainfall, wind direction and velocity, period of sunshine etc. into detailed consideration for different locations. Similarly, for effluents from chemical plants, it would be necessary to assess the detailed impact on rivers or coastal areas in the case of seas, of such effluent discharge.

The location study would also need to take the source of manpower into account in considering alternative locations. The availability of a pool of skilled or semi-skilled workers in any location would be an important consideration. Most major projects require to incorporate training programmes, either during plant construction or as in-plant training. Information would need to be collected, for alternative locations in respect of availability of both skilled and semi-skilled workers, defining the type of skills and the source of such skills and of unskilled labour. An estimate would have to be made regarding general usage levels and allowances for various categories and labour in different locations, together with general living conditions including housing, social welfare, recreational facilities and the like. Any special labour conditions and attitudes will need to be identified, along with the labour history in different locations. Labour legislation, to the extent that it may differ in alternative locations, should also be specified.

It may be desirable, in respect of certain projects, to consider the facilities available at different locations for civil constructions, machinery erection or installation and maintenance of plant facilities. This would be largely by way of availability and quality of contractors and building materials. While this would not be a determinant locational factor, it may affect project costs and it would be useful to examine the implications in this regard.

The fiscal and legal regulations and procedures applicable in alternative locations need to be defined. The various national or local authorities who need to be contacted in respect of power supply, water supply, building regulations, fiscal spects, security needs etc. should be listed. The corporate and individual income taxes, excise duties, purchase tax and other national or local taxes should be defined for different locations, together with the incentives and concessions that may be available in one or other area for new industries. This could vary considerably for different areas and may constitute a significant locational consideration in a number of cases. It would also be useful to list the building and other legislation in alternative locations to which the project would need to conform.

Climatic and weather conditions can also be an important locational factor. Apart from the direct impact on project costs of resultant aspects such as dehumidification, airconditioning, refrigeration or special drainage and other facilities, the environmental effects may be significant. Information needs to be consequently collected in respect of temperature, rainfall, flooding, dust and fumes and the like for different location, together with earthquake frequency and other such factors.

A checklist on local conditions is annexed to the explanatory notes of this chapter.

4. Final choice of location

The locational analysis in a feasibility study needs to cover a number of aspects. A good starting point for such analysis continues to be the location of raw materials and inputs or the principal consumption centres as related to the defined scale of the plant, depending on whether a project is more resource-oriented or market-oriented. Where multiple materials are to be utilized, the sources of such materials should be taken into account, together with transport costs to alternative locations. The possibilities of substitution of materials and inputs either per se or from alternative supply sources as may have emerged from the study of materials and inputs, should also be considered. The market for the product needs to be conceived in dynamic terms and demand elasticities as should have been assessed in the demand analysis, together with the possibilities of alternative pricing formula for different market segments should also be taken into consideration. Infrastructure implications should then be considered in terms of both availability and cost. A combination of these aspects would enable the determination of net production and distribution costs in alternative locations. On these costs, it would be necessary to superimpose the weight to be attached in respect of socio-economic environmental considerations. Some of these aspects can be quantified and these need to be added to net production cum distribution cost. The most appropriate location would be where net production costs cum distribution costs are the lowest, where there is no significant difference in such costs between two or more locations, other factors could be taken into consideration to a greater extent. A number of other socio-economic and environmental factors, however, and can only be assessed in qualitative terms.

These include climatic and weather conditions and social welfare facilities such as education and medical services; recreational facilities and other environmental aspects. Information on such aspects should also be collected as part of the locational study. In projects, where net production cum distribution costs do not vary materially for alternative locations, the qualitative socio-economic environmental considerations could have over-riding effect in locational recommendations.

For projects which are not unduly resource-oriented or market-oriented, an optimum locational situation could well be a combination of a number of factors such as reasonable proximity to raw materials and markets, favourable environmental conditions, particularly socio-economic aspects, a good pool of labour, adequate availability and reasonable pricing of power and fuel, an equitable structure of taxes, good transportation, adequate water supply and facilities for waste disposal. A feasibility study has to take all these factors into appropriate consideration.

B. Site selection

Once project location has been determined in terms of a particular geographical area, the specific site for the project needs to be defined in the feasibility study or at least the cost implications of two or three alternative sites may need to be identified. This will need a detailed evaluation of the specific characteristics of each alternative site, under the categories of (i) cost of land, (ii) local conditions: infrastructure and socio-economic environment, and (iii) site preparation and development. Each of these aspects can have varying implications and significance depending on the nature of the project, the type of civil constructions contemplated, the weight of the heavier equipment items, the type of effluent, the number of workers and other such considerations. It would therefore be desirable for the site selection study to review all these aspects in the context of the proposed project. Information on some of the detailed aspects may not be readily available and it may be necessary, in some case, to do further investigation.

Cost of land

The cost of land would be an obvious element of site determination. Information in this regard is generally available. Where industrial areas or parks are located, these could constitute possible site alternatives and would, in any event, provide indications as to land costs in the area.

Local conditions: infrastructure and socio-economic environment

The availability and cost of electrical power would tend to be common for most sites within a given locational area. If an independent power facility has to be set up as part of the project, the cost of such facility would also tend to be more or less similar at various sites within an overall location area. Similarly, cost of electrical substations and electrical equipment such as transformers would also tend to be the same at different sites. However, power transmission lines would need to be extended to the factory site and this cost could vary substantially from site to site. An estimate needs to be made of such costs for alternative sites.

Transportation implications could be a very important element for comparing the suitability of different sites. Since the volume of inputs and outputs would be known after the plant capacity is determined, transportation alternatives and costs could be calculated and compared for different sites. Preliminary estimates need to be made to the extent applicable, in respect of (i) terminals for oil or gas or other materials, (ii) railway sidings from the nearest railhead, (iii) feeder roads connecting with main highways, and (iv) water transport possibilites. These could serve as the basis of comparison between different sites.

For a determined plant capacity, it would be relatively easy to define the requirements of water for various purposes such as cooling or steam generation, as also for drinking needs. Where water supply constitutes a basic requirement for the manufacturing process, as for pulp or cement, such assessment assumes even greater significance. The source and cost of water supply to the extent required has then to be estimated at alternative sites. Such costs can vary considerably and this aspect may constitute a significant element of site selection, particularly if large quantities of water are required.

The disposal of effluent may constitute a significant problem in many industries, as discussed earlier in this chapter. The possibilities of effluent disposal at different sites needs to be carefully studied in the context of the type of effluent. It would obviously not be appropriate to select a site for a cement plant which would be windward of a dense urban community nor discharge refinery effluent into a river used for drinking water supply downstream of such discharge.

The proximity of suitable labour to plant sites would be an important consideration from the viewpoint of costs of labour housing and construction of a housing colony, with necessary supporting facilities. While such colonies may need to be considered for major projects such as steel plants, heavy engineering industries and the like, involving a large labour complement, it would prove an undyly heavy financial burden in most other cases, at least during the initial stages.

It would be necessary to make a survey of soil conditions including bearing qualities, groundwater level etc. at alternative sites for determining building and plant designs. Possible effects of earthquakes would need to be specially considered in areas prone to earthquakes.

Site preparation and development

The cost of site preparation and development as classified in Schedule should be considered for alternative sites and should be identified in detail for the particular site selected.

Final site selection

On the basis of the comparative data that would emerge the most suitable site should be selected where net production costs cum distribution costs are lowest. The selection of plant location and site would not necessarily need to be undertaken in two distinct stages. Generally, alternative sites are considered in conjunction with wider locational considerations so that much of the information required is, in fact, collected at the same time. It would also be useful if the conclusions of the location of site study would be set out in a table, so that the relevant information could be incorporated in the next stage of project formulation.

It is often necessary to relate the concept of plant site and location to decisions or possibilities already in the minds of the project sponsors, whether public, institutional or private. To the extent that locational guidelines are defined by the sponsors, the task of the feasibility study is reduced. If, however, the study has to indicate the various alternatives without any such guidelines or constraints, it is necessary that the above factors should be taken into due consideration in evaluating various possibilities.

Check-list on local conditions

1. Climate and weather

1.1 Air temperature

maximum - minimum - average temperatures over
one day - one year - ten years

1.2 Humidity

maximum - minimum - average humidity over
one day - one year - ten years

1.3 Sunshine

daily duration of sunshine over
one year - ten years

1.4 Wind

- direction and number of days (wind rose)
- direction and maximum velocity
- destructive winds (hurricanes etc.):
  direction, velocity, frequency

1.5 Precipitations (rain, snow)

- duration and height of precipitation (max. - min. - average)
over one hour - one day - one month - one year - ten years
- extremes (hailstorms etc.)

1.6 Dust and fumes

- dust winds
duration, direction, velocity, contents of matter
per m^3 of air
- drifting sand
- fumes from neighbouring plants

1.7 Flooding from surface sources

height, duration and season of flooding

1.8 Earthquakes

- magnitude according to international scales
  (e.g. Richter-scale)
- frequency

3. Waste disposal

3.1 Dumps

type, location, access, dues, public transports

3.2 Sewage system

type (rainwater, mixed) diameter and material of pipes network, point of tie-in, dues

3.3 Sewage treatment plant

type, location, dues

4. Manpower

4.1 Employees

type and level of training, availability, salaries

4.2 Labour

type and level of skill, availability, wages

4.3 Allowances, payroll taxes, recruitment taxes, travel days etc.

4.4 Labour history and jurisdiction, labour laws and industrial relations

5. Fiscal and legal regulations

5.1 Fiscal regulations

taxes, customs, deprecation rates etc.

5.2 Legal regulations

building legislation, restrictions, safety regulations, compensation laws, standards

5.3 Insurances

fire, accident, liability, flood, storm damage

5.4 The liability to maintain on-site medical facilities

6. Construction, erection and maintenance facilities

6.1 Contractors
civil, electrical, mechanical etc. etc.
state: firm, address, capacity, level of skill

6.2 Building materials
state: availability, quality source, price

2. Transport facilities

2.1 Roads

- width of roads and bridges
- bearing capacity
- clearances under bridges
- type of road (all weather, macadam, dust-piste)
- close downs due to seasonal conditions
- road network (show on maps)

2.2 Railway

- railway network (show on maps)
- gauge, profile
- capacity (loads, quantities) of rolling stock
- loading and unloading facilities
- traffic restrictions due to seasonal conditions
- warehouses and storage
- tariffs

2.3 Water transport

- channel network, rivers, harbours (show on maps)
- width and depth of channels and rivers
- capacity of vessels
- loading and unloading facilities
- warehouses and storage
- fares

2.4 Air transport

- type of landing place (airport, piste)
- length of run ways
- warehouses and storage
- fares

2.5 Passenger transport systems

- buses, tramway etc.

Chapter 6: Project Engineering

The scope of the project should not only cover the plant site but all other activities required to supply inputs, deliver outputs and provide ancillary infrastructure investments. This comprehensive approach should help to determine which investments have to be undertaken by the investor or any third party. Functional and physical layouts serve as a basis for defining the scope of the project and the subsequent engineering work.

Once the entire extension of the project is understood, the appropriate technological processes to be employed, the type and extent of machinery and equipment required, and the cost of technology and equipment involved need to be determined on the basis of the identified plant capacity.

Next the various structures and civil works such as factory buildings, auxiliary structures and plant infrastructure facilities have to be defined and the relevant cost estimates be prepared.

6. Project engineering

6.1 Project layouts

6.1.1 Fundamental data and alternatives

- State fundamental data for the preparation of project layouts, such as required

  production programme
  supply programme
  technology
  equipment
  civil works
  local conditions, etc.

- Prepare and describe alternative project layouts

6.1.2 Selection of layouts

Select and describe in detail optimum layouts, state reasons for selection, show selected layouts on appropriate drawings

6.2 Scope of project

6.2.1 Fundamental data and alternatives

- State fundamental data for the definition of the scope of the project

- Prepare and describe alternatives

6.2.2 Selection of scope of project*

---

* Definition of "scope of project" see Chapter .03

Select and describe in detail the optimum scope of the project:

- state reasons for selection

- use physical layout drawings to show scope of project and project components

- number and list project components to serve as bases for further engineering and cost estimates

6.3 Technology(ies)

6.3.1 Fundamental data and alternatives

- state fundamental data for the technologies to be used

- describe possible alternative technologies

6.3.2 Selection of technology

Select and describe in detail the optimum technology(ies)

- state reasons for selection

- describe selected technology, stating type, source, specification

When selecting the technology(ies) the following aspects should be considered:

- nature of technology required (e.g. labour versus capital intensity, non-obsolescence, etc.)

- technology sources

- means of technology acquisition: licensing; purchase; joint venture

- cost of technology

6.3.3 Cost estimate

Estimate cost of technology

(1) Investment cost

- lump sum payments - use schedule 6-1 and insert total in schedule 10-1/1.

(2) Production cost

- royalties

- fixed annual payments - use schedule 6-1 and insert total in schedule 10-11.

6.4 Equipment

Equipment should be classified as to

(1) Production equipment

(2) Auxiliary equipment

(3) Service equipment

(4) Spare parts, tools

For details see check-list
attached to the explanatory notes of this chapter

6.4.1 Fundamental data and alternatives

- state fundamental data for equipment engineering

- list necessary equipment and possible alternatives

6.4.2 Selection of equipment

Select and describe in detail optimum equipment

- state reasons for selection

- describe selected equipment, stating number, type, specification, capacity, source.

6.4.3 Cost estimate

Estimate cost of equipment as to

(1) Investment cost

(1.1) Production equipment

(1.2) Auxiliary equipment

(1.3) Service equipment

(1.4) Primary stock of spare parts, wear and tear parts and tools.

Use schedules 6-2 and 6-3 and insert totals in schedule 10-1/1.

6.5 Civil engineering works

Civil engineering works should be classified as to

(1) Site preparation and development

(2) Buildings and special civil works

(3) Outdoor works (auxiliary and service facilities)

For details see check-lists.

6.5.1 Fundamental data and alternatives

- Describe fundamental data for civil engineering
- List civil engineering works and possible alternatives

For civil engineering, inter alia, the following aspects should be considered:

- physical plant layout
- availability and quality of construction material, plant and manpower
- technical requirements of plant operation
- local conditions
- cost

6.5.2 Selection of civil engineering works

Select and describe in detail optimum civil works

- state reasons for selection
- describe selected civil works, stating number, type, specification (if applicable)

6.5.3 Cost estimates

Estimate cost of civil engineering works as to

(1) Investment cost

(1.1) Site preparation and development

(1.2) Buildings and special civil works

(1.3) Outdoor works

Use schedules 6-4 and 6-5 and insert totals in schedule 10-1/1.

(2) Production cost, i.e., annual cost for maintenance and repair of civil engineering works of:

(2.1) Site preparation and development

(2.2) Building and special civil works

(2.3) Outdoor works

Use schedules 6-6 and 6-7 and insert total in schedule 10-11.

Estimate of costs of technology

1. Technology(ies) selected

1.1 Specification(s)

1.2 Supplier(s)

2. Costs

2.1 Lump-sum payments (incorporated fixed assets)

Technology	local	foreign	total
.			
.			
.			
Total				*)

*) insert in Schedule 10-1/1.

2.2 Royalty payments

2.2.1 As ...% of annual sales for a period of ... years

Year	anticipated sales	cost of estimated royalties *) local	foreign	total
1				
2				
3				
4				
.				
.				

*) insert in Schedule 7-1.

2.2.2 As a fixed annual payment for a period of ... years

Technology	cost of estimated royalties *) local	foreign	total
.			
.			
.			
.			
Total				*)

*) insert in Schedule 7-1.

Schedule 6-2

Estimate of Investment - Cost - EQUIPMENT

ESTIMATE OF INVESTMENT COST									
EQUIPMENT									
PROJECT COMPONENT : Nº ____ DESCRIPTION ____									
Item						Unit Cost	Cost		
Nº	Quantity	Unit	Description	[illegible]	[illegible]		foreign	local	total
(1)			Production equipment						
			. . . . .						
			. . . . .						
			. . . . .						
(2)			Auxiliary equipment						
			. . . . .						
			. . . . .						
			. . . . .						
(3)			Service equipment						
			. . . . .						
			. . . . .						
			. . . . .						
(4)			Primary stock of spare parts, tear and wear parts, tools						
			. . . . .						
			. . . . .						
			. . . . .						
Total									

Carry over TOTAL of project component
to Summary sheet (Schedule 6-3)

Schedule 6-3

Summary Sheet

Investment - Cost : EQUIPMENT

SUMMARY SHEET · INVESTMENT COST				
E Q U I P M E N T				
PROJECT COMPONENT		INVESTMENT COST CARRIED OVER		
No	DESCRIPTION	foreign	local	TOTAL
	TOTAL			

Insert TOTAL in Schedule 10-1/1.

Schedule 6-4

Estimate of Investment - Cost - CIVIL ENGINEERING WORKS

ESTIMATE OF INVESTMENT COST

CIVIL ENGINEERING WORKS

PROJECT COMPONENT : No ____ DESCRIPTION ____________

Item						Unit Cost	Cost		
[illegible]	[illegible]	[illegible]	Description	[illegible]	[illegible]		foreign	local	total
(1)			Site preparation and development						
			. . . . .						
			. . . . .						
			. . . . .						
(2)			Buildings and special civil works						
			. . . . .						
			. . . . .						
			. . . . .						
(3)			Outdoor works						
			. . . . .						
			. . . . .						
			. . . . .						
Total									

Carry over TOTAL of project Component
to Summary sheet (Schedule 6-5)

Schedule 6-5

Summary Sheet

Investment - Cost - CIVIL ENGINEERING WORKS

SUMMARY SHEET: INVESTMENT COST				
CIVIL ENGINEERING WORKS				
PROJECT COMPONENT		INVESTMENT COST CARRIED OVER		
No	DESCRIPTION	FOREIGN	LOCAL	TOTAL
TOTAL				

Insert TOTAL in Schedule 10-1/1.

Schedule 6-6

Estimate of Production - Cost - CIVIL ENGINEERING WORKS

ESTIMATE OF PRODUCTION COST									
CIVIL ENGINEERING WORKS									
PROJECT COMPONENT No ___ DESCRIPTION ___________									
Item						Unit Cost	Cost		
[illegible]	[illegible]	[illegible]	Description	[illegible]	[illegible]		foreign	local	total
			Maintenance and repair of works of						
(1)			Site preparation and development						
			. . . . .						
			. . . . .						
			. . . . .						
(2)			Buildings and special civil works						
			. . . . .						
			. . . . .						
			. . . . .						
(3)			Outdoor works						
			. . . . .						
			. . . . .						
			. . . . .						
Total									

Carry over TOTAL of project component
to Summary sheet (Schedule 6-7)

Schedule 6-7

Summary Sheet

Production - Cost - CIVIL ENGINEERING WORKS

SUMMARY SHEET : PRODUCTION COST				
CIVIL ENGINEERING WORKS				
PROJECT COMPONENT		PRODUCTION COST CARRIED OVER		
Nº	DESCRIPTION	FOREIGN	LOCAL	TOTAL
TOTAL				

Insert TOTAL in Schedule 7-1.

Explanatory Notes on Chapter 6 - Project Engineering

A. Project layouts

Functional and physical layouts serve as a basis for both defining the scope of the entire project and for undertaking the detailed engineering work, with the objective of estimating the related investment and production costs.

When preparing layout drawings, a good knowledge should be available of the size of the market and the estimated plant capacity, the supply base of the project, the local conditions prevailing at the related plant site and the needed type of technology, equipment and civil works.

Functional layout drawings are normally not to scale and should deal with all functional connexions and requirements stemming from the operation of the entire project. The degree of detail required depends on the size and technical sophistication of the project.

Typical functional layout drawings are:

i. Materials flow diagrammes generally show the flow of all materials and utilities as well as of final and intermediate products, by-products and emissions through all sections of the plant. For illustration purposes, the main equipment and/or structures and buildings are frequently shown.

ii. Quantity flow diagrammes indicate the quantities entering or leaving the process; the magnitudes involved are frequently indicated by varying widths of the flow line.

iii. Production line diagrammes show in detail for each section the progress of production, stating locational area and space requirements, description and dimensions of main equipment and its distance to the next section, requirements on power and other utilities as well as the necessary dimension of foundations and mounting devices.

iv. Transport layouts show distance and means of transport outside the production line. They are used, if greater distances are to be bridged for inputs and outputs.

They also indicate quantities to be transported, speed of vehicles and eventual transport restrictions.

v. Utility consumption layouts show the main points of consumption of power, water, gas, compressed air, etc., indicating the demanded qualities and quantities.

vi. Intercom layouts indicate the necessary connexion of all parts of the project with telephones, telex, intercom, etc.

vii. Manpower requirements are also often shown in layout drawings indicating number and skill of the manpower required.

viii. Organizational layouts (organigrammes) show the organizational set-up of the entire project. The organizational layout is often supported by an organization requirements chart, showing locational, area and personnel requirements of specific departments and their functional relationship.

ix. General functional layouts, showing the inter-relationship between equipment, buildings and civil works. It is essential to provide in these layouts for further possible extensions of the capacities of production, storage, transport, buildings and others.

Physical layout drawings

Physical layout drawings are prepared by fitting functional layouts into conditions actually prevailing at the site. These drawings should indicate the actual arrangement and main dimensions of the

- major equipment
- structures and buildings, civil works
- roads, railroads and other transport facilities up to their point of connexion to the public network
- various utility lines (electricity, water, gas, telephone, sewage, etc.) within the plant site and outside up to their connecting points with public or private networks
- Areas for further extension.

Physical layout drawings are based on maps, showing the results of geodetical, geological, hydrological, soil, mechanical and other surveys.

The scales of such layouts vary between 1:1000 and 1:200 depending on the size and complexity of the project. They should be chosen large enough to show all essential details for further engineering.

B. Scope of Project

(See Chapter .03)

C. Technology

An essential function of the feasibility study is to define the nature of the technology required for a particular project, evaluate technological alternatives and select the most appropriate technology in terms of optimum combination of available factor-resources for the project in question. The various implications of acquisition of such technology should be assessed, including contractual aspects of technology licensing, where this is resorted to. In the case of technology licensing, the specific engineering and technical services associated with the selected technology also need to be defined and disaggregated from the technology package and the agencies to perform such services should be identified. The selection and acquisition of technology has then to be dovetailed with the selection of machinery and equipment, as this often bears a close relation to the production techniques chosen.

Considerable economic literature has emerged in recent yeare on the conceptual aspects of technological choice. Most such studies centre around the degree of capital intensity as against the extent of labour orientation that can be applied in a particular project. With relatively cheap labour available in most developing countries, the labour-intensity aspect does acquire a definite significance, both in terms of overall employment objectives and the direct cost implications of capital substitution at the enterprise level. The relative interrelationship between factor prices of labour and capital, as also the implications of substantial changes in one or the other, should be reflected, both in the choice of production techniques and in the degree of mechanization at various levels of production operations. However, this aspect should not be considered in isolation, as it is the overall combination of various factor resources in the context of a particular project that should constitute the determinant element of selectivity.

Technology market

In most industrial sub-sectors, the market for technology tends to be highly imperfect, with oligopolietic tendencies getting increasingly accentuated with greater product sophistication. Thus, while various alternative production techniques may be available for the manufacture of relatively simple consumer goods, technological choices become increasingly limited when production of more sophisticated products is involved. In highly dynamic technological branches of sectors such as petrochemicals and electronics, the technology market becomes highly restricted even at the global level. Nevertheless, for most industrial projects and products which are of significant interest in developing countries, a considerable degree of technological choice does exist and needs to be identified.

1. Nature of technology required

The first step is the identification of the nature of technology required for a particular project. Production techniques can take various forms and may relate to process technology or manufacturing techniques and may be patented or unpatented in whole or in part. Even when technology is not patented, the know-how element has to be specifically acquired. Unpatented know-how can range from relatively simple production techniques to complex process know-how poseessed only by few enterprises. The source of technology acquisition would, to a large extent, depend on the nature and complexity of the techniques involved. Where such techniques are directly related to the operation of a particular conglomeration of machinery and equipment such as in a sugar or cement plant, the know-how element should normally be part and parcel of equipment supply.

No separate acquisition of technology should be necessary in such cases and the problem becomes that of training of personnel in the operation, use and maintenance of the plant equipment. It is in respect of products, where the manufacturing technology is independent of machinery and equipment that acquisition of technology assumes real significance. In the majority of cases in developing countries, technology acquisition relates to unpatented know-how, comprising the sum total of knowledge, experience and skills for manufacturing a product or products and for setting up an enterprise for this purpose. Thus, whether for a foundry project or for the manufacture of consumer durables or for a wide range of intermediate products, manufacturing or production know-how has to be specifically obtained from those possessing such know-how.

Technology selection

It is necessary for the feasibility study to evaluate the alternative techniques available and to determine the most appropriate technology in a particular context. Such an evaluation as related to a defined plant capacity and different technologies, should commence with a quantitative assessment of output, production build-up and gestation period and a qualitative assessment of product quality and marketability. Next, the implications of the alternatives on capital investment and production costs have to be assessed over a period of time. Apart, however, from the above basic criteria, it must be ensured that the technology has been fully proven and is utilized in the manufacturing process, preferably in the plant from which the technology is secured. While new and unproven or experimental techniques should not be considered appropriate, it is necessary that obsolescent technology be avoided which necessitates considering technological trends and the implications of resorting to more developed techniques over a period of time. For example, high voltage circuit breakers apply different technologies for extinguishing break sparks, such as bulk-oil, air-blast and SF_6. It would not, for example, be desirable to base a new plant on bulk-oil technology if it is considered that SF_6 technology is the more developed technique. In the production of various types of fertilizers, technological choice should be based on the latest developments rather than on older, more-proven processes, which are likely, however, to be considered obsolescent in the near future.

Technology selection has to be related to the principal inputs that may be available for a project and to an appropriate combination of various factor resources for both short- and long-term periods. In certain cases, the raw material constraint could determine the technology to be used. The quality of lime-stone, for example, would be a determinant factor whether the wet or dry process would be used for a cement plant. The availability of surplus bagasse would determine the type of technology for production of paper or newsprint. Furthermore, the non-availability or restricted availability of certain raw materials could also constitute a technological constraint. A technological process based on indigenous raw materials and inputs may be preferable to one where the principal inputs have to be imported indefinitely, particularly if serious foreign exchange constraints can affect the inflow of such materials. Apart from wider policy implications, supplies of such materials and inputs are much better assured in the former instance and may be less subject to external influences. This is not to suggest that the production programme should not be phased to provide for progressively integrated manufacture of certain products. In fact, such progressive integration may be the only practicable means of undertaking production in a developing country for a large numger of products.

A specific technology has to be viewed in the context of the total product mix that it generates and if an alternative technology results in a wider product mix, starting from the same basic production materials and inputs, the value of the total mix, including saleable by-products would obviously need to be taken into account.

The degree of capital intensity considered appropriate could also define the parameters of technological choice. In countries with shortage of labour, or where labour is very expensive as in Western Europe, capital-intensive techniques may obviously be more appropriate and economic. In other countries with excess labour, on the other hand, labour-saving techniques may prove unnecessarily expensive. This factor situation may be applicable in respect of the overall technology as well as the degree of mechanisation in a number of projects or particular production operations such as material-handling. It is necessary for the feasibility study to identify the choices from this factor viewpoint at both situations and to evaluate and select the most appropriate technique or techniques.

The extent to which a particular technology or production technique can be effectively absorbed in a particular country could also have a bearing on choice of technology. It is often suggested that a particular technology is too sophisticated for a particular developing country as it is above the level of technological absorptive capacity. In many cases, such an approach may tend to be exaggerated and in a number of instances, it has been used to impose obsolescent techniques for projects in these countries. There would, however, be some instances when a particular technology pertaining, for example, to complex data processing may not be able to be effectively absorbed in a particular country as the technical personnel required for the "software" work may not be able to be effectively trained within a reasonable period.

It is important to take full account of the cost of capital in judging the appropriateness of more capital-intensive techniques. There is often a tendency in developing countries to consider a more capital-intensive technique as being more suitable per se because it is used in industrialised countries. This may not necessarily be the case and the additional capital cost involved in such technologies needs to be viewed against the labour costs than less capital-intensive techniques may involve. The question of labour-capital-intensity as also the technical aspects of choice of technology can only be judged on techno-economic considerations and should be subject to a careful cost-benefit analysis in the feasibility study.

2. Technology sources

Together with selection of technology, it is necessary to define alternative sources from which such techniques can be acquired. The sources of unpatented technological know-how can vary with the nature and complexity of the concerned production process and can range from individual experts to other enterprises already engaged in the manufacture of the product in question, these being either domestic or foreign. A third choice, particularly for certain specialised products and techniques, is provided by consultancy organisations. An experienced spinning master or a good foundry man may be quite adequate for the transfer of know-how in a spinning mill or in a foundry. For much of the engineering-goods sector, where considerable documentation in the form of blueprints and manufacturing drawings may be necessary for a new project, recourse may have to be taken to some other manufacturing enterprise in the concerned production sector, though, for simple products and components, experienced individual experts may also prove adequate. In sectors such as production of petrochemicals, process technology would need to be secured from other manufacturing enterprises or from specialised consultancy agencies.

Industrial property rights

Where a desired technology is patented or is covered by registered trademarks, it is necessary to specifically secure such industrial rights, from the holders of such rights. Where patents are involved, the coverage and life of particular patents related to a required technology needs to be found out. In the case of a large number of products, the use of a particular trade-mark or trade name may be of special significance for product marketing and the implications in this regard need to be assessed. In the production, for example, of electric motors or steam turbines the use of an international brand name could be of considerable significance in product marketing both internally in the country and by way of exports. The use of particular brand-names may also be significant for the marketing of a wide rance of consumer products, ranging from perishable items to consumer durables and this aspect needs to be specifically assessed for the product in question.

3. Means of technology acquisition

Where technology has to be secured from some other enterprise, the means of such acquisition has to be determined. This can take the form of (i) technology licensing or (ii) outright purchase of technology or (iii) a joint venture involving participation in ownership by the technology supplier. The implications of each of these methods of acquisition should be analysed.

Licensing

Technology licensing has developed into a popular and effective mechanism for trade in technology and such a license gives the right to use patented technology and the transfer of related know-how on mutually agreed terms. Most such licenses in the case of industrial projects in developing countries have to be obtained from foreign enterprises holding industrial property rights or possessing unpatented know-how, though in some developing countries, such licenses can also be obtained from other domestic enterprises, particularly where no patents are involved. In cases where technology licensing is considered necessary, it is also desirable to consider (a) the disaggregation of the technology package and (b) some of the critical contractual elements in licensing. Though both these aspects would relate to the post-feasibility implementation stage, consideration of these aspects in the study could greatly assist in the subsequent negotiations of the technology license contract.

Disaggregation

The need for disaggregation of the technology package into various component parts, such as the technology paper, related engineering services, phasing of domestic integration, supply of intermediate products and even supply of equipment by the licensors in some cases, arises from the fact that prospective licensees from developing countries tend to be in a weak bargaining position and there is often a tendency on the part of technology suppliers to load the technology package with various features which may not be essential to the technology as such. It is necessary to distinguish between the essential technological features which need to be acquired and other aspects which need to be considered and evaluated separately.

Contractual aspects

The contractual aspects of technology licensing*/ would necessarily have to be confined to certain essential issues pertaining to the project in question which need to be considered prior to the negotiations for acquisition of technology. These can relate to (i) definition of technology to be acquired and guarantees by the licenser, (ii) remuneration to technology, (iii) duration of agreement, and (iv) purchase of intermediate products, components and inputs by prospective licenses. It is important to clearly define the technology to be acquired. Where process technology is involved, the process should be described, as also the production results expected to be achieved. Where manufacturing techniques are being acquired, the documentation and other elements of production know-how should be elaborated. It is also necessary to define the guarantees which should be provided by the technology licensor regarding the quality of the know-how and the fact that it would be transferred fully and completely following the license agreement. The appropriate payment for technology needs to be identified, together with the form of such payment. This tends to range generally from 5 to 10 years, depending on the technology. From the viewpoint of the proposed project, such duration should invariably cover the period necessary for adequate absorption of the know-how by the prospective licensee but any extension far beyond such period should be avoided. Since a feasibility study would undoubtedly seek to define the sources from which critical intermediate products and inputs would be secured, this aspect should also be covered in the technology contract to the extent that such intermediate products may necessarily have to be secured from the licensor for varying periods. Where such intermediate products and components can also be obtained from sources other than the technology supplier, it would not be desirable to have a contracual commitment to purchase such items from the licensor.

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*/ For a more detailed discussion of such contractual aspects, reference may be made to the "Guidelines for acquisition of technology in developing countries". UN, New York, 1973 (Sales No.E.73.II.B.1).

Purchase of technology

In certain industrial branches, it may be desirable to acquire the technology by outright purchase and where this would be more suitable, this should be highlighted in the feasibility study. This would be more appropriate when "one-time" technological rights or know-how are to be secured and where there is little likelihood of subsequent technological improvements or need for continued technological support to the prospective licensee.

Equity participation

The question of permitting or desiring equity participation by a technology supplier is one of policy for the project sponsors and should, in that sense, be considered beyond the scope of the feasibility study. However, the study should bring out the implications of such participation in terms of (i) continuing technological support on a long-term basis, (ii) possible access or otherwise to existing markets of the technology supplier either in the country in question or in external markets which can be served by the proposed project, (iii) participation in risk in respect of new products not tested in a particular market or (iv) participation implications from the viewpoint of covering resource gaps in projects involving large outlay. Such evaluation should also, at the same time, highlight the financial benefits that would accrue to the technology supplier both in this capacity and as an equity participant,

The nature of detailed technological services that would be required in conjunction with the use of a particular technology, should be defined in the study, together with the type of agencies to perform such functions. These functions would include detailed engineering, plant design and equipment layout, auxiliary facilities and the like at the pre-implementation stage, supervision functions during implementation, and testing, commissioning and start-up functions in the post-implementation period. Generally, the nature and scope of such technical services can be defined fairly specifically. In certain instances, the technology and the engineering services are combined in one party such as a consultancy organisation, but even in such cases, the cost of the services should be separately considered and judged on its own merits.

4. Cost of technology

It is necessary that, apart from selection of technology and defining of the engineering and technical services that may be required in conjunction with such technology, the cost of technology and technical services should be estimated in the feasibility study. This may often present difficulty, as negotiations in respect of technology acquisition and technical services between the prospective licensee and licensor would be subsequent to the preparation of the study, may also depend on the degree of regulatory control of such licensing arrangements by governmental bodies in a number of developing countries. The assessment made in the feasibility study in this regard could, however, serve as guidelines to the project sponsors in respect of technology negotiations and could define the framework within which such negotiations would b conducted.

Yet an assessment needs to be made of the appropriate remuneration for technology and services. For this purpose, reference may be necessary to technology payments made in other instances for the same industry to the extent that information can be obtained. An assessment could also be made of various alternatives of remuneration payment such as a lump sum payment or a running royalty rate or a combination of the two. A royalty payment may be more appropriate when the nature of technology would necessitate a continuing relationship with the technology licensor over a period of time. An assessment of the appropriate royalty rate should also be made. This tends to range from factional percentages up to 3 to 5 per cent of actual sales, depending on the nature of the industry and plant capacity. In the case of technical services, assessment of appropriate costs would be easier in most cases, as the cost of comparable services can generally be obtained except when such services are highly complex or are propristory in nature.

The estimates of technology payment can be quantified and the pro forma at Schedule ... may be utilised for the purpose. As for accounting for such technology remuneration, lump sum payments for patents and trademarks for spscial rights and concessions, and for unpatented know-how can be capitalised and amortised according to prevailing regulations in a country and incorporated into fixed capital assets. Royalty payments, however, are generally not capitalised and are included in production costs.

D. Selection of equipment [1)]

The selection of equipment is closely linked with technology selection and the two functions are interdependent. As pointed out earlier, in certain projects, such as sugar or cement plant, production and operational technology is part and parcel of the supply of equipment and no separate arrangements for technology acquisition may be necessary. In cases, however, when technology has to be independently acquired, the selection of equipment should usually follow the determination of technology, as the two aspects are closely inter-linked. The requirements of machinery and equipment need to be identified in the feasibility study on the basis of plant capacity on the one hand and the production technology selected on the other.

1. Basic aspects

The function of equipment selection at the feasibility study stage is broadly to define the optimum group of machinery and equipment necessary for a defined production capacity and using a defined production technique or techniques. The nature of this function would obviously differ in emphasis with the type of project. For most process-oriented industries, machinery, groups or individual machines have to be defined for various processing stages so that flow is continuous and uninterrupted with the various stages merging into one another. Thus, in all projects, the capacity rating of equipment has to be defined for each processing stage and related to the capacity and machinery requirements at the next production stage. The requirements of machinery and equipment have thus to be directly related to capacity needs at different stages of processing. In the case of manufacturing industries, the equipment choice is much wider, as different machines can perform similar functions with various degrees of accuracy. Thus, the complex of machine tools required for the manufacture of diesel engines or certain kinds of compressors could take alternative forms. From an investment viewpoint, equipment costs would obviously be kept

1) A Guide to Industrial Purchasing, UN, New York, 1972, Sales No. ID/82
Contract Planning and Organisation, UN, New York, 1974, Sales No. ID/117

to a minimum, consistent with the needs of various machinery functions and processes. Thus the defining of equipment requirement for a machine-building enterprise, for example, would necessitate a detailing of various machining and other operations required for projected production volumes over a period of time, the breakdown of the machine-hours required for each operation and the selection of specific machine tools to perform each function together with defining the number of machines required for different production levels to be achieved over a period of time.

2. Relation to other study components

The determination of equipment requirements would also have to be related to other study components. While most such aspects should be covered in the determination of plant capacity and technological processes, certain considerations may prove pertinent at this stage also, as the choice of equipment even within the framework of a defined plant capacity and technology may still be fairly wide. In certain cases, there may be infrastructure constraints such as the availability of power for a large electric furnace, or transportability of very heavy equipment to a difficult interior site. In some instances, the use of highly-sophisticated equipment, such as machine-tools with numerical controls, may not be appropriate in initial production stages, owing to the period required for training and skill formation. The use of more sophisticated equipment may also be ruled out or postponed on account of overall investment constraints or foreign exchange availability when such equipment has to be imported. The degree of maintenance requirements and the availability of maintenance facilities could also constitute an important factor. Governmental policies, such as import controls, may restrict the import of certain types of equipment and equipment selection has then to be tailored to domestic availability.

3. List of production equipment

The list of plant machinery and equipment should include all moveable and immovable machines and equipment for production, processing and control and related facilities thereto, which constitute an integral unit with the machines and which would not serve any other purpose. Such equipment can be variously classified for different types of projects. One classification of the production equipment could be to divide the items into the subgroups of (i) plant (process) machinery; (ii) mechanical equipment; (iii) electrical equipment; (iv) instrumentation and controls (v) process conveying and transport equipment, and (vi) other plant and machinery. The erection and installation of machinery has also to be provided for and this may necessitate special foundations, special supporting structures, walls, beams and ceilings. The equipment groups and machines for various functional processes or production centres should be subdivided to the level of individual machines and facilities and it is obviously necessary for the machinery list to be full and complete so as to cover the requirements for each stage of production from raw material receipt to the dispatch of final product. Apart from providing a detailed list of equipment, the rated performance required for various process equipment also needs to be defined, together with specifications for calling of quotations. While this needs to be very specific from the viewpoint of machinery performance, it should be so tailored so as to enable adequate competitive offers from machinery manufacturers. For each project component the complete list of equipment should be tabulated in accordance to the Schedule annexed to these explanatory notes.

Spare parts and tools

It is also necessary to prepare a detailed list of required spare parts and tools with estimated costs of such items. This should include the parts to be obtained with original equipment and parts and tools resulting from operational wear and tear. Spare part needs would depend on the nature of the industry, availability of spare parts and manufacturing capacity for such items within a country and facilities for imports, when necessary. Generally, 3 to 6 months' requirements are stocked but, in some cases, this could be higher. This has to be carefully evaluated in determining the volume of such parts, as this would have an impact on plant inventories and working capital.

Imported and domestic equipment

Machinery and equipment requirements including spare parts also need to be broken down in terms of imported equipment and machinery which would be available domestically. Cost estimates for imported equipment would need to be on the basis of c.i.f. and landed costs, together with internal transport, insurance, etc. to the plant site. Transport and other costs of domestic equipment should also be incorporated up to the plant site. The cost of erection of equipment should also be specifically estimated, particularly when this is undertaken as an independent operation. In other cases, installation costs should be specifically provided, though separately in the cost estimates. The installation costs may vary from a relatively low figure of around 1 to 2 per cent to a range extending from 5 to 15 per cent, depending on the nature of equipment and the type of erection and installation that may be involved. Provision for price escalation should be made, where appropriate, particularly where delivery is extended over a period of 18 months and more.

The cost of domestically produced equipment usually tends to be higher in developed countries, particularly where there are rigorous import controls and this has to be allowed for, in estimations of investment costs. Delivery periods in respect of domestic equipment also tend to vary considerably from equivalent imported machinery and this must be taken into account in time-scheduling.

4. Machinery supply contracts

The feasibility study should also prescribe some of the principal elements which need to be incorporated in the machinery supply contracts from the viewpoint of the project authorities purchasing such equipment. This should cover contractual provision relating to operating manuals; installation instructions and erection procedures in the case of heavy process and other equipment; guarantees and warrantiss necessary including penal provisions, particularly for critical equipment items; delivery clauses, including penal clauses for late or delayed deliveries; escalation clauses; procedures for testing, commissioning or take over as the case may be; provisions relating to the guarantee period and the like.

It is important to emphasise that, however detailed and complete the list and evaluation of machinery and equipment may be at the stage of a feasibility study, this may need to undergo substantial modification if the basic parameters of a project are modified in the course of investment decision, including changes in the technological process adopted. Such modifications would, however, need to be elaborated in the post-feasibility stage.

E. Structures and civil works

1. Cost estimates

In the light of the selected site, site conditions, selected technology and equipment, estimates need to be prepared for the costs of civil works and building structures. To cover all parts of the construction programme, it should be divided into three categories:

Site preparation and development

For details see check-list at the end of this chapter.

Buildings

Factory or process buildings

Ancillary buildings, such as maintenance buildings, garages, cafeteria, research and control laboratories, medical service buildings and others

Stores and warehouses for supplies, finished and semi-finished products, tools, spare parts, etc.

Administration buildings

Staff welfare buildings

Residential buildings

Others

For details see check-list at the end of this chapter.

Outdoor works

For details see check-list at the end of this chapter.

All required constructions and civil works should be dealt with under one of these categories in order to ensure the completeness of the cost estimates. When undertaking such estimates, detailed drawings have to be prepared to support and supplement the layout drawings with a view to enable an accurate computation of all quantities. Depending on the technical difficulties and on the sophistication of the project, different scales have to be selected. In most cases scales of 1:200 and 1:100 will be sufficient, but detail drawings may be going down to scales of 1:50, 1:20 or even 1:10.

The next step is to specificy the quality of the construction materials to be used and the levels of workmanship to be applied. These two factors have an essential bearing on the investment cost outlay. Materials which are not available in a developing country have often to be transported over long distances to the construction site. Keeping the increased risk of losses and/or damages during the transport aside for the time being, excessive transport costs may endanger the profitability of the project. Furthermore, insufficient experience of local labour to work with certain construction materials may have a negative impact on the quality of the construction work. This aspect should be kept in mind especially with regard to the post-construction period when most of the occuring maintenance work has to be done by local labour.

The third step is to perform quantity surveys based on drawings and specifications. The quantities to be surveyed should correspond to the prices used for the cost estimates.

Cost estimates for buildings and civil engineering works should be based on unit and/or cost parameters such as square metres of built-up area or cubic metres of enclosed space of a building which may be obtained either by resorting to already existing comparable values for equal or similar works or by obtaining suitable quotations from contractors.

The calculation of costs of certain fixed installed equipment, such as plumbing, central heating, electrical wiring, piping of all kind, etc. deserves in many countries particular attention in view of the prevailing depreciation policies. For office, administration and residential buildings, such fixed installed equipment is treated as an integral part of the building, thus being subject to the same depreciation rate as the building itself. For factory buildings, ancillary buildings, stores and warehouses, these installations are commonly listed under equipment, auxiliary equipment or service equipment with quite different depreciation rates.

2. Non-factory buildings

The feasibility study should also determine the required non-factory constructions and their timing. Thus, administration buildings have sometimes to be built even before factory constructions are stored. Since elaborate administration structures should be constructed only once substantial profits accrue, it is suggested to plan the initial facilities on the basis of minimum essential needs. On the other hand, social welfare facilities f r plant labour should be provided adequately: a good cafeteria and basic recreation facilities can contribute greatly to productivity and sound management-labour relations. Whilst final decisions regarding such facilities would rest with the project authorities, it would be desirable for the study to define an appropriate pattern.

The question whether housing facilities have to be provided needs to be specifically considered. Generally speaking, it should not be provided except in very limited cases such as for shift engineers and supervisors. Site conditions would be a determinant factor in this regard. A plant located at some distance from an urban centre may face problems in obtaining suitable plant labour so that transport facilitiee for plant personnel may need to be provided. In more distant areas, however, there may be no alternative but to provide for a housing colony with supporting educational, medical and social welfare facilities. This may be a very expensive burden on a project, but may be unavoidable in a number of cases in developing countries.

The feasibility study should highlight these aspects and present alternatives such as:

(a) housing colony;
(b) extensive transport facilities;
(c) payment of transport allowances; or
(d) any other possibility.

It is also necessary for the study to ascertain the special financing facilities that may be available from governmental and institutional sources for undertaking such housing construction.

Check-list
Classification of
Equipment

1 Production equipment

1.1 Plant (process) equipment

1.2 Mechanical equipment

1.3 Electrical equipment

1.4 Instrumentation and controls

1.5 Process conveying and transport

1.6 Other plant and machinery

2 Auxiliary equipment

2.1 Transport

cars, buses, trucks, tank-trucks, fork-lifts, railway equipment, water transport, ropeways etc.

2.2 Utility supply

electric power equipment, water supply (pumping stations etc.) gas (booster stations etc.)

2.3 Generating plants for

electricity, steam, hot and warm water, compressed air etc. (as far as not included in production equipment)

2.4 Emergency power

stand-by diesels, batteries etc.

2.5 Workshop equipment

mechanical, electrical, measuring instruments etc.

2.6 Laboratory

2.7 Storage and warehouse equipment

2.8 Intercom

central units for telephone, wireless, telex, clocks etc.

2.9 Heating, ventilation, air conditioning

2.10 Packaging equipment and durable packaging, mechanical saws, nailing machinee, planners, drums, containers, etc.

2.11 Sewage disposal and treatment

pumps with drives, ecrew conveyers, treatment plant

2.12 Waste disposal and treatment

2.13 Other auxiliary equipment

3 Service equipment

3.1 Office equipment

office machines, reproduction equipment, furniture, lockers etc.

3.2 Canteen

3.3 Medical service

3.4 Plant security

fire protection, supervision etc.

3.5 Plant yard cleaning and service

mechanical brooms, sprinkler cars etc.

3.6 Staff welfare and residential buildings

3.7 Other service equipment

Note: Costs of auxiliary and service equipment should only be listed as long as they are not included in Civil Works - installations.

Check-list

Classification of cost of

Site preparation and development

1 Translocation of existing structures, pipes, cables, powerlines, roads etc.

2 Demolition and removal of structures and foundations

3 Wrecking

4 Grubbing

5 Site grading, cutting and filling to establish general job levels but not detail grading

6 Draining, removal of standing surface water, reclamation of swamps etc.

7 Diversion of streams etc.

8 Utility connections from site to point of tie-in into public or private network

8.1 Electric power (high tension/low tension)

8.2 Water (potable water and/or use water)

8.3 Communications (telephone, telex etc)

8.4 Roads

8.5 Railway sidings

8.6 Other utility connections

9 Other site preparation and development work

10 Temporary work for plant construction, as far as not covered under unit prices of civil works (site overheads)

Note: Costs of site preparation and development should be calculated as far as they are not covered by "outdoor works"

Check-list

Classification of

Buildings and Civil Works

1 Buildings and structures. (Normal construction and installation work - use unit prices or cost parameters for cost estimates such as m^2 of built-up area or m^3 of space enclosed)

1.1 Buildings including excavation, bricklaying, concrete and reinforced concrete works, water-proofing, masonry, structural steel rooring and cladding, steel-sheet works, carpentery etc.

1.2 Structural finishing including masonry, carpentery, steel works, plaster, joinery, glazing, waterproofing, caulking, ceramic tiling, flooring, asphalting, parquetery, paving, wall papering, painting etc.

1.3 Technical installations and equipment, including heating and ventilation, air conditioning, plumbing, gas, power current, low-tension current installations

2 Special civil engineering works including: (Use unit prices for cost estimates) pile foundations, slurry trench walls, walls, soil consolidation, drainage, lowering of ground water table, steel sheet piling, ramps, chimneys and stacks.
Foundations for all kinds of heavy equipment.

3 Buildings and structures (special construction and installation works). Use unit prices for cost estimates. Cost of equipment only to be estimated if not yet listed under auxiliary production or service equipment.

Generating plants for steam, hot and warm water, air treatment, power and low tension currents, emergency power plants, storage tanks for fuel and gasoline, filling stations, central units for telephone, intercom, clocks, fire fighting etc., compressed air centers, pneumatic dispatch tube systems, air curtains, booster stations, elevators, cranes, kitchens, laundries, laboratories, etc.

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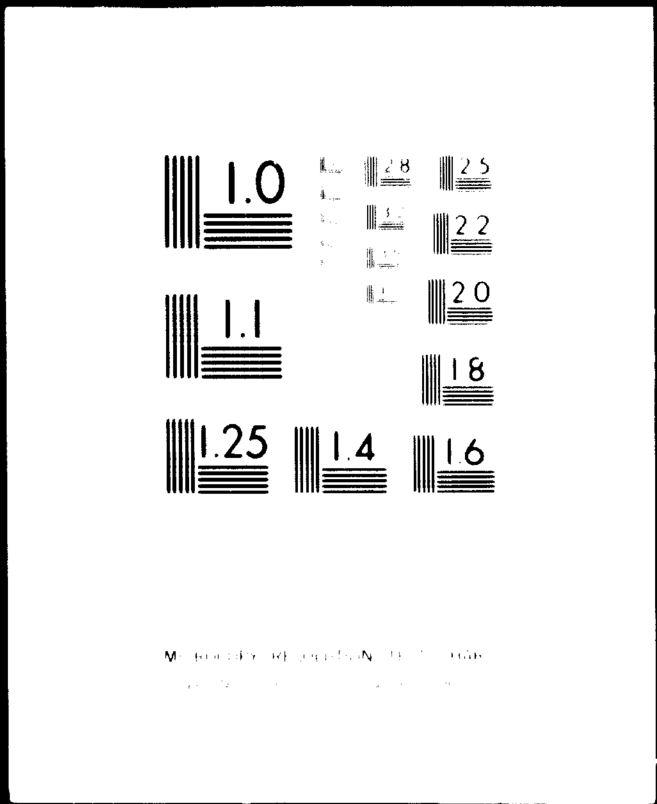

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Check-list

Classification of

Outdoor Works

1 Utility supplies and distribution (Use unit prices for cost estimates provided listed items not yet covered under site development, buildings or equipment).

Water (use water and drinking water)

Electric power (power current, low tension current)

Communication (telephone, telex)

Steam

Gas

2 Emissions handling and treatment

(costs estimates like under 1)

Sewage system (stormwater, sanitary, production)

Oil and grease separators

Pumping stations and screw conveyers

Treatment plants

Waste storage boxes, refuse burning plants

Others

3 Traffic installations

(costs estimates like under 1)

Yards, roads, paths, parking areas

Railway tracks

Sheds for bicycles, motor cycles and cars

Traffic lights

Outdoor lights

Outdoor lighting

4 Landscaping

(costs estimates like under 1)

Plants, grass, sods

Water basins

Others

5 Fencing and supervision

(Costs estimates like under 1)

Fences, walls

Doors, gates, barriers

Supervision and plant security installations

Others

Chapter 7 Plant organization and overhead costs

Project engineering and organizational planning are closely related and should therefore be undertaken jointly in a series of feedback operations. Organizational planning will enable the calculation of overhead costs which in some projects can become decisive for its profitability. A feasible division of the plant in components (production cost centres) and service and administrative cost centres is imperative for a realistic assessment of overhead costs.

7. Plant organization

7.1 Cost centres

7.1.1 Fundamental data and alternatives

- State fundamental data to set up cost centres such as
  - engineering layouts,
  - production programme and capacity,
  - types of cost centres (production, service, administrative),
- Prepare alternatives

7.1.2 Selection of cost centres

State reasons for selection, show selected cost centres

7.2 Overhead costs

7.2.1 Fundamental data and alternatives

- State fundamental data: list of cost items and differentiation between factory and administrative overheads, depreciation and financial costs,
- List alternative arrangements.

7.2.2 Selection of occuring cost items and their grouping into groups of overheads

State reasons for selection.

Use Schedule 7-1 to collect overhead costs and insert total in Schedule 10-11.

Schedule 7-1

<u>Overhead Cost Schedule</u> (alternative 1)

Cost items	Service Cost Centres											Administr. and Finance Cost Centres					
	Social Service	Plant management	Off-site transport	Purchasing	Stores	Repair and Maint.	Power, heat, light	Steam	Water supply	Laboratories	Effluent disposal	Sub total (1)-(11)	General Admin.	Personnel	Training	Account. and Book-keeping	Sub total (13)-(16)	Total (1)-(16)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
A. Maintenance (from Sched.6-9)						X												
B. Insurance													X					
C. Communication				X									X					
D. Travel				X									X					
E. Rents													X					
F. Recurring land charges (from Sched.5-2)													X					
G. Royalties (from Sched.6-1)													X					
H. Property taxes													X					
I. Effluents											X							
J. Licenses-fees													X					
K. Sub-total																		
L. Depreciation																		
- Building																X		
- Machinery																X		
- Office equipment																X		
M. Sub-total																		
N. Total																		

Insert line K, column (12) into Schedule 10-11, line 3.3

Insert line K, column (17) into Schedule 10-11, line 4

Insert line M, column (16) into Schedule 10-11, line 5.3

Explanatory notes on Chapter 7: Plant organization and overhead costs

A. Plant organization

Project engineering and organizational planning are closely related and should therefore be undertaken jointly in a series of feedback operations. The size of workshops, their grouping within the production process, their organizational attachment as well as the number, size and organizational set-up of service, administrative and sales units depend largely on the capacity and the required engineering to attain the established production programme.

When dealing with the organizational arrangements for a new project, attention has to be paid to the planning of overhead costs related to the operations of the factory, the administration and the sales and distribution service. Disregarding the final organizational set-up, the project planner should therefore at first obtain a good understanding of the types of operations and services needed to achieve the production objective. To facilitate this task it is suggested to divide the production process into a number of related functions which are to be grouped into cost centres. The service cost centres have to be established similarly which have to render certain types of services for the production line. The same applies to administration and sales.

Within the framework of the Manual it is hardly possible to enter into the intricacies of cost centre accounting. In the attached bibliography sufficient reference is made to existing literature. At this point only a brief checklist is provided of cost centres as they may occur in any plant and which should be reflected in the organization of the project.

Production Cost Centres are those areas of activity e.g. within the vegetable oil processing factory where industrial operations are performed with the purpose of producing vegetable oils. These cost centres are:

- Delinting
- Decorticating
- Pressing
- Solvent extraction
- Bagging
- Neutralizing
- Bleaching
- Deodorizing
- Winterizing
- Filling and packing

Service Cost Centres are those areas of activity which render the various services necessary for the smooth running of the plant. The following service cost centres are commonly found in most plants:

- Social services: including housing, health service, cantine, transport, company food stores, etc.
- Plant management: of production workshops
- Off-site transport: all transport activities which are not related to connected production processes
- Purchasing: of raw material, spare parts and other supplies
- Stores: for purchased raw materials, spare parts, packing materials, supplies and equipment
- Repair and maintenance: of machinery and equipment, buildings, vehicles, etc.
- Electricity: for productive and general use
- Steam: for productive use
- Water supply: in case of company's own supply
- Laboratories: process control
- Effluent disposal

Changes may be made according to the actual organizational structure of the factory under study.

Administration and finance comprise all activities related to managerial planning, control, and performance evaluation. Again, practice varies with respect to the number of centres to which these activities are actually assigned. Larger factories maintain specialized centres for planning, budgeting, costing, statistics, personnel training, accounting and finance. Smaller factories have a fewer number of such centres. Hence, it is suggested to accumulate all expenses related to administration and finance in one centre under this designation.

B. Overhead costs

In most feasibility studies very little attention is paid to the planning of overhead costs. Frequently it is observed that overhead costs are computed as a percentage surcharge on total material and manpower inputs, a procedure which in most cases is not sufficiently accurate. Admittedly, the amount of time and effort required to calculate overhead costs should be positively related to the results to be obtained. Even if this relationship is not satisfactory, it might be argued that the project team should in any case have an excellent comprehension of the various cost centres required to organize and operate the project and the various types of cost items accruing there and that consequently a detailed analysis should be undertaken.

The following major blocks of overhead costs should be distinguished:

Factory overheads which accrue in conjunction with the transformation, fabrication or extraction of raw materials. Typical cost items are:

	Source
- Wages and salaries (including benefits and social security contributions)	from Chapter 8
- Auxiliary material - Office supplies - Utilities (water, electricity, gas, steam, etc.)	from Chapter 4
- Repair and maintenance (contractual)	
- Effluent disposal	
- Others	

These cost items should be estimated at the service cost centres where they accrue.

Administrative overheads which should only be calculated separately in cases where they derive considerable importance. Otherwise they could be included under factory overheads. Typical cost items are:

- Wages and salaries (including benefits and social security contributions)	from Chapter 8
- Office supplies - Utilities - Communications	from Chapter 4
- Engineering costs (contractual)	
- Rents	
- Insurances (property)	
- Taxes (property)	
- Others	

These cost elements should be estimated for the administrative cost centres such as management, book-keeping and accounting, central engineering, legal and patent office, traffic management, public relations etc.

Depreciation charges are frequently included under factory overheads, but since they are not required for cash flow analysis it is suggested to deal with them separately. This way it is still possible to use them for the calculation of factory costs and unit costs as well as for simple financial evaluation.

Depreciation charges should be calculated based on the original value of fixed investments according to the methods (e.g. straight line) and rates adopted by management and approved by the Tax Authorities. The same applies to the amortization of non-physical assets such as the capitalized pre-production capital expenditures.

Financial overhead costs such as interests on term loans constitute frequently part of administrative overheads. The Manual, however, treats this item separately in Chapter 10.C.

The list of overhead cost items is repetitive in the sense that wages, salaries, utilities, and supplies are mentioned although all material inputs (see Chapter 4) and manpower requirements (see Chapter 8) are computed elsewhere. It is left within the discretion of the user of the Manual, once all material inputs and manpower costs are compiled by production, service and administration cost centres as outlined in Chapters 4 and 8, whether to

Alternative 1:

- transfer the respective sums to the Total Production Cost Schedule (No. 10-11) in Chapter 10.C and deal only with the remaining cost items in the Overhead Cost Schedule (No. 7-1) in this chapter, or to

Alternative 2:

- transfer the material and manpower overhead costs from Chapters 4 and 8 to the Overhead Cost Schedule (7-1), estimate the remainder of the overheads and transfer afterwards the total overhead costs to the Total Production Cost Schedule in Chapter 10.C.

In order to avoid any unnecessary burden on the proposed pro forma system, it is suggested to use alternative 1.

As a result of this exercise the residual factory overhead costs are to be derived from Schedule 7-1, line I, column (1)-(11) and the residual administrative overhead costs from Schedule 7-1, line I, column (12)-(15). Both sums have to be inserted in Schedule 10-11.

Chapter 8: Manpower

With the determination of plant production capacity and the technological processes to be employed, it is necessary to define the requirements of personnel for the project under consideration at various levels of management, production and other related activities. It is also necessary to define the requirements of training at various levels and during different stages of the project.

8. Manpower

8.1 Labour

8.1.1 Fundamental data and alternatives

- Describe fundamental data required for the determination of labour inputs
- Prepare alternative manning tables, considering inter alia the
  - organizational layout
  - strategies and objectives of management for operating the factory
  - skill requirements and level of training of labour
  - availability of labour, local/foreign

8.1.2 Selection of labour

Select and describe in detail the manning table for labour

- state reasons for selection
- describe in detail the selected alternative
  - show structure (organization)
  - prepare detailed manning table, considering the subdivision into production labour and non-production labour (e.g. administration)

8.1.3 Cost estimate

Estimate annual labour cost at nominal feasible capacity, subdivided into

- cost of production labour (variable) and
- cost of non-production labour (fixed)

Use Schedules 8-1 and 8-2 and insert totals in Schedule 10-11.

8.2 Staff

8.2.1 Fundamental data and alternatives

- Describe fundamental data required for the determination of staff inputs
- Prepare alternative manning tables, considering <u>inter alia</u>
  - organizational layout
  - strategies and objectives of management for administering and operating the factory, marketing the products etc.
  - skill requirements and level of training of staff
  - availability of staff, local/foreign

8.2.2 Selection of staff

Select and describe in detail the manning table for staff

- state reasons for selection
- describe in detail the selected alternative
  - show structure (organization)
  - prepare detailed manning table

8.2.3 Cost estimate

Estimate annual cost of local and foreign staff

Use Schedules 8-3 and 8-4 and insert totals in Schedule 10-11.

Schedule 8 - 1 : Manning Table LABOUR

MANNING TABLE : LABOUR : VARIABLE / FIXED

DEPARTMENT:		WAGE CATEGORIES No OF LABOUR								SUB-TOTAL		TOTAL
FUNCTION	SHIFT	f	l	f	l	f	l	f	l	f	l	
	I											
	II											
	III											
	I											
	II											
	III											
	I											
	II											
	III											
	I											
	II											
	III											
	I											
	II											
	III											
TOTAL LABOUR												

Insert total in Schedule 8 - 2

Schedule 8-2

Estimate of Production Costs : Wages

ESTIMATE OF PRODUCTION COSTS: WAGES

No	Department (Project component) Description	Variable costs wage categories (No of labour)				Sub total		Total	Fixed costs wage categories (No of labour)				Sub total		Total
		f	l	f	l	f	l		f	l	f	l	f	l	
Total No of labour															
Working hours per day						X	X	X					X	X	X
Working days per year						X	X	X					X	X	X
Hours per year															
Wages per hour						X	X	X					X	X	X
Surcharge %						X	X	X					X	X	X
Wages per year						X	X	X					X	X	X
TOTAL															

Insert TOTALS in schedule 10-11.

Schedule 8 - 3 : Manning Table STAFF

MANNING TABLE . STAFF											
DEPARTMENT:	SALARY CATEGORIES No OF STAFF										
FUNCTION									SUB TOTAL		TOTAL
	f	l	f	l	f	l	f	l	f	l	
TOTAL STAFF											

Insert total in Schedule 8 - 4

Schedule 8-4

Estimate of production costs : Salaries

ESTIMATE OF PRODUCTION COST : SALARIES

NO	DEPARTMENT (PROJECT COMPONENT) DESCRIPTION	SALARY CATEGORIES (NO OF STAFF)								SUB TOTAL		TOTAL
		f	l	f	l	f	l	f	l	f	l	
	TOTAL NO OF STAFF											
	WORKING MONTHS PER YEAR											
	MANMONTHS PER YEAR											
	SALARIES PER MONTH											
	SURCHARGE %											
	SALARIES PER YEAR											
	TOTAL											

Insert TOTAL in schedule 10-11.

Explanatory notes on Chapter 8: Manpower

The manpower estimate serves mainly two purposes. Firstly a detailed manning table is required for the calculation of the cost of manpower as part of the production costs, and secondly, the structure of the required personnel will be compared to the structure of the labour force available in the project region. This comparison will lead to an assessment of training requirements.

To estimate labour and staff costs, use should be made of Schedules 8-1 and 8-3. These schedules are to be prepared for all departments, which when added should yield the total manpower costs of the project. The various departments should be derived from the organizational layout plan. It should be ensured that all labour and staff are included under one or other of the departments and categories and that no double counting takes place.

A. Manpower requirements

Manpower planning should start from the departmental level defining the labour and staff requirements by functions and categories (workers: supervisory, skilled, semi-skilled and unskilled labour; staff: managerial, administrative and sales). To set up the departmental manning table, use should be made of schedules 8-1 and 8-3. The manning table of the entire project can be obtained by simply aggregating the departmental manning tables in schedules 8-2 and 8-4 for labour and staff.

When planning personnel requirements, due consideration should be given to:

- a general assessment of the demand and supply of manpower and especially labour in the area;
- the appraisal of manpower and occupational skills available at national and regional levels in view of the skills and technological requirements of the project;
- the leading provisions of labour legislation covering industrial relations (individual and collective), wage levels, fringe benefits, procedures of recruitment and discharge;
- the number of shifts;
- the number of annual working days.

Particularly the number of working days are frequently over-estimated not keeping in mind losses of working days due to Sundays, national holidays and the like. Often not more than 200 to 250 working days per year are actually available.

Pre-production phase

When estimating manpower requirements, a distinction should be made between the pre-production and the operational phases. During the pre-production phase, it may be assumed that manpower requirements occur mainly in conjunction with all preparatory measures needed to start the operational phase. Thus, the managerial staff, supervisors, and some foremen and specialized machine operators have to be recruited in advance not only to be trained but to attend to the construction of buildings and the installation of equipment to be operated by them later on. Estimates should be made by categories of staff and workers as well as by functions applying standard pro forma man/months costs to arrive at the labour costs to be capitalized. Obviously, the number of persons required at this phase should be kept at a minimum so that pre-production costs are kept as low as possible. Foreign expertise may also be required for functions such as detailed engineering or supervision of construction or equipment erection and the number of persons, costs and periods in each case should be specified. Where foreign expertise is provided for this stage on a lump sum basis, and such services are performed externally, this should be specified, but where such expertise is provided at plant site or within the country in question, it would be desirable to specify the man/months and periods in each case. This is necessary to ensure that suitable training programmes can be set up for domestic personnel well on time so that both the number of foreign personnel and the periods for which they may be required may be kept to a minimum.

Operational phase

When estimating manpower requirements for the operational phase, the needed functions and skill levels should be determined by departments (schedules 8-1 and 8-3) and aggregated for the project (schedules 8-2 and 8-4). A distinction has to be made between variable and fixed wage and salary costs as well as between the local and foreign manpower components. The number of shifts has to be considered. When calculating the total wage and salary costs attention has to be paid to the fact that the hourly wage rate and the monthly salaries do not constitute the only manpower cost but that provision has to be made for:

- annual, sick and training leave which reduce the number of effective working days;

- social security, fringe benefits and welfare costs which increase the cash manpower costs;
- installation grants, subsistence payments and similar cash costs which occur with recruitment and employment of manpower; and
- payroll taxes.

Both in the cases of wage and salary estimates it is suggested to cover these extra manpower costs with surcharges which have to be computed separately for wage and salary earners. An example is provided at the end of the explanatory notes.

When estimating manpower requirements it is also necessary to describe the required qualifications and skills by categories of labour and staff in order to provide a framework for recruitment and suitable training programmes. When estimating these requirements, the selected technology, manpower availability and changing levels of productivity should be considered.

B. Labour norms

In respect of labour requirements a common error is the adoption of labour norms prevailing in industrialized countries. This is of particular significance in the engineering goods sector where norms relating to machine hours and the like vary considerably between industrialized countries and most developing countries. Inadequate skills and experience in the latter inevitably reduces the performance and productivity, particularly in initial stages of production operations. A part of the gap in skills and experience can be made up by extensive training programmes, but it is necessary that realistic norms should be adopted in the early years of production and manpower needs assessed accordingly. Such norms may not, however, be easy to prescribe and have to be based largely on experience of similar industrial activities in the country and area of the proposed project.

C. Supervisory and managerial staff

The availability of suitable supervisory personnel often constitutes a serious bottleneck in many developing countries since the production experience required by such personnel is usually not available. It is necessary that manpower planning for this category is undertaken well in advance of requirements. The feasibility study should define the requirements on a shift by shift basis and prescribe the qualifications and experience necessary. In view of inadequate availability of such experienced personnel, the timing of recruitment, possible sources of availability and the nature of training programmes necessary should be highlighted.

What is true of supervisory personnel is even more applicable to managerial staff as the provision of qualified and experienced managers is a basic prerequisite for successful project implementation and operation. It is, therefore, essential to define the requirements of such personnel in the feasibility study so that recruitment can be made by the project authorities well in time. In many projects, key senior personnel need to be associated with the project during the pre-production stage and even during the prior stage of project formulation and feasibility study. The timely provision of qualified managerial staff at all functions within the plant to be created is of utmost signifcance. 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. 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.

D. Foreign experts

The lack or inadequacy of managerial skills at the technical, administrative and commercial levels can only be offset through sound recruitment policies together with extensive training programmes. A feasibility study should indicate the qualifications and experience required by key managerial personnel. Persons with the basic educational qualifications can generally be obtained and shortfalls in experience can only be made up through intensive training during the pre-production stage. Such training would, in many cases, have to be arranged in foreign countries and negotiated as part of the technology suuply arrangement. In many cases, the inadequacy of experience managerial talent is sought to be convered through the employment of foreign personnel, either by hire of individual expatriates or in the form of management contracts with foreign companies. This is inevitably an expensive course and does not serve the important objective of development of indigenous managerial skills if it is extended over long periods as is often the case. The study of manpower needs should assess the availability of suitable domestic managerial skills and where foreign assistance is considered necessary, the duration and conditions of obtaining such assistance should be prescribed. The duration should be for the minimum period necessary and an important condition should be the selection and training of suitable domestic counterpart personnel who can gradually take over such responsibilities.

E. Training

Since lack of technical personnel and skills can constitute a significant bottleneck in developing countries, extensive training programmes need to be programmed and undertaken for various projects. Training may be organized at the proposed plant either on an in-plan or on-the-machine basis or through a training unit, or at other training institutes or similar factories in the country or abroad. The training at the factory may be provided by managerial personnel, both technical and others, at the higher levels or by specially recruited experts or by expatriate personnel, whose services may be provided by technical or operating collaborators for this purpose. The timing of training programmes is of crucial importance as adequately trained persons should be able to take up their positions as and when they are required. Thus, before commencement of production, personnel at various levels should already have undergone necessary training during the pre-production and construction stage. In the case of managerial and key non-technical personnel, such training would be in various management aspects and procedures while for various levels of supervisory and production personnel, it would be in different production branches in such detail as to enable such personnel to train others in the same fields.

The requirements of training for various levels of plant personnel, the duration of such training for each category, and the appropriate location and arrangements for training should be defined. In many cases, training units need to be set up at plant site during the pre-production stage. In other instances, foreign training may have to be provided for a number of personnel, and this should constitute an important element of technical assistance in cases of technology licensing and joint ventures. Considerable funds may need to be allocated for training programmes. In terms of growth of efficiency and productivity, this may well prove to be the most necessary and appropriate investment.

The provision for training is required not only before the commencement of production but from time to time thereafter, as 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.

F. Planning of overhead manpower cost

When estimating manpower requirements by project components, the project planner will not only have to plan at the level of production cost centres but equally important at the level of service administration and sales cost centres. A check-list of the usually encountered cost centres of the latter types is provided in chapter 7 "Plant Organization and Overhead Costs". Once the manpower overhead costs are computed it is left to the discretion of the user of the Manual whether to

Alternative 1: transfer the respective sums directly to the Total Production Cost Schedule (No. 10-11) in chapter 10.C, or to

Alternative 2: transfer the overhead manpower costs to the Overhead Cost Schedule (7-1) and shift afterwards the total overhead costs to Schedule 10-11.

In order to avoid any unnecessary burden on the proposal pro forma system, it is suggested to use Alternative 1.

G. Computation of surcharges on wages and salaries

The following example for the computation of surcharges on wages and salaries is only a typical one which shows the way how to proceed.

All figures, given in this example, depend on the working programme on the one side (working days per week, number of shifts etc.) and on the labour laws and benefits granted to staff and labour on the other.

They should be checked carefully before introducing them into the production cost estimates.

Effective working days per year

Number of days per year (including leap year) (3 x 365 + 1 x 366) : 4			365,25
Deduct sundays 365,25 : 7		-	52,18
Deduct saturdays (if appropriate)		-	52,18
Number of paid days per year			260,89 say 261 days
Deduct paid unproductive working days:			
- official and religious holidays, not on saturdays or sundays	say 11		
- leave (according labour laws)	say 20		
- sickness (according statistics)	say 15		
- training etc.	say 10		
- others	say 5		
		-	61 days
Number of effective working days per year:			200 days

<u>Computation of surcharges</u> due to

(i)	unproductive working days $\frac{61}{200} \times 100 =$		30%
(ii)	social security (insurances of all kind, etc. according to local labour jurisdiction)	say	15%
(iii)	social security for unproductive working days 15% of 30%		4,5%
(iv)	allowances		
	for leave, equivalent to say	20 days	
	for christmas, equivalent to say	20 days	
	for subsistence, equivalent to say 1 day/month	12 days	
		52 days	
		52 : 200	26%
(v)	payroll-tax, according laws	say	2,5%
		Total surcharge	78%

Note: If shift work and/or regular overtime work is necessary for plant operation (e.g. a steel works), the pertaining allowances have to be added to the above surcharges.

Chapter 9: Project Implementation

Project implementation phase embraces the period from the decision to invest until commercial production is started. A number of stages fall into this phase, such as negotiating and contracting, project design, construction and running-in which, if not planned properly, may extend over too many years and may thus endanger the anticipated profitability of the project. Therefore, primary objective of implementation planning is to determine the financial implications during the implementation phase with a view to securing sufficient finance until production is started and beyond. Equity vs. loan financing as well as the financial implications of investment delays should receive particular attention.

During the implementation phase a series of simultaneous and interacting investment activities take place with different financial implications. To measure them, an optimum implementation programme and time schedule should be prepared and shown in the feasibility study.

9. Project implementation

9.1 Fundamental data and activities

- State fundamental data for project implementation
- Elaborate implementation programme and time schedule and show alternatives, considering inter alia:
  - Establishment of a project implementation management
  - Arrangements for technology supply
  - Detailed planning of equipment, tendering, evaluation of bids, awards of contracts
  - Detailed planning of civil works, tendering, evaluation of bids, awards of contracts
  - Arrangements for financing
  - Construction period:
    - Purchase of land
    - Supervision, co-ordination, testing and take over of equipment and civil works
  - Build-up of administration, recruitment and training of staff and labour
  - Arrangements for supplies
  - Arrangements for marketing
  - Establishment of contacts to public authorities for timely approval of licences, contracts, etc.
  - Preliminary and capital issue expenses

9.2 Selection of project implementation programme and time schedule

- Select and describe in detail the optimum implementation programme and time schedule, list activities and show their sequence in bar diagrams and/or networks
- State reasons for selection

9.3 Cost estimate of project implementation

Investment (land, technology, civil works, plant and equipment) and production costs (material and labour inputs and overhead costs) are explained and estimated in the preceding relevant chapters. All cost components are collected in the following Chapter 10 with the objective of determining their timely sequence of occurrence based on the implementation schedule to be decided upon in the present chapter. For activities which occur during the investment phase up to the moment when the project is becoming operational, cost estimates have to be made for the:

- Establishment of a project implementation management
- Arrangements for technology supply
- Detailed planning of equipment, tendering, evaluation of bids, awards of contracts
- Detailed planning of civil works, tendering, evaluation of bids, awards of contracts
- Arrangements for financing
- Construction periods:
  - Purchase of land
  - Supervision, co-ordination, testing and take over of equipment and civil works
- Build-up of administration, recruitment and training of staff and labour
- Arrangements for supplies
- Arrangements for marketing
- Establishment of contacts to public authorities for timely approval of licences, contracts, etc.
- Preliminary and capital issue expenses

For cost estimates use Schedule 9-1 and insert total in Schedule 10-2/1.

Schedule 9 - 1

Estimate of Investment - Cost - PROJECT IMPLEMENTATION

ESTIMATE OF INVESTMENT COST

PROJECT IMPLEMENTATION

Item						Unit Cost	Cost		
No.	Quantity	Unit	Description	[illegible]	[illegible]		foreign	local	total
(1)			Management of project implementation • • • • • • • • • •						
(2)			Detail planning, tendering • • • • • • • • • •						
(3)			Supervision, coordination test-run and take over of civil works, equipment and plant • • • • • • • • • •						
(4)			Build-up of administration recruitement and training of staff and labour • • • • • • • • • •						
(5)			Arrangements for supplies • • • • • • • • • •						
(6)			Arrangements for marketing • • • • • • • • • •						
(7)			Build-up of connections • • • • • • • • • •						
(8)			Preliminary and capital issue expenses • • • • • • • • • •						
Total									

Insert Total in Schedule 1o - 2/1

Explanatory Notes on Chapter 9: Project Implementation

A. Project Scheduling

A realistic schedule needs to be drawn up for various stages of the project implementation - investment phase - as an essential part of the feasibility study as the implementation of every project must be related to a time-span. Such a schedule should initially define the various implementation stages, such as negotiations and contracting, project formulation, actual construction and running-in in terms of required time-periods for each stage and thereafter lay down a time-programme combining the various stages into one co-ordinated, consistent and related pattern of activities which dovetail into one another. This comprehensive schedule embraces the entire investment phase of which the actual construction period is only one, although the most important part. Project implementation scheduling normally only covers the construction stage,and the Manual will not differ in this regard. Emphasis is, however, put on the fact that a considerable amount of time may elapse from the moment when the investment decision is taken until construction actually starts. This period is covered with tendering, opening of bids, evaluation of bids, final negotiations on technology and award of contracts and may extend up to 6 to 12 months. In extreme cases this period may be much longer with the result that the cost data given in the feasibility study may become outdated and need complete overhauling. If a construction period of two to three years follows afterwards, the cost data taken for the investment decision may be several years old. Therefore, continuous cost control both in terms of projections and of actual data is required.

Varying periods of time are required for various stages of implementation in different projects. These depend on overall circumstances prevailing in a country and the specific nature and requirements of a particular project. These stages can be broadly classified as follows:

- Establishment of a project implementation management
- Arrangements for technology supply
- Detailed planning of equipment, tendering, evaluation of bids, awards of contracts
- Detailed planning of civil works, tendering, evaluation of bids, awards of contracts
- Arrangements for financing

- Construction period:
  - Purchase of land
  - Supervision, co-ordination, testing and take over of equipment and civil works
- Build-up of administration, recruitment and training of staff and labour
- Arrangements for supplies
- Arrangements for marketing
- Establishment of contacts to public authorities for timely approval of licences, contracts, etc.
- Preliminary and capital issue expenses

The above categories do not invariably lend themselves to stage by stage analysis with one stage invariably leading to the other. A great deal of overlapping may take place and will be necessary in certain projects in which one or other of these activities may have to be undertaken either earlier or later, depending on the estimate of time required.

In the context of the Manual project implementation planning is mainly dealt with in order to draw the project planner's attention to the financial implications of project scheduling (equity vs. loan financing, working capital requirements etc.) and the timely revealing of implementation delays and their financial impacts. At this stage, with the determination and planning of the construction period being completed, the first portion of the schedule of the cash flow table can be drawn up. The operational schedule of the cash flow table is formulated with the help of the production programme as outlined in Chapter 3 C. With the schedule of the cash flow table being finalized, all investment and production costs can be summarized and scheduled in Chapter 10.

1. Project implementation management

When implementing a project, the investor should at first set up his own project implementation management team which should receive delegated authority to act always or only in his absence as counterpart to contractors and consultants. The efficient implementation of a project may considerably depend on the support services the counterpart team is able to furnish. Thus, it may be assumed that e.g. its intimate knowledge of local conditions should be an asset. This team should not only remain active during the implementation period, but should ideally form the nucleus of the managerial, technical and operational staff to be put in charge of operating the plant.

2. Choice of technology

The selection of technology should not take unduly long as the relevant aspects should have been highlighted in the feasibility study. However, negotiations with technology suppliers or licensors may take considerable time in certain cases, particularly if minority or significant capital participation is sought from the licensors. It should generally be possible, however, to finalize these aspects within one or two months.

3. Detailed planning of equipment and civil works, tendering, evaluation of bids, awards of contracts

An adequate period should be provided for various kinds of activities before the actual site work begins. It should cover detail planning, preparation of tender documents, call for tenders, evaluation of tenders, contract negotiations and preparatory work for site installation.

There would be considerable lapse of time between the time when machinery quotations are invited and when final orders are placed but this period can generally be projected without too much difficulty. The delivery periods for equipment may, however, be very prolonged and may range from 3 to 6 months for relatively simple equipment to two years and more for complex process machinery, machine tools and heavy electrical equipment. In ordering the machinery, the time-span for erection, as also the requirements for various processing stages, needs to be fully borne in mind, so that the equipment arrives in proper sequence, from both these viewpoints. When both imported and domestic equipment is involved, the problem of delivery sequence becomes all the more significant. In many cases, deliveries of domestically-manufactured equipment in developing countries take considerably longer and need to be planned in advance to a greater extent.

4. Project financing

After the decision to invest has been taken and once the timely occurrence of investment costs becomes comprehensible, arrangements for project financing need to be initiated. This would require an estimate of the overall investment cost which would need to be covered by equity investment or loan finance. It would be necessary to determine the equity-loan ratio, together with supplier-credit or institutional loan finance that may be required. This may take considerable time but it may not be practicable to proceed with the project till project financing is resolved.

Also, a good comprehension should exist at the feasibility stage of all implementation costs to be encountered. Only if such a comprehensive assessment is available will it be possible to determine the mode of financing and the accruing financial costs which constitute part of the total production costs. Although project financing should be elaborated in more detail at this point, reference is made to the following Chapter 10 in which all investment and production costs will be summarized and properly scheduled, based on the results of implementation scheduling and production programming.

5. Construction period

Purchase of land

One of the critical steps is the purchase of land and the regulation of access to the plant site. This may sometimes lead to long-lasting negotiations if e.g. no agreement on the sales price can be reached. Optional contracts concluded at an early stage may help to avoid such delays.

Supervision, co-ordination, testing and take over of equipment and civil works

First of all the investor has to decide which of these activities should be performed by his own staff or by consultants.*

The commencement of civil constructions and plant facilities has to follow the preparation of a plant layout plan and the purchase of land at the selected site and site preparation and development. As for site preparation, this can generally be planned without any major problem and the process should not take unduly long except where site development presents difficulties. Civil works and construction activities would obviously have to be undertaken in an order of sequence

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* Manual on the Use of Consultants in Developing Countries, UN, New York 1972, Sales No.E.72.II.B.10

in terms of construction time and building requirements and such sequence needs to be carefully defined in relation to infrastructure needs and availability and the arrival and erection schedule of different groups or items of equipment. A large rotary kiln or boiler may take considerable time to erect and unless such erection is taken up in good time and in appropriate sequence, it may constitute a major bottleneck.

While civil constructions and infrastructure facilities are proceeding at site, machinery and equipment may need to be inspected at various locations and to be dispatched. Arrangements also need to be made for port clearance of imported items and transport of domestic machinery to site. All these aspects need to be adequately scheduled, so that there is no delay at any point.

As buildings and facilities are completed, arrangements for erection and installation of equipment have to be finalized. This needs to be taken up in good time, both when such erection work is subcontracted or when it is undertaken by the project authorities.

Critical stages during the implementation phase are the testing of equipment, trial production and commissioning of the plant. This period is particularly crucial since it can only be initiated once the entire plant has been erected if one disregards partial tests and trial runs which have to be undertaken as the implementation proceeds from stage to stage. Several project implementation techniques and schedules exist to facilitate this task.

6. Build-up of administration and labour and staff recruitment

The recruitment and training of staff and labour has also to be appropriately scheduled, so that trained personnel is available as and when required. Too often, recruitment is left to a very late stage and training programmes are initiated only when the plant is ready to commence production, leading to unnecessarily poor capacity utilization in early production stages. During the implementation phase the administrative structure of the plant has to be developed and set up based on the organizational layout.

7. Supplies

It is also necessary to finalize arrangements for basic production materials. For imported supplies, considerable time needs to be allowed but even in case of domestic materials, the flow of inputs has to be carefully scheduled, so that there is no time-lag. In some cases this may take considerable time, of the input materials are first to be grown, such as sugarcane for a sugar plant.

8. Pre-production marketing

The preparation of the sales market should start early enough to ensure that the output can really be sold as scheduled. Otherwise, a stock of unsold products would accumulate and the major assumptions concerning the commercial profitability would no longer be correct.

Market preparation ranges from advertising and training of salesmen and merchants to the provision of special sales facilities (e.g. deep freezing equipment).

9. Governmental approvals

Governmental approvals may take much time in certain developing countries, even at the initial stage, particularly if varying degrees of foreign investment are involved. The period involved may range from 30 to 90 days or more. Governmental approval would also be required, in many cases, for import of machinery and equipment and in respect of the arrangements for technology supply. The import of intermediate goods, including processed materials, parts and components may also require sanction of governmental agencies, at the production stage. In all these cases, adequate time should be provided for obtaining such approvals, so that this does not constitute a bottleneck. It is difficult to specify any period as conditions differ from country to country but, where such approvals have to be obtained, two to six months may be necessary in most cases.

B. Types of schedules

Suitable project scheduling should ensure that factory buildings and ancillary structures and infrastructure facilities are ready in time for the erection and installation of machinery and equipments, that trained manpower is available to operate the plant as soon as it is ready, and that basic production materials and auxiliary supplies are available in the plant to the extent required for effective commencement of operations. Any delay or lack of scheduling in respect of any aspects would inevitably have an adverse effect on plant operations during early production stages.

On the other hand, if factory buildings and constructions are ready far ahead of machinery supplies or vice versa or if production personnel are recruited too much in advance or unduly heavy production-material stocks are collected, this could mean unnecessary locking-up of funds in unutilized capacity, manpower or inventories. An effective balance has to be struck between the various input requirements in terms of timing and this can only be achieved through accurate project scheduling.

While the periods required for various implementation activities can be defined for each such activity, a project schedule has necessarily to be well-knit and co-ordinated in respect of such activities. This requires a methodical and systematic analysis and various methods of such analysis and scheduling can be considered for adoption. The most simple and popular approach is the preparation of a bar or Gantt chart, which divides project implementation into various component activities, showing the time-periods required for each activity and thereafter working back to the date or time-period by which the project activity should commence or particular decisions should be taken. The bar chart methodology can be applied to every project and does not present any significant problem in its preparation. The main limiting factor of this method is that it does not indicate the sequential relationships that exist between different activities or the constraints that each may involve. In a complex project, involving a number of inter-related and sequential activities, this approach may not prove adequate and a networks diagram may be necessary, defining such sequential relationships. Two techniques often used in this connection are the Critical Path Method (CPM) and the Project Evaluation and Review Technique (PERT).* In the former case, the sequential interrelationships are defined and certain critical activities are identified, through a system of labelled arrow diagramming. The emphasis in the PERT methodology is on activities defined in terms of specific events and decisions, also using arrow diagramming. Both these methods and certain variations of these techniques, seek to ensure that, given the constraints and time taken by different activities, a project should be implemented within the least time-span and incurring minimum costs. Ultimately, however, the success of any network

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* <u>Programming and Control of Implementation of Industrial Projects in Developing Countries</u>, UN, New York, 1970, Sales No. ID/SER.L/1

<u>The Initiation and Implementation of Industrial Projects in Developing Countries</u>, UN, New York, 1975, Sales No. E.75.II.B.2

diagramming also depends on sound judgements regarding the duration of various project activities. Once these can be defined with reasonable accuracy, network techniques can pinpoint the areas where greater efforts need to be concentrated during various stages of project implementation.

Whatever technique is employed, it is important that the initial schedule is reviewed from time to time in the course of project implementation and problems and constraints are identified and resolved during implementation. It may be impracticable to expect an initial project schedule to be so comprehensive and accurate as not to require to be revised and updated from time to time. In fact, such updating is an essential function of the scheduling process itself and it is only through constant review that pragmatic adjustments can be made in project implementation. In the feasibility study, it should be possible to indicate as to which activities are likely to be more critical during different stages of implementation. These can serve as useful guidelines at the stage of review.

C. <u>Cost estimates for project implementation</u>

Costs of project implementation constitute investment costs which are to be capitalized and which concern

1. <u>Project implementation management</u>

- salaries and wages of managerial staff
- rent and operation of offices, cars, living quarters etc.
- travel and communication expenses
- duties and taxes during the implementation period

2. <u>Detail planning of equipment and civil works, tendering and evaluation of bids</u>

- salaries and wages of planning staff
- rent and operation of officers, cars, etc.
- travels, transportation, communication
- fees for various types of consultants
- site and laboratory tests

3. Supervision and co-ordination of construction, testing, trial runs, start-up and commissioning

- salaries and wages of site staff
- costs of foreign experts
- rents (e.g. living quarters, offices)
- raw and auxiliary materials, supplies and utilities for test runs and start-up
- interests during construction (e.g. for term loans and current bank accounts)
- others

4. Build-up of administration, recruitment and training of staff and labour

- salaries and wages of administrative staff including section for personnel recruitment
- advertising costs for personnel
- salaries and wages of training staff and/or fees of training experts and/or fees for external training (locally or abroad) including travel and subsistence payments
- training materials
- salaries and wages of recruited staff and labour from date of recruitment until production start-up
- rent and operation of offices, training facilities, cars, living quarters etc.

5. Arrangements for supplies

- salaries and wages for purchasing staff
- travel expenses etc.
- communication

6. Arrangements for marketing

- salaries and wages for sales and marketing staff
- advertising
- training of salesmen and merchants
- travel expenses
- communication

7. Build-up of connexions with authorities

- cost for necessary approvals of operation etc.

8. Preliminary and capital issue expenses

- registration/incorporation fees
- printing and incidentals
- prospects and other printing expenses
- public announcement expenses
- under writing commission
- brokerage
- legal fees
- other expenses

The cost estimates should be based on an organizational layout of project implementation and consider inter alia:

- the decision of the investor to what extent the above-mentioned activities should be performed by his own staff or by consultants and contractors
- the time schedule of implementation, showing the proposed start and duration of these activities
- the necessary number of staff and labour (in major projects shown on a manning table) and the pertaining salaries and wages
- the local availability of offices, living quarters, transport facilities etc.
- the fees and rules of agreements of consultants and experts plus eventual additional allowances for their foreign staff.

Chapter 10 Financial and economic analysis

Project preparation should be geared towards the requirements of financial and economic analysis. Once all elements of a feasibility study are prepared, the next step is to compute the total investment outlay. Provided the conditions of project financing are already known at the feasibility stage, financial costs are to be calculated and included in the total production costs. Financial analysis should preferably rely on discounting methods and sensitivity analysis. If the required shadow prices are available, the project should also be subjected to national economic evaluation to estimate direct and indirect benefits and costs to aggregate consumption.

10. Financial and economic analysis

10.1 Total investment outlay

Calculate the total investment outlay by summarizing all investment components as described in chapters two to six and 9. Use

- Schedule 10-1/1 Initial fixed investment,
- Schedule 10-2/1 Pre-production capital costs,
- Schedule 10-3/2 Working capital requirements,

and summarize in Schedule 10-6/1 Total initial investment outlay. Project the annual investment expenditures in Schedule 10-6/2.

10.2 Project financing

- Describe and justify selection of sources of finance among alternatives
- Describe finally selected source(s) and conditions
- Prepare cash flow table for financial planning, use Schedule 10-8/3
- Estimate annual financial costs and insert total in Schedule 10-11.

10.3 Total production costs

Calculate total production costs by summarizing all cost items as described in chapters three to nine. Use

- Schedule 7-1 to collect all overhead costs and
- Schedule 10-11 to summarize total production costs. Project production expenditures in Schedule 10-12.

Estimate unit costs.

10.4 Commercial profitability

Compute commercial profitability criteria such as:

- Pay-back period,
- Simple rate of return,
- Net present value,
- Internal rate of return,
- Break-even point.

For cash flow tables see Schedules 10-13 and 10-14.

10.5 National economic evaluation

When applying the UNIDO method of economic project evaluation (Guidelines), estimate:

- direct benefits to aggregate consumption,
- direct costs to aggregate consumption,
- indirect benefits and costs to aggregate consumption,
- redistribution of income.

To apply the UNIDO method, calculate

- shadow price of labour,
- shadow price of foreign exchange, and
- shadow price of investment.

Estimate:

- social rate of discount.

Explanatory Notes on Chapter 10 - Financial Analysis

A feasibility study, as was explained at the outset of the Manual, is a tool for the project promoter to take a decision on the investment proposal under review. To facilitate this decision, both investment and production costs have to be made transparent and be put in a context keeping in mind that the profitability of a project will ultimately depend on the size and structure of investment and production costs and their timing.

With the basic components of investment and production costs of a project of defined capacity being determined in previous chapters in the form of land and site development, building and civil works, technology and equipment, material inputs, labour inputs and project implementation costs, the feasibility study should now assemble these components with a view to obtaining the total investment outlay, total production costs and the profitability of the project. Once the size of the investment is known, an assessment of the project financing should be made.

When assembling the components of investment and production costs, particular attention has to be paid to the timing of expenditures and costs as they influence the cash flow of the project and its internal rate of return. Knowing the project implementation and production schedules, investment and production costs have to be planned on an annual basis in line with the requirements of cash flow analysis. This division into annual portions is most suitably done at this stage of project planning where all costs are available. Frequent reference should be made to preceding chapters of the Manual where the components of investment and production costs are described in detail.

There is no set and exact formula for computing the investment and production costs, various approaches can be considered to arrive at these figures, given the cost data of the project components. Apart from such data, however, it is necessary to provide elements of correction in respect of calculations of fixed assets, pre-production capital costs, working capital and production costs through provisions for contingencies and price escalation. This becomes necessary as profitability calculations have to be based on a range of data, and each set of data is only valid under a number of specific assumptions to be given.

Contingencies include those items under the respective headings which cannot be foreseen at the pre-investment study stages. Some items cannot be accurately anticipated even at the project implementation stage. It is, therefore, prudent to provide separately for contingencies depending on the nature of the contracts envisaged.

A. Total investment outlay

Investment costs are defined as the sum of fixed capital (fixed investments plus pre-production capital costs) and working capital, with fixed capital constituting the resources required for constructing and equiping an investment project, and working capital corresponding to the resources needed to operate the project.

At the pre-investment stage, two mistakes are frequently to be observed. Most commonly working capital is either not at all included or in insufficient amounts, thus causing serious liquidity problems to the nascent project. Furthermore, total investment costs are sometimes confused with total assets, the latter corresponding, however, to fixed assets plus pre-production capital costs plus current assets. The amount of total investment costs is, in fact, smaller than total assets since it is composed of fixed assets and working capital which is obtained as the difference between current assets and current liabilities (see further below). Since a pre-investment study is much more concerned with the size of total investment and its financing, total assets are of minor importance in the context of a feasibility study.

1. Fixed capital

As indicated, fixed capital is composed of fixed investments and pre-production capital costs.

1.1 Fixed investments

Fixed investments should include:

(i) land and site preparation;
(ii) buildings and civil works;
(iii) plant machinery and equipment including auxiliary equipment; and
(iv) certain incorporated fixed assets such as industrial property rights.

To arrive at the fixed investment, the final amounts derived from schedules 5-1,6-1,6-3,6-7 have to be inserted in Schedule 10-1/1 given at the end of this chapter and be added up. Total fixed investment can then be projected for each year of the construction period until full production is reached. Schedule 10-1/2 can be used for this purpose.

1.2 Pre-production capital costs

Apart from capital costs of fixed investments, every industrial project incurs certain costs prior to commercial production which e.g. are due to the aquisition or generation of capital assets. These costs which have to be capitalized include a n mber of items which originated during the various stages of project formulation and implementation. They are briefly outlined below:

Preliminary and capital issue expenses

They 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 allotment of shares. Preliminary expenses also include legal fees for loan applications, land purchase agreements, etc.

Cost of preparatory studies

(a) Cost of pre-investment studies - including opportunity, pre-feasibility, feasibility and support or functional studies; engineering and other studies (e.g. project design report) undertaken for the implementation of the project;

(b) Consultant fees for preparing studies, engineering, and supervision of erection and construction, although consulting services are debitable to the 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;

(c) Other expenses for planning the project.

Pre-production expenses

(a) Salaries, fringe benefits and social security contributions of personnel engaged during the pre-production period;

(b) Travel expenses;

(c) Preparatory installations, such as workers' camps, temporary offices, stores, etc.;

(d) pre-production product promotion costs, creation of the sales network and promotional advertising;

(e) Training costs, including fees, travel and living expenses of the trainees and their salaries and stipends, fees payable to external institutions; and

(f) Interest on loans during construction.

The last item is likely to be of special significance in many projects and should be accounted for separately than interest on loans during production. Possible interest earnings of equity capital if such capital had been otherwise invested up to the time of production should not be capitalised but is only considered for evaluation purposes.

Trial runs, start-up and commissioning costs

This item includes fees payable for supervision of start-up operations, wages, salaries, fringe benefits and social security contributions of personnel employed, consumption of production materials and auxiliary supplies, utilities and other incidental start-up costs. Operating losses incurred during the running-in period up to the stage when satisfactory levels are achieved have also to be capitalised.

Pre-production expenditures can be tabulated according to Schedule 10-2/1.

In allocating pre-production capital costs, two practices are generally adhered to viz:

(a) to capitalize the entire pre-production capital costs and to amortize them over a certain period of time, ranging from two to ten years; or

(b) to initially allocate, where attributable, a part of the pre-production capital costs to the respective fixed assets and amortize the sum of both.

Pre-production capital costs which are not attributable are capitalized as a total and are also amortized over a period of two to ten years. For the phasing of pre-production capital costs on an annual basis see Schedule 10-2/2.

2. Working capital requirements

The term working capital simply defines the financial means required to operate the project according to its production programme. 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 products and cash-at-hand. Current liabilities are mainly composed of creditors (accounts payable), free of interest.

2.1 Accounts receivable (debtors)

The size of this item is predetermined by the company's credit sales policy. Since the ratio of 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 generalisation. 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 to be valued at production costs minus depreciation and interests with the understanding that the latter are to be covered by the sales value and not by the working capital.

2.2 Inventories

Working capital requirements are considerably affected by the amount of capital immobilized in the form of inventories. Every attempt should be made to reduce inventories to as low a level as practicable.

(a) Production 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 rapidly transported, only limited stocks should be maintained unless there are special storage problems. If the materials are imported and if import procedures are dilatory, the inventories equivalent of up to six months consumption may have to be maintained. Other factors influencing the size of production materials stocks are the reliability and seasonality of supplies, the number of suppliers, possibilities of substitution and expected price changes.

(b) Spare parts

Levels of spare parts inventories depend on the local availability of supplies, import procedures and maintenance facilities in the area, and on the nature of the plant itself.

(c) Work-in-process

The assessment of work-in-process requirements necessitates a comprehensive analysis of the production process, and of the degree of processing already reached by the different material inputs during each stage. The requirements are expressed in months (days) of production depending on the nature of product. In machinery products, this can extend to several months. The valuation is at factory costs minus depreciation.

(d) Finished goods

The inventory of finished goods depends on a number of factors, such as the nature of the product and trade usage. The valuation is at factory costs minus depreciation plus administrative overheads.

2.3 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 is often the case, no provision is normally necessary, except in so far as the working capital required at the end of six-month period may not have been covered by the finished stocks or receivables. It may also be prudent to provide for a certain amount of cash-in-hand. This could be done by providing a contingency reserve on working capital, which could be around 5 per cent. Schedule 10-3/2 gives an example how to calculate the cash requirements.

2.4 Accounts payable (creditors)

Raw and auxiliary materials, supplies, utilities, etc. are usually purchased on credit up to a certain period and taxes are paid during the year after the income has been gained. Such credited payments reduce the amount of working capital required.

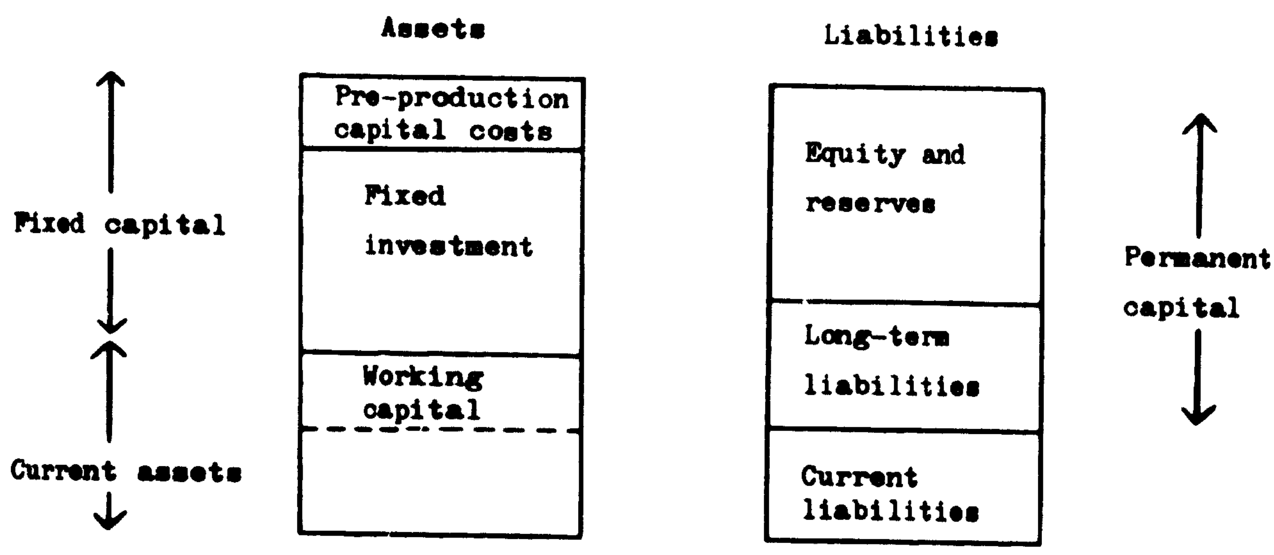
2.5 Calculation (see Schedules 10-3/1, 10-3/2, 10-4 and 10-5)

When calculating the annual working capital requirements, the minimum coverage of days for current assets and liabilities has to be determined at first. Secondly, annual factory and production costs have to be computed since the values of some components of the current assets are expressed in these terms. As working capital requirements change as the project is gradually becoming fully operational, it is necessary to obtain factory and production cost data for the start-up and full capacity production periods (for an example see Schedule 10-3/1).

The next step is to determine the coefficient of turnover for the components of current assets and liabilities by dividing 360 days by the number of days of minimum coverage (see Schedule 10-3/2). Subsequently, the cost data provided in Schedule 10-3/1 for each item of the current assets and liabilities are to be divided by the respective coefficients of turnover and put in Schedule 10-3/2 . The working capital requirements for the different production stages are finally obtained by deducting the current liabilities from the sum of current assets. The required cash-in-hand is calculated separately at the bottom of Schedule 10-3/2.

Working capital for seasonal factories such as a sugar factory needs to be calculated on a slightly different basis. A year has to be divided into operational and non-operational periods. The working capital requirements during the operational phase are calculated on a normal basis. For the slack season, the needed working capital has to be scaled down since only fixed costs have to be maintained. However, during the operational season, inventory must be increased, and therefore working capital requirements will grow. A seasonal factory has to build up the working capital in the operational season and decrease it during the non-operational period. The calculation of the working capital for seasonally employed firms is based on an annual forecast of payments and receipts. In the illustrative example in Schedule 10-5 all payments are listed which are compared to monthly receipts coming from sales, while in Schedule 10-4 the schedule starts with the months during which larger payments have first to be undertaken (May). The last column of Schedule 10-5 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 balance.

The calculation of working capital requirements at the stage of the feasibility study is of particular importance since it forces the project promoter to think about the funds needed to finance the operations of the project as compared to the invested funds such as pre-production capital costs and fixed investments (fixed assets). Conceptually the term working capital should not be confused with the term current assets, which normally ought to be larger in size. As can be seen from the following graph, working capital should be financed out of permanent capital which is composed of equity capital, reserves and long and medium-term liabilities. Since current liabilities (mainly accounts payable) represent financial means put at the project's disposal free of charge, they can be deducted from the current assets to arrive at the working capital needed to operate the plant. This way the amount of long-term financing (permanent capital) is reduced to the amount of fixed capital plus working capital. This amount (see Schedules 10-6/1 and 10-6/2) will be used further below when assessing the project proposal's commercial profitability.



Working capital = Current assets minus current liabilities
or = Permanent capital - fixed capital

3. Total investment outlay

From the figures of pre-production expenses, fixed investments, and working capital estimates, the total investment outlay of the project under consideration can be calculated (see Schedule 10-6/1). The phasing of such outlay is shown in Schedule 10-6/2. It is to be noted that, when phasing the total investment outlay first the initial investments and afterwards all subsequent increments should be inserted in the schedule until full capacity is reached.

4. Total assets

In order to furnish sufficient data for ratio analysis (see Chapter 10.B, para. 7), it will be prudent to provide at the stage of project preparation a special schedule on total assets. This will be rather easy to accomplish by converting Schedules 10-6/1 and 10-6/2 into Schedules 10-7/1 and 10-7/2 and substituting item 3 current assets for working capital. When phasing current assets, first the initial amounts and afterwards all subsequent investments should be inserted in the schedule until full capacity is reached.

Schedule 10-1/1

Initial Fixed Investment

(insert totals in Schedule 10-6/1)

No.	Investment item	Foreign currency	Local currency	Total cost
1	Land (from Schedule 5-1)			
2	Site preparation and development (from Schedule 6-7)			
3	Structures and Civil Works (a) Buildings and civil works (from Schedule 6-7) (b) Auxiliary and service facilities (from Schedule 6-7)			
4	Incorporated fixed assets (from Schedule 6-1)			
5	Plant machinery and equipment (from Schedule 6-3)			
6	TOTAL INITIAL FIXED INVESTMENT	2880	4920	7800

Schedule 10-1/2

Fixed Investment Schedule *)

(insert in Schedule 10-6/2)

Period	Construction period (initial fixed investment)						Start-up and full capacity utilization (replacement investment)										Total		
Year	1			2			3			...			8			...			
	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt		FC	LC	Tt
Fixed investment	1,000	2,000	3,000	1880	2920	4800	-	-	-				-	1,000	1,000		2880	5920	8800
1. Land																			
2. Site preparation and development																			
3. Structures and Civil Work																			
4. Incorporated fixed assets																			
5. Plant and machinery																			

FC = Foreign currency; LC = Local currency; Tt = Total

*) This Schedule projects the initial investment of Schedule 10-1/1 over time and in addition lists the replacement investment in year 8.

Schedule 10-2/1

PRE-PRODUCTION CAPITAL COSTS
(insert totals in Schedules 10-6/1 and 10-7/1)

Item	Categories	From Schedule	Foreign Currency	Local Currency	Total
A	Pre-investment studies	2-1			
B	Preparatory investigations	2-1			
C	Management of project implementation	9-1			
D	Detail planning, tendering	9-1			
E	Supervision, coordination test-run and take over of civil works, equipment and plant	9-1			
F	Build-up of administration recruitment and training of staff and labour	9-1			
G	Arrangements for supplies	9-1			
H	Arrangements for marketing	9-1			
I	Build-up of connexions	9-1			
J	Preliminary and capital issue expenses	9-1			
	Total A to J		120	380	500

Schedule 10-2/2: Pre-production capital costs schedule

(insert in Schedule 10-6/2 and 10-7/2)

Year	Construction						Start-up and full production					Total		
	1			2			3			4	5	FC	LC	Tt
	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt					
Pre-production capital costs	70	230	300	50	150	200	-	-	-			120	380	500

FC = Foreign currency; LC = Local currency; Tt = Total

Schedule 10-3/1

Calculation of working capital

1. Minimum requirements of current assets and liabilities

a) Accounts receivable	30 days at production costs minus depreciation and interests
b) Inventory:	
Local raw material A:	30 days
Local raw material B:	14 days
Imported raw material:	100 days
Spare parts:	180 days
Work-in-process:	9 days at factory costs minus depreciation
Finished products:	15 days at factory costs min.depreciat.plus admin.overh.
c) Cash-in-hand	15 days, see separate calculations at the bottom of Schedule 10-3/2
d) Accounts payable	30 days, for raw materials and utilities

2. Annual production cost estimate (in 000)*

(insert in Schedule 10-3/2, line IV)

Period	Construction		Start-up			Full Capacity		
Years	1	2	3	4	5	6	7	8
Production schedule	0	0	55%	75%	80%	100%	100%	100%
Raw materials								
- local material A			910	1240	1320	1650	1650	1650
- local material B			275	320	400	500	500	500
- imported material			1265	1785	1840	2300	2300	2300
Labour			690	940	1000	1250	1250	1250
Utilities			250	340	360	450	450	450
Repair			180	260	280	350	350	350
Maintenance - spare parts			250	250	250	250	250	250
Depreciation			780	780	780	780	780	780
Factory overhead costs			1350	1350	1350	1350	1350	1350
= Factory costs			5950	7265	7580	8880	8880	8880
Administrative overhead costs			500	500	500	500	500	500
Financial costs (interests)			375	330	280	180	90	-
Sales costs			250	250	250	250	250	250
Distribution cost			80	115	120	150	150	150
= Total production or manufacturing costs			7155	8460	8730	9960	9870	9780
(Production cost excl.depreciation and interests)**			(6000)	(7350)	(7670)	(9000)	(9000)	(9000)

* When projecting total production costs, please refer to Section C of this chapter which defines total costs taking into account the particular requirements of simple and non-discounted evaluation methods, discounted cash flow analysis and the computation of unit cost prices.

** For insertion into cash flow tables 10-8/3, 10-13 and 10-14. All data are rounded off.

Calculation of working capital

Schedule of working capital

(insert line III.A, year 6 in Schedule 10-6/1; line III.B in Schedule 10-6/2 and line I.D in Schedule 10-10)

	X	Y	Years					
	Minimum days of coverage	Coefficient of turnover	Start-up			Full capacity		
Years			3	4	5	6	7	8
I. Current assets								
A. Accounts receivable	30	12	500	612	640	750	750	750
Inventory								
a) Raw material								
- Local material								
Material A	30	12	63	100	110	138	138	138
Material B	14	24	10	15	17	20	20	20
- Imported material	100	3.6	350	480	511	639	639	639
b) Spare parts	180	2	146	146	146	125	125	125
c) Work-in-process	9	40	130	162	170	202	202	202
c) Finished products	15	24	236	290	304	358	358	358
C. Cash-in-hand (from V below)	15	24	153	166	168	178	175	171
D. Current assets	-	-	1588	1971	2066	2410	2407	2403
II. Current liabilities								
A. Accounts payable	30	12	-177	-293	-329	-408	-408	-408
III. A. Working capital			1411	1678	1773	2002	1999	1995
B. Increase in working capital			-	267	95	229	-3	-4

The cash balance Schedule is based on the following calculation:

Years	X	Y	3	4	5	6	7	8
IV. Total production costs	-	-	7155	8455	8730	9960	9870	9780
less: Raw material	-	-	2450	3340	3560	4450	4450	4450
Utility	-	-	250	340	360	450	450	450
Depreciation	-	-	780	780	780	780	780	780
	15	24	3675	3995	4030	4280	4190	4100
V. Required cash balance	-	-	153	166	168	178	175	171

Note: Based on the minimum requirements of current assets and liabilities, a coefficient of turnover is calculated.

$$\text{Coefficient of turnover} = \frac{360 \text{ days}}{n \text{ days of minimum requirements}}$$

The cost data provided in Schedule 10-3/1 for each item of the current assets and liabilities is then to be divided by the respective coefficients of turnover and the result is to be put into Schedule 10-3/2.

Schedule 10-4

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	-	-	-	-	-	1,800
October	-	-	-	-	-	780
November	-	-	-	-	-	680
December	-	-	-	-	-	940
January	-	-	-	-	-	3,280
February	-	-	-	-	-	2,840
March	-	-	-	-	-	3,060
April	-	-	-	-	-	4,020
Total	-	-	-	-	-	29,180

Schedule 10-5

Estimated monthly receipts and payments

Month	Receipts	Payments	Deficit	Surplus	Aggregated
May	2,500	5,680	3,180		3,180 min.
June	1,340	3,160	1,820		5,000
July	840	2,100	1,260		6,260
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	3,280		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	-

Schedule 10-6/1

Total initial investment outlay

(insert in Schedule 10-6/2)

Item	Investment item	Foreign currency	Local currency	Total
1	Initial fixed investments (from Schedule 10-1/1)	2880	4920	7800
2	Pre-production capital costs (from Schedule 10-2/1)	120	380	500
3	Working capital (at full capacity) (from Schedule 10-3/2, year 6, line III/A)	-	2000	2000
		3000	7300	10300

Schedule 10-7/1

Total initial assets

(insert in Schedule 10-7/2)

Item	Investment item	Foreign currency	Local currency	Total
1.	Initial fixed investment (from Schedule 10-1/1)	2880	4920	7800
2.	Pre-production capital costs (from Schedule 10-2/1)	120	380	500
3.	Current assets (at full capacity) (from Schedule 10-3/2, year 6, Line D)	400	2000	2400
		3400	7300	10700

Schedule 10-6/2

Total investment outlay

(insert in Schedules 10-13, line B.1)

Year	Construction						Start-up and full production																	Total		
	1			2			3			4			5			6			...	8			...	FC	LC	Tt
	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt		FC	LC	Tt		FC	LC	Tt
1. Fixed investment	1,000	2,000	3,000	1,880	2,920	4,800	-	-	-	-	-	-	-	-	-	-	-	-		-	1,000	1,000		2,880	5,920	8,800
a) Initial fixed investment	1,000	2,000	3,000	1,880	2,920	4,800	-	-	-	-	-	-	-	-	-	-	-	-		-				2,880	4,920	7,800
b) Replacement (from Sched. 10-1/2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	1,000	1,000		-	1,000	1,000
2. Pre-production capital costs (from Sched. 10-2/2)	70	230	300	50	150	200	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-		120	[illegible]	2,000
3. Working capital increase (from Sched. 10-3/2, line II/A,B) x/	-	-	-	-	-	-	-	1,410	1,410	-	270	270	-	90	90	-	230	230		-	-	-		-	2,000	2,000
Total investment outlay	1,070	2,230	3,300	1,930	3,070	5,000	-	1,410	1,410	-	270	279	-	90	90	-	230	230		-	1,000	1,000		3,000	[illegible],300	11,300

FC = Foreign currency; LC = Local currency; Tt = Total

x/ figures are rounded off

Schedule 10-7/2

Total assets

(insert in Schedules 10-8/3, line B_1 and 10-10)

Year	Construction						Start-up and full production																	Total		
	1			2			3			4			5			6			...	8			...	F C	L C	T t
	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt		FC	LC	Tt		FC	FC	Tt
1. Fixed investment	1,000	2,000	3,000	1,880	2,920	4,800	-	-	-	-	-	-	-	-	-	-	-	-		-	1,000	1,000		2,880	5,920	8,800
a) Initial fixed investment	1,000	2,000	3,000	1,880	2,920	4,800	-	-	-	-	-	-	-	-	-	-	-	-		-				2,880	4,920	7,800
b) Replacement (from Sched. 10-1/2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	1,000	1,000		-	1,000	1,000
2. Pre-production capital costs (from Sched. 10-2/2)	70	230	300	50	150	200	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-		120	330	500
3. Current assets increase (from Sched. 10-3/2, line I.D)	-	-	-	-	-	-	180	1,410	1,590	110	270	380	40	90	130	70	230	300		-	-	-		400	2,000	2,400
Total assets	1,070	2,230	3,300	1,930	3,070	5,000	180	1,410	1,590	110	270	380	40	90	130	70	230	300		-	1,000	1,000		3,400	8,300	11,700

FC = Foreign currency; LC = Local currency; Tt = Total

B. Project financing

The allocation of financial resources for a project constitutes an obvious and basic prerequisite not only for any investment decision but also for project formulation and pre-investment analysis. A feasibility study would serve little purpose if it was not backed by a reasonable assurance of resource availability for a resultant project if the conclusions of the study proved positive and satisfactory. A preliminary assessment of project financing possibilities should already have been made in most cases before a feasibility study is undertaken. This should be particularly so if a project opportunity or pre-feasibility study had been previously undertaken, as such studies would indicate the order-of-magnitude of capital outlay required and a feasibility study should only be proceeded with if financing prospects to such extent could be defined fairly clearly.

As discussed earlier, resource constraints may define the parameters of a project well before an investment decision and at various stages of project formulation. A large steel plant may not be practicable in a small country with extensive ores but with very limited financial resources. Such resource constraints may limit the consideration of certain projects or may restrict project capacity to the minimum economic levels necessary in particular situations. Financial constraints could operate in respect of all levels of project sponsorship and would be applicable whether a particular project is under consideration or is sponsered by an individual entrepreneur, a major industrial group, either domestic or foreign, or a governmental or semi-governmental agency, the only difference being that such constraints would become operative at different levels of magnitude in these cases. [1)]

Apart from instances where resource constraints constitute a major limiting factor in the consideration of project possibilities and project size and in the majority of latter cases also, it is only when the basic techno-economic parameters of a project are defined that the detailed requirements of financing can be adequately assessed. Thus, in a feasibility study, the capital outlay of a project can be appropriately determined only after plant capacity and location have been decided, together with estimation of costs of a developed site, buildings and civil works and technology and equipment. It is equally necessary to

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1) Industrial Joint-Venture Agreements, UN, New York, 1971, Sales No. E.71.II.B.23

define the financial requirements of a project at the operational stage in terms of working capital which can only be determined once the estimates of production costs on the one hand and sales and income on the other over a period of time, as reflected in a cash flow analysis, were made. Unless both these projections are available and unless resource availability adequately covers the requirements of funds, both in terms of initial capital investment and working capital needs over a period of time, it would not be prudent to proceed to the stage of project implementation. There are innumerable instances of projects which ran into serious financing problems because of inadequate estimates of fund requirements at the initial investment or operational stages through underestimation of investment and production costs or overestimation of sales and income.

1. Sources of Financing

Share capital

The general financing pattern for an industrial project is to cover the initial capital investment by share capital or a combination of share capital and loans to varying extents and to meet working capital needs through short- and medium-term loans from national banking sources. Within this framework, however, various permutation and combinations are possible and need to be assessed. In certain projects, equity and preference share capital covers not only initial capital investment but also working capital needs, for the most part. This generally occurs in situations where institutional capital is scarce and is available only at high cost. Since earnings from capital through term deposits are also high in such situations, a project would need to be very attractive financially before it could mobilise adequate investible resources. In other cases, where relatively inexpensive long-term or medium-term credit is available, there is a tendency to finance projects increasingly through such loans. In all cases, an appropriate balance needs to be achieved between the degree of investment through share capital and through credit in the form of various types of loan finance. The higher the proportion of share capital the less would be the income from individual share units as dividends would have to be distributed between a larger number of units.

The higher the proportion of loan finance on the other hand, the higher would be the interest liabilities. In every project, therefore, the implications of alternative patterns and forms of financing must be carefully assessed and a suitable financing pattern should be determined, which would be consistent both with availability of resources and overall economic returns.

Share capital is generally considered under two categories, viz. equity and preference capital. Preference capital usually carries a fixed rate of dividend and limited voting rights and can be cumulative or non-cumulative in terms of dividends and can be redeemable or non-redeemable, with the redemption period varying between 5 to 15 years. Equity capital is of course the real venture capital for any project.

Loan financing

In view of greater availability of borrowings in most cases, project financing may well start by identifying the extent to which loan capital can be secured together with the interest rate applicable. Such loan capital would need to be separately defined in the form of (i) short- and medium-term borrowings from commercial banks for working capital purposes, and (ii) term borrowings from development financial institutions, national or international or supplier credits of various forms. Short-term borrowings from commercial banks and local financial institutions are available against hypothecation or pledging of inventories. The limits to which inventories are financed by commercial banks are fixed by banks for each enterprise depending on banking practices in the country, the nature of the project and inventories and the creditworthiness of the enterprise and its management. The limits usually vary between 50 per cent and 80 per cent leaving a margin of 20 to 50 per cent of inventories and production costs to be financed by venture capital. Bank borrowing for working capital can be on a temporary basis. After the first few years of operation when the enterprise overcomes its teething problems and initial financial and other difficulties, it should be possible, in many cases, to repay such bank credits out of cash surplus deriving out of depreciation and undistributed profit. However, in some cases, such surplus may be used for further capacity expansion so that the enterprise may need to rely on long-term bank credits for some time. As a matter of fact, working capital should even be partly financed out of long-term funds (equity capital and long-term loans) since its largest portion is permanently tied in inventories (raw materials, work in process, finished goods and spare parts). In our example one quarter of the working capital is originally financed out of equity funds, as shown in Schedule the loan for financing working capital requirements being repaid during the seventh year since sufficient cash surplus (line D) has already been accumulated. The overall liquidity situation of the project is not jeopardized by this repayment. In considering loan financing, certain norms pertaining to capital market practices 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 need to be maintained.

Investment may also be financed partly by issue of bonds and debentures. The market for bonds and debentures tends, however, to be fairly limited as far as new projects are concerned, but such securities are often issued to finance the expansion of existing enterprises.

Loan finance can be of different categories which are related generally to the period of loan. Working capital, as just mentioned, is usually for relatively short periods ranging up to one or two years, though it may be for a longer period in cases where the manufacturing cycle is longer such as for heavy electrical or mechanical equipment. Medium and long-term credit can be obtained either from financial institutions or from supplier credit or from external governmental sources and can range for periods of 3 to 5 years for medium-term credit to 10 to 15 years in the case of long-term loans.

Apart from share capital and loan finance, an important financial category at the operational stage is the internal revenue generated by the project itself. This can take the form of retained profits, depreciation and accumulated reserves.

Once the total investment outlay (fixed investment, working capital and pre-production capital costs) has been identified and the types of financing secured in principle, both the costs of the project and the means of financing have to be compared.

Example:

1. Cost of the project: The total initial investment outlay (see Schedule 10-6/1) amounts to $10.3 million.

		(000$)	(000$)
A.	Fixed investment		
	Land	300	
	Buildings	1,800	
	Equipment	5,700	
	Total initial fixed investment		7,800
B.	Working capital (including bank borrowing)		2,000
C.	Pre-production capital costs		500
D.	Total initial investment outlay		10,300

2. Means of finance: Financing of the total initial investment outlay is envisaged as follows:

	Sources	Fixed investment	Working capital	Total
A.	Short-term borrowing (commercial bank)	-	1,500	1,500
B.	Long-term borrowing as supplier's credit	3,000		3,000
C.	Promoters and Collaborators' Contribution Equity capital	5,300	500	5,800
D.	Total	8,300	2,000	10,300

2. Public policy and regulations on financing

Share capital finance, and equity capital in particular, constitute the hard core of entrepreneurial decision in respect of financing. In most cases, the initial equity base is provided by the project sponsors. The extent of such initial equity depends on anticipated profitability, availability of funds for this purpose and availability of alternative sources of capital participation.

Where a project is expected to yield a high rate of profitability, maximum participation would be sought by the sponsors within an appropriate equity-debt pattern and subject to fund constraints. To the extent of any resource gap or where the sponsors may wish to limit their risks to a particular proportion of shares, outside capital participation has to be arranged. This can be mobilized either from national sources, individual or institutional or through foreign capital participation. In case a developing country has a reasonably well-developed capital market, share capital can be mobilized through public issues of shares. Such share issues are usually underwritten by banks and other financial institutions. In a number of cases, financial institutions, including specialized institutions dealing in industrial financing, participate in share capital to varying extents. Usually such participation is in the form of minority shareholding though. In some developing countries, it may be necessary for institutional agencies to acquire majority holdings initially and release these gradually to domestic entrepreneurs as and when domestic entrepreneurship is willing to take over such holdings or a part thereof.

The question of foreign capital participation may raise a basic policy question regarding the need and extent of such participation. In a number of developing countries, foreign capital participation requires governmental approval. In some countries, such approval is often not accorded, particularly in respect of non-priority sectors of investment. In other cases, only minority foreign participation is generally permitted. In certain countries, however, even majority foreign participation is welcomed, particularly in sectors involving large capital outlay or in projects having significant employment potential. In cases where foreign capital participation is considered, the first need therefore is to assess the policy implications and the reaction from governmental authorities. Thereafter, it is necessary to evaluate the implications of foreign capital participation in so far the project is concerned. In some cases, where foreign technological assistance and support may be required for a number of years or where access to improvements and innovations may be necessary, it may be desirable to have the technology supplier or licensor also participating in capital ownership. In some cases, technical management may have to be entrusted to a foreign company, usually a licensor, and in such cases also, foreign capital participation may be desirable. The extent of foreign participation would, however, have to be considered on a case to case basis and would have to be determined within the framework of national policies, by the nature and magnitude of investment outlay, the extent of technological and management support required over a period of time, the extent of the resource gap that may otherwise develop, the relations between a technology licensor and licensee and various other factors. It may not be possible, however, to discuss a number of these aspects at the stage of a feasibility study and only the policy and general implications of foreign capital participation can be elaborated at this stage.

The growth of public sector enterprises in a number of developing countries also needs to be considered from the viewpoint of share capital financing. In certain countries, such enterprises are not permitted, as a matter of policy, to have foreign capital participation or even domestic capital participation from private sector sources. In such cases, the share capital requirements have to be fully financed from governmental sources and the requirements should be identified on such a basis.

3. Financing institutions

Most developing countries have established developmental financing institutions which take different forms, such as Industrial Finance Corporation or Industrial Development Bank and in most of these countries, there is more than one institution available for project finance. Larger countries have established financial institutions at the state and national levels */.

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 wholly or partly, 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, besides regional international institutions such as the Asian Development Bank or African Development Bank. There are commercial banks also operating on international or national level which provide or participate in term-financing.

In many developing countries, the availability of industrial finance in the form of institutional finance and from other sources has grown to a point which makes it possible for new entrepreneurs to promote industrial projects with a relatively limited percentage of total capital required provided by themselves. The situation varies widely from country to country but, in some countries, the initial proportion of capital to be invested by sponsors of industrial projects can be limited to around 20 to 25 per cent of total investment outlay.

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*/ Thus, in India, financing institutions for new industry have been set up both 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.

The requirements of imported machinery and spares can often be financed on deferred credit terms. Machinery suppliers of industrialized countries are generally willing to sell machinery on deferred payment terms with payments generally spread over 6 to 10 years and sometimes for even longer periods. Deferred payment terms are available against bank guarantees which enable such machinery suppliers to obtain refinancing facilities from financial institutions in their respective countries.

An important source of finance is also available at government to government level in the case of many developing countries. This can take the form of general bilateral credit or tied credit which may be related to the purchase of machinery and equipment from a particular country or even from a particular source.

The various forms and sources of financing have different implications in terms of impact on different projects and may even affect project formulation. Supplier credits and other forms of medium-term credit, though initially advantageous in terms of coverage of resource gaps at the initial stage, constitute a heavy debt burden during early years of production and their incidence on production costs should be determined and accounted for in the cash flow analysis. Loan finance from international institutions, as also from national institutions require that projects should be formulated in considerable detail, so that the full implications are adequately highlighted. In some cases, there is insistence that the feasibility study should be prepared by recognized consultants or that management responsibilities for certain major projects are assumed by experienced and acceptable parties.

The various aspects discussed above need to be fully assessed before evolving a suitable financing package for a project under consideration. The determination of such a package would invariably necessitate identifying the most economic pattern in terms of cost of finance, assessing the feasibility of obtaining capital on such a basis, and ensuring that such a pattern is consistent with public policies and regulations on the one hand and with projected cash flows of the proposed enterprise on the other. The various sources of finance can then be tabulated in Schedule 10-8/1. Schedule 10-8/2 shows the utilisation of these financial resources during the construction, starting-up and full capacity operation.

To enable appropriate financial analysis, three different financial statements have to be projected for a time span equivalent to the estimated life of the project (in our case 10 years): cash flow statement, net income statement and balance sheet. It has to be noted that all accounts entered into these 3 statements have to match as the cash flow statement, the income statement and the balance sheet are interrelated.

In the case of expansion projects, financial statements based on historical data should be provided for the past 3 to 5 years in addition to the projected pro formas.

4. Cash flow table for financial planning

It is not sufficient only to ensure sources of finance, but it is also necessary to ensure that the timing of inflow of funds (from financial resources and sales revenue) is synchronized with the outflow of investment expenditures and production costs and other expenditures if significant losses of revenue, in terms of interest (arising out of idle funds) or delays in project implementation (as a result of financial bottlenecks) is to be avoided.

It is, therefore, necessary that a cash flow table showing the inflow and outflow of finance must be prepared. Such a cash flow table is of utmost importance for the investment phase of the project, during which it must be drawn up at least on a monthly basis. At the pre-investment stage, however, it is usually planned on an annual basis.

Just as planning of capital financing murt provide that necessary capital is available for financing investment expenditure and that the schedule of its inflow is synchronized with the schedule of investment expenditure, similarly financial planning for the operation period must ensure that cash inflow from sales revenue will be adequate to cover production costs and all financial commitments, such as debt service charges, both interest and principal, taxes, and payments of projected dividends. This aspect is particularly significant in the early years of operation, when output is usually considerably below capacity, while the burden of debt service is usually the highest during these years. Thi. is, for instance, the case with supplier credits which usually have to be repaid over 5 to 8 years in equal instalments of principal plus interest.

In Schedule 10-8/3 an example of an integrated cash flow is given comprising the periods of construction, start-up and full capacity operation. It may be advisable to prepare a separate cash flow for the construction and trial run period in spite of the integrated cash flow, because the former can define the full implications in greater detail, particularly as far as the question of foreign exchange is concerned. The foreign exchange balance is also significant for the operation period. However, it may be unduly cumbersome to show the foreign exchange component in the operational cash-flow separately. When required, a separate table for the foreign exchange component of the cash flow for the operation period can be prepared.

The cash flow table is designed in a way which enables the use of data assembled during the preparatory stage of the feasibility study as explained before. Thus, for financial resources, see Schedule 10-8/2 for sales revenue see Schedule 3-1, for total assets see Schedule 10-7/2 */ and for production costs see Schedule 10-12. The scheduling of the debt service (interest and repayment of the principal) can either be done on a separate schedule if more calculations are required or directly on the cash flow table for financial planning. Only for the calculation of the corporate tax and dividends, an additional schedule is needed (Schedule 10-9, net income statement). The corporate tax is computed as a percentage of the net profit after allowance for depreciation as prescribed by the Government, regardless of the actually applied depreciation and after interest paid on credits (but not repayment of principal).

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*/ As far as changes in inventories of raw materials, work-in-process and finished products are concerned, please refer to Schedule 10-3/2 "Calculation of working capital" which shows the growth of inventories as production expands until full capacity is reached. Any possible additional changes in stocks were not taken into account in order not to burden the case too much. If it is desired to do so, the Total Assets Schedule of the Cash[illegible]w Tables (Schedule 10-8/3, line B.1.) has to be corrected, as well as lin[illegible] and D. It should be noted, however, that the cumulative cash balance (line D) should not become negative and that the sources of funds will have to be increased to finance the larger stocks.

The cash flow table is closely linked to the projected balance sheet since its cumulative cash balance - which should never become negative - is to be transferred to the cash balance (line A.l.a. of Schedule 10-10) of the projected balance sheet. The cash balance is growing quite significantly in the case at hand, and so do the reserves.

As a consequence of frequently encountered scarcity of capital, it is the general tendency of inexperienced promoters to maintain in the pre-investment studies the investment 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. In order to shed more light into the financial structure of investment proposals, every pre-investment study must consider and provide for alternative modes of financing and endeavour to develop contingency plans. The cash flow tables for financial planning proposals have therefore to provide a number of answers concerning the amounts and timing of finance needed and should be prepared for all alternatives in order to facilitate the final choice.

5. <u>Net income statement</u> (Schedule 10-9)

This statement is used to compute the project's net income or deficit by periods for the entire duration of the project. It differs from the cash flow statement in as much as it follows the accrued concept by which revenues are associated with those costs which were needed to achieve the former during the period under consideration. For reasons of simplicity, changes in inventories of raw materials, goods-in-process and final products were assumed to be sero. For this subject reference should be made to relevant literature.

The net income statement also serves as a link to the projected balance sheet. Thus the accumulated losses/reserves (Schedule 10-9, line 8) are to be derived from the Net Income Statement in order to be inserted in the projected balance sheet (Schedule 10-10, lines A.3. and B.4.).

6. Projected balance sheet (Schedule 10-10)

The projected balance sheet also serves to calculate the financial requirements of the project. This method and the cash-flow forecast outlined above serve the same purpose and each method can be useful under distinct circumstances. From the banking point of view, both types of forecasts should be made. Since a cash-flow table has in any case to be prepared for commercial profitability evaluation (see paragraph D of this Chapter), it is no shortcoming if a projected balance sheet were not furnished. It should, however, be known that this method centres around the forecasting of key balance sheet items, such as cash balance and other current assets (viz. raw materials, accounts receivable, work-in-process and finished products) and fixed assets as well as equity and loan capital and current liabilities. The projected balance sheet gives the total financial picture at certain intervals during the life of the project.

All components of the balance sheet are already contained in the schedules designed until now, although a number of adjustments have still to be made. Thus, current assets stem from Schedule 10-3/2 */, fixed assets from Schedule 10-7/2, keeping in mind that annual depreciation allowances are required in order to arrive at the book value. Current liabilities, short and medium-term loans and equity capital are listed in Schedule 10-8/2. Whereas current liabilities are gradually growing, short and medium-term loans decrease by the annual repayments of the principal. Reserves are derived from Schedule 10-9, line 8, and have to be listed cumulatively. The growth of reserves is reflected in the corresponding increase in the cash balance which is to be obtained from Schedule 10-8.3, line D.

*/ Changes in inventories of raw materials, work-in-process and finished products have been taken into account when calculating the working capital. See Schedule 10-3/2 "Calculation of working capital" for the growth of current assets.

As far as accumulated reserves are concerned, it is a matter of company policy whether to maintain high reserves and retained profits as compared to equity capital or to convert such reserves into equity capital. Frequently tax laws even enforce this conversion since they foresee high taxes on retained profits.

7. Financial ratio analysis

The cash-flow table for financial planning, the net income statement and the projected balance sheet constitute the main elements for financial analysis as a supporting measure for financial planning. In financial analysis several techniques are being applied of which only ratio analysis will be briefly discussed in the Manual, leaving an assessment of the proposed financial methods aside since a sufficient amount of literature is available on this subject. Ratio analysis, on the other hand, is of elementary importance for project planners.

Ratios used in project planning are mainly to be derived from the projected balance sheet and the net income statement. The most common ratios are the simple rate of return on total investment outlay or our equity capital. See also paragraph D of this Chapter. When calculating the simple rate of return on equity capital, it should be noted that equity should include paid-in share capital reserves and undistributed profits. The ratio is calculated by dividing the profit (after tax) by the average amount of equity (= equity at the beginning, plus equity at the end of the year divided by two). The simple rate of return on total investment outlay compares the long and medium-term loans plus equity capital including reserves and undistributed profits with the sum of profits (after tax) and interests on long-term loans.

Other ratios are dealing with the liquidity of the project proposal in order to show its capability of corresponding to its current liabilities. These ratios are, however, of more importance for the lending finance institution than for project planners:

for year 6

(a) Current ratio $= \frac{\text{current assets}}{\text{current liabilities}} = \frac{2,400}{400} = 6.0$

(b) Liquidity ratio $= \frac{\text{cash and accounts receivable}}{\text{current liabilities}} = \frac{180+750}{400} = 2.3$

(c) Quick or acid test ratio $= \frac{\text{current assets-inventores}}{\text{current liabilities}} = \frac{2,400-1,482}{400} = 2.3$

The financial autonomy of the project is best explained by a number of ratios comparing the liabilities and capital, both equity and permanent. Thus it is, e.g., possible to show current and long-term liabilities as percentage of total liabilities, the long-term liabilities as percentage of the permanent capital (total capitalization ratio) or the long-term liabilities as percentage of the equity capital (equity debt ratio).

The equity-debt ratio is an indicator of the financial risk that a new project is facing and compares borrowed and owned funds. Financial prudence sets certain norms for this ratio.

In a number of projects of large or medium-size, an ideal equity-debt ratio of 1:1 tends therefore to be adopted, but this is by no means a standard pattern and a feasibility study should define the appropriate financing arrangement, taking the availability of resources and the nature and requirements of funds into full account. Equity-debt ratios of 1:2 or 1:3 or even higher are practised in many countries, a generalization is, however, not permissable since each project has to be assessed on its own merits.

The equity-debt ratio is also a measure of investor coverage. As indicated above, the smaller the equity capital, the higher the income per share unit. Equity owners are therefore favouring low equity debt ratios since it gives leverage to equity capital and allows control over projects even with a small amount of capital.

From the investment bank's point of view a sound equity-debt ratio is asked for since the largest portion of the equity capital is tied in land, buildings and equipment which cannot easily be liquidated or only at a loss in case of banruptcy of the project. Banks are therefore frequently not giving loans for one project above the amount the promoter is prepared to invest, thus limiting the loan to 50 per cent of the required investment outlay.

The equity-debt ratio of the example under review is 1.29:1 which is very satisfactory.

Finally, the debt service coverage should be looked at in order to make sure that all long-term loans and the related financial expenses can be repaid in the agreed yearly instalments without depriving the firm of needed funds. The forecasted net profit estimates after tax serve as a basis from which the interest and instalments payments of the principal are deducted annually. The income available for meeting liabilities is divided by the commitments in order to arrive at the debt service coverage.

Ratios allow a comparatively sound judgement on the profitability of the project. Prior to submitting a project for financing it should therefore be checked in a summary form whether the major ratios are in line with established standards for the industrial branch under consideration.

Other ratios frequently applied in financial analysis relate to the operational performance and profitability of the project.

$$\text{Net profit margin} = \frac{\text{Net profit (after tax and interest)}}{\text{sales}}$$

$$\text{Gross profit margin} = \frac{\text{Gross profit}}{\text{sales}}$$

The test of financial leverage is applied if the returns of the employed capital is to be measured:

$$\text{Earnings per share} = \frac{\text{Net profit}}{\text{shares}}$$

Schedule 10-8/1

Sources of finance

(insert in Schedule 10-8/2)

Item	Sources of finance	Local currency	Foreign currency	Total
A	Promotors			
	a) Equity	3,500	-	3,500
	b) Preference capital	-		-
	c) Loans	-		-
	d) Other forms such as deferred credits for supply of assets	-		-
	Total of A	3,500		3,500
B	Collaborators			
	a) Equity	2,300	-	2,300
	b) Preference capital	-		-
	c) Loans	-		-
	d) Other forms such as deferred credits for supply of know-how or equipment	-		-
	Total of B	2,300		2,300
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	Commercial Banks	1,500		1,500
F	Public subscriptions			
G	Suppliers' credits	-	3,000	3,000
H	Current liabilities	-	400	400
	Total of A to H	7,300	3,400	10,700

<u>**Schedule 10-8/2**</u>

<u>**Sources of initial funds Schedule**</u>

(insert in Schedule 10-8/3, line A.1 and 10-10)

Year	Construction						Start-up and full capacity operation															Total		
	1			2			3			4			5			6			...					
	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt
1. <u>Financial resources</u>																								
1.1 Equity capital	-	3,300	3,300	-	2,500	2,500																-	5,800	5,800
1.2 Preference capital																								
1.3 Loans */	-	-	-	-	1,500	1,500																-	1,500	1,500
1.4 Suppliers' credits	-	-	-	3,000	-	3,000																3,000	-	3,000
1.5 Currant liabil-ities							180	-	180	110	-	110	10	-	40	70	-	70				400	-	400
1.6 Subsidies																								
1.7 Public subscrip-tions																								
Total		3,300	3,300	3,000	4,000	7,000	180	-	180	110	-	110	40	-	10	70	-	70				3,400	7,300	10,700

* Loans of different terms should be shown separately.

FC: foreign currency; LC: local currency; Tt: Total

Schedule 10-8/3: Cash flow table for financial planning

	Construction		Start-up and full capacity operations										Salvage value in last year	Total
Year	1	2	3	4	5	6	7	8	9	10	11	12		
Production Schedule (3-3)	0	0	55%	75%	80%	100%	100%	100%	100%	100%	100%	100%		
A. Sources of funds	3,300	7,000	7,055	9,485	10,040	12,570	12,500	12,500	12,500	12,500	12,500	12,500	-	124,450
1. Financial resources total (from Schedule 10-8/2)	3,300	7,000	180	110	40	70	-	-	-	-	-	-		10,700
2. Sales revenue (from Schedule 3-1)	-	-	6,875	9,375	10,000	12,500	12,500	12,500	12,500	12,500	12,500	12,500	-	113,750
B. Uses of funds	-3,300	-5,000	-8,797	-8,889	-9,511	-10,758	-10,370	-11,592	-10,592	-10,592	-10,592	-10,592	+3,500	107,085
1. Total assets schedule incl. replacements (from schedule 10-7/2) a/	-3,300	-5,000	-1,590	-380	-130	-300	-	-1,000	-	-	-	-	+3,500	-8,200
2. Production costs (from Schedule 10-12) b/	-	-	-6,000	-7,350	-7,670	-9,000	-9,000	-9,000	-9,000	-9,000	-9,000	-9,000	-	-84,020
3. Debt service (total)														
a. Interests: suppliers' credits	-	-	-240	-192	-144	-96	-48	-	-	-	-	-	-	-720
b. bank overdrafts	-	-	-135	-135	-135	-80	-40	-	-	-	-	-	-	-525
c. bank term loans	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d. Repayments: suppliers' credits	-	-	-600	-600	-600	-600	-600	-	-	-	-	-	-	-3,000
bank overdrafts	-	-	-	-	-600	-450	-450	-	-	-	-	-	-	-1,500
bank term loans	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4. Corporate tax (from Schedule 10-9)	-	-	-	-	-	-	-	-1,360	-1,360	-1,360	-1,360	-1,360	-	-6,800
5. Dividends 4% on equity (from Schedule 10-9)	-	-	-232	-232	-232	-232	-232	-232	-232	-232	-232	-232		-2,320
C. Surplus/Deficit (10-9)	0	2,000	258	596	529	1,812	2,130	908	1,908	1,908	1,908	1,908	3,500	-
D. Cumulative cash balance: c/	0	2,000	258	854	1,383	3,195	5,325	6,233	8,141	10,049	11,957	13,865	17,365	17,365

a/ Not including interest during construction. b/ "Production costs" do not include interests on loans and depreciation. Interests are entered in B.3.a-c 'Interests'. Instead of depreciation allowances, the anticipated replacement expenditures are to be entered in B.1 'Replacements'. c/ The cash flow balance should be programmed in such a way that all necessary replacements (B.1) can be covered in any year by the cumulated surplus. This item should never become negative. Insert this line in Schedule 10-10, line A.1.a. cash balance.

Schedule 10-9

Net Income Statement a/

(Insert line 4 in Schedule 10-8/3, line 4,
line 6 in Schedule 10-8/3, line 5,
and line 8 in Schedule 10-10, A.3 and/or B.4)

Year	Construction		Start-up and full capacity utilization							
	1	2	3	4	5	6	7	8	...	12
Production Programme	-	-	55%	75%	80%	100%	100%	100%	100%	100%
1. Sales	-	-	6,875	9,375	10,000	12,500	12,500	12,500		12,500
2. Production Costs	-	-	-7,155	-8,457	-8,729	-9,956	-9,868	-9,780		9,780
3. Gross or taxable profit (1 - 2)	-	-	-280	918	1,271	2,544	2,632	2,720		2,720
4. Tax	-	-	- (tax holiday incl. year 7)	-	-	-	-	-1,360		-1,360
5. Net profit (3 - 4)			-280	918	1,271	2,544	2,632	1,360		1,360
6. Dividends (4% on 5,800 equity)			-232	-232	-232	-232	-232	-232		-232
7. Undistributed profits			-512	686	1,039	2,312	2,400	1,128		1,128
8. Accumulated undistr. profits			-512	+174	1,213	3,525	5,925	7,053		11,565
Ratios: gross profit: sales (%)			-4.0	9.8	12.7	20.3	21.0	21.8		21.8
net profit: sales (%)			-4.0	9.8	12.7	20.3	21.0	10.9		10.9
net profit: equity (%)			-4.8	15.8	21.9	43.8	45.3	23.5		23.5

a/ This table can also be used as a supporting table for Schedule 10-14 to calculate the corporate tax to be inserted into the cash-flow table for a project with outside financing. Use line 4.

Schedule 10-10

Projected balance sheet

(in 000)

Years	Construction		Start-up and full capacity operations									
	1	2	3	4	5	6	7	8	9	10	11	12
A. **Assets** (total)	3,300	10,300	9,880	9,560	9,440	10,770	12,920	13,250	14,380	15,510	16,640	17,770
1. **Current assets** (total)	-	2,000	1,850	2,820	3,480	5,590	7,720	9,130	10,540	12,450	14,360	16,270
a. **Cash balance** (from 10-8/3, line D)	-	2,000	260	850	1,380	3,190	5,320	6,230	8,140	10,050	11,960	13,870
b. Current assets (from 10-3/2, line I.D)	-	-	1,590	1,970	2,100	2,400	2,400	2,400	2,400	2,400	2,400	2,400*
2. **Fixed assets** (net)	3,300	8,300	7,520	6,740	5,960	5,180	4,400	4,620	3,840	3,060	2,280	1,500
Fixed investment including pre-production costs (from Schedule 10-7/2)	3,300	8,300	7,520	6,740	5,960	5,180	4,400	4,620	3,840	3,060	2,280	1,500**
3. **Losses** (from 10-9, line 8)	-	-	510	-	-	-	-	-	-	-	-	-
B. **Liabilities** (total) (from Schedule 10-8/2)	3,300	10,300	9,880	9,560	9,440	10,770	12,120	13,250	14,380	15,510	16,640	17,770
1. **Current** liability (line 1.5)	-	-	180	290	330	400	400	400	400	400	400	400
2. **Short + medium term loans** (lines 1.3 and 1.4)	-	4,500	3,900	2,100	1,050	-	-	-	-	-	-	-
3. **Equity capital** (line 1.1)	3,300	5,500	5,800	5,800	5,800	5,800	5,800	5,800	5,800	5,800	5,800	5,800
4. **Reserves** (from 10-9, line 8)	-	-	-	170	1,210	3,520	5,920	7,050	8,180	9,310	10,440	11,570

* Salvage value: 2000 working capital

** Salvage value: 1500 fixed assets

C. Production costs

A realistic forecasting of total production or manufacturing costs for a project proposal is essential for the determination of the future viability of the project. One of the major deficiencies encountered in pre-investment studies is the inaccuracy of production cost estimates which frequently leads to unexpected losses and, if they are reinforced by low capacity utilization caused by wrong sales forecasts, may quickly push the nascent establishment out of operations. As will be seen in Part D of this chapter, risk analysis will be a means of improving the accuracy of predictions made. Risk analysis should, however, not become an excuse for too little attention being paid to production cost forecasts.

Production costs should be calculated as total costs and preferably also as unit costs. In most pre-investment studies only total production costs are dealt with since it is relatively less complicated at the feasibility stage to estimate all cost items in their entirety disregarding whether they are material, labour or overhead costs than to calculate unit costs. For cash flow analysis it is anyhow sufficient to first calculate total production costs and to project them thereupon as annual production expenditures for the life of the project.

1. Total production costs

As indicated, this Manual is geared towards discounted cash flow analysis as a means of commercial profitability evaluation. Therefore, all cost elements required for the calculation of total production costs have to be scheduled in line with the production programme until full capacity is reached. It is, however, not necessary to prepare a phasing for each cost element separately. Once total production costs at full output level are defined and their breakdown into variable and fixed costs established */, it is possible to adjust the variable costs

*/ Variable costs change more or less in close proportion to variations in production. Typical variable costs are material, production labour and utility costs. Variable costs can be further divided into a) proportional costs which change proportionally with volume of production (e.g. raw materials); b) degressive costs which change at a lower rate than the volume of production (e.g. maintenance repair); c) progressive costs which change at a higher rate than the production volume (e.g. overtime); and d) degressive costs which decrease with an increase in the volume of production (e.g. maintenance costs of unutilized machines).

Continued next page.

proportionally to the percentage of capacity utilization with fixed costs remaining constant. All cost elements entering into production costs are described in the preceding chapters of the Manual. It is now the time to assemble the cost elements in order to arrive at total production costs. For this purpose Schedule 10-11 should be used. The definition of total production costs as given in chapter 0.6 and as applied throughout the Manual divides total production costs into four major categories: factory costs, administrative costs, financial costs and sales/distribution costs.

1.1 Factory costs

Materials (variable costs)

Manpower (variable costs)

Factory overheads (fixed costs)

Depreciation (fixed costs)

To arrive at factory costs, the final amounts derived from Schedules 4-2, 7-1, 8-2 and 8-4 have to be inserted in Schedule 10-11 given at the end of this chapter.

1.2 Administrative overheads

The composition of administrative overhead costs as well as procedures for their computation were described in chapter 7. It is at this stage therefore only necessary to transfer the final amounts from Schedules 4-2, 7-1, 8-2 and 8-4 to Schedule 10-11.

1.3 Financial costs

Financial costs could be considered as part of the administrative overheads particularly if viewed from the position of an ongoing

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Fixed costs remain unchanged regardless of changes in the level of activity and include mainly overhead and depreciation charges, the latter only if calculation based on time. Fixed costs are frequently incurred on a time basis such as long-term contractual services, rents, administrative salaries.

This differentiation can be maintained due to a strong simplification which is only valid for a specific range of capacity utilization. This simplification should be kept in mind when dealing with break-even analysis in Part D of this chapter and that the assumed cost curve may actually have a different shape.

establishment or one which is being expanded and where the financing scheme is already known. Since this is frequently not the case with new projects, it is proposed to keep financial costs as a separate heading. Most feasibility studies show a declining amount of external finance and, correspondingly, decreasing financial costs (interests).

The computation of financial costs was outlined in Part B of this chapter. All that is required at this point is to insert the financial costs in Schedule 10-11.

1.4 Sales and distribution costs

The composition of sales and distribution costs as well as the procedures for their computation were described in chapter 3. The estimated costs have to be transfered from Schedules 3-2, 8-2 and 8-4 into Schedule 10-11.

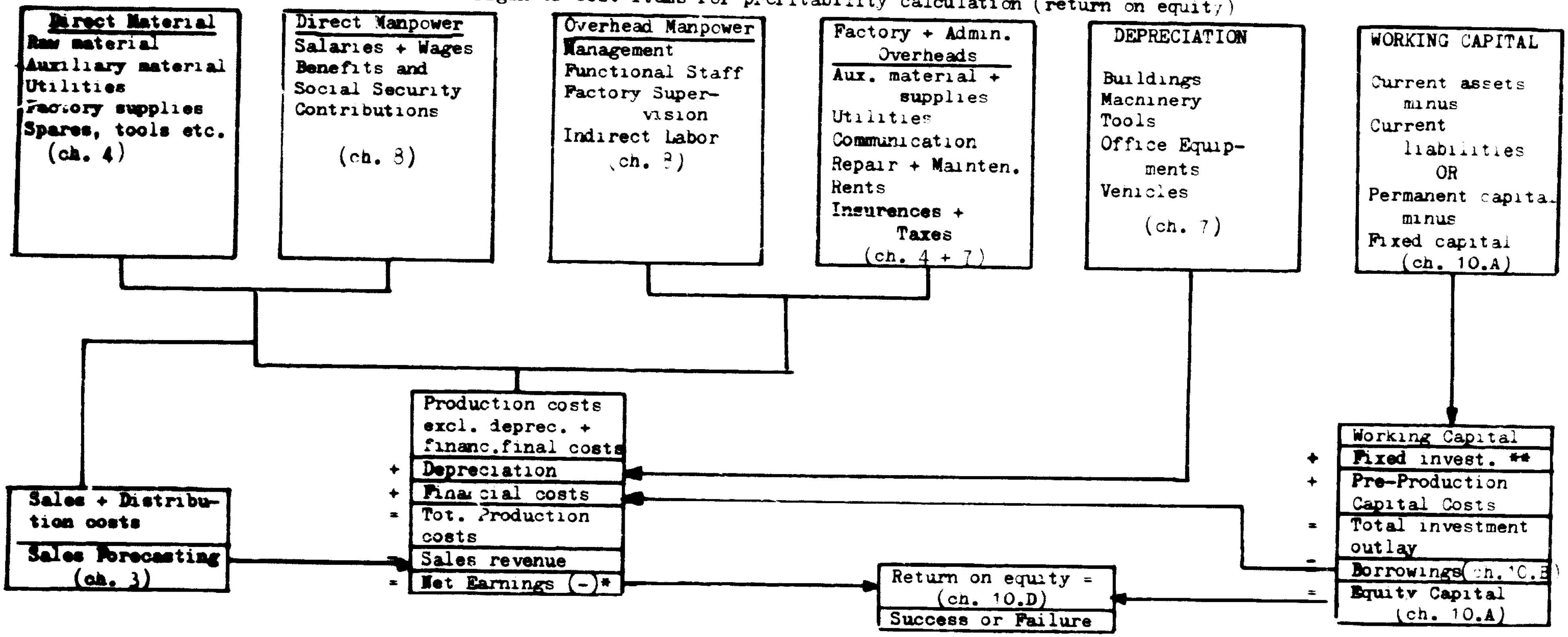
When assembling all cost categories and cost items, it should be remembered that since this Manual is geared towards discounted cash flow analysis, mention should be made for which purpose the total production cost estimate will be needed:

a) gross or net profit estimates in the Income Statement (Schedule 10-9),
b) simple methods of commercial profitability calculation (chapter 10.D),
c) cash flow analysis (chapter 10.D), or
d) calculation of working capital requirements (Schedules 10-3/1 and 10-3/2).

For the gross or net profit estimate and the calculation of working capital requirements the necessary supporting tables list total production costs. In both cases as well as for the calculation of simple commercial profitability criteria, depreciation charges form part of total costs. They are, however, not to be included in the cash flow tables prepared for financial planning and discounting. At the stage of a feasibility study it should also be remembered that project financing is frequently not yet decided and that therefore the project may have to be presented as case with or without outside financing. Accordingly, interest payments and repayments of the principle would have to be added or deleted in the cash flow tables (Schedules 10-13 and 10-14).

Exhibit 4

Origin of cost items for profitability calculation (return on equity)



*/ Calculate corporate income tax if applicable

**/ Fixed investments: Chapter 10.A based on Chapters 5,6,

Exhibit No. 4 shows the interaction of the various cost elements in a feasibility study and the chapters of the Manual in which they are covered. This way the reader obtains a better comprehension of the cost structure and its impact on the project's profitability (return on equity).

2. Unit costs

For purpose of cash flow analysis it is sufficient to calculate total costs. At the feasibility stage an attempt should, however, also be made to calculate unit costs. For a single product project unit costs are easily calculated simply by dividing total costs by units to be produced at full capacity. In the case of a new multi-product project reliable unit costs can hardly be provided because of the difficulty encountered when calculating overhead costs. The normally adopted procedure of imputing unit overhead costs on direct material and direct labour */ unit costs by means of different percentage surcharges is not applicable since these surcharges do not yet exist for new projects. In addition it is not permissable to refer to comparative data such as surcharges calculated for an ongoing factory in a developed country and to apply it for a new project in a developing country. Cost accounting surcharges vary from factory to factory and from country to country. Cost surcharges are computed with the help of a specially designed cost centre accounting scheme. In the case of an ongoing project, surcharges are based on historical data. In the absence of such data it may perhaps be thought in the case of new, large-scale projects to build up an *ex ante* cost centre accounting scheme and to compute *ex ante* surcharges. Such a procedure faces, however, too many imponderabilities which make this proposal hardly practicable.

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*/ Direct and indirect costs

From the viewpoint of product costing (calculation of unit cost prices), production costs should be divided into direct and indirect costs. Direct costs are easily attributable to a product unit or service such as cost of production materials and production labour. Indirect costs (e.g. factory administrative overheads) cannot be allocated directly to a particular unit of output and have therefore at first to be apportioned to cost centres and thereafter be appropriated to the unit cost price by way of surcharges which are to be obtained from the cost accounting department. This procedure does not cause particular problems in the case of existing establishments which can rely on historical data. At the feasibility stage of a new investment proposal with no industrial data at hand, even an approximative calculation of surcharges to allocate indirect costs to the unit cost price must, however, become a doubtful exercise. Direct costs usually coincide with variable and indirect costs with fixed costs.

The solution propagated in the Manual is to consider only the variable unit costs and to deduct them and the expected profit from the anticipated unit sales price. The residual unit costs should then be multiplied by the output and the derived figure should be checked whether it is sufficient to accomodate total fixed costs.

Schedule 10-11

Total Production Costs (at full capacity year 6)
(see also Schedule 10-3/1)

Cost item	Foreign Currency	Local Currency	Total
1. Direct materials and inputs (from Schedule 4-2)	2,300	2,950	5,250
2. Direct manpower: labour and staff (from Schedules 8-2 and 8-4)	-	1,250	1,250
3. Factory overhead costs	250	1,350	1,600
3.1 Manpower costs (from Schedules 8-2 and 8-4)	-	..	..
3.2 Overhead materials (from Schedule 4-2)	(250)	..	(250)
3.3 Other factory overheads (from Schedule 7-1, line K, column 12)	-	..	..
4. Depreciation (from Schedule 7-1, line L, column 12)	-	780	780
(1) - (4) Factory costs	2,550	6,330	8,880
5. Administrative overhead costs	-	500	500
5.1 Manpower costs (from Schedules 8-2 and 8-4)	..	..	..
5.2 Overhead materials (from Schedule 4-2)	..	..	..
5.3 Other administrative overheads (from Schedule 7-1, line K, column 17)	..	..	..
6. Financial overhead costs: interests (from Chapter 10.C)	100	80	180
7. Sales and distribution costs	-	400	400
7.1 Manpower costs (from Schedules 8-2 and 8-4)	-	..	..
7.2 Others (from Schedule 3-2)	-	..	..
(1) - (7) Total production or manufacturing costs	2,650	7,310	9,960

Schedule 10-12

Production Cost Schedule (Expenditures)

(see also Schedule 10-3/1)

(insert totals line 9 in Schedule 10-9, line 2, and totals line 10 in Schedules 10-8/3, 10-13 and 10-14)

Year	Start-up									Full Capacity Operation						Full Capacity Operation											
	3			4			5			6			7			8			9			10			[illegible]		
Prod. Schedule	55%			75%			80%			100%			100%			100%			100%			100%			100%		
	FC	LC	T	FC	LC	T	FC	LC	T	FC	LC	T	FC	LC	T	FC	LC	T	FC	LC	T	FC	LC	T	FC	LC	T
1. Direct materials	1265	1615	2830	1785	2160	3945	1840	2360	4200	2300	2950	5250	2300	2950	5250	2300	2950	5250	2300	2950	5250	2300	2950	5250	2300	[illegible]	[illegible]
2. Direct manpower	-	690	690	-	940	940	-	1000	1000	-	1250	1250	-	1250	1250	-	1250	1250	-	1250	1250	-	1250	1250	-	1250	[illegible]
3. Factory overheads	250	1350	1600	250	1350	1600	250	1350	1600	250	1350	1600	250	1350	1600	250	1350	1600	250	1350	1600	250	1350	1600	250	[illegible]	[illegible]
4. Depreciation	-	780	780	-	780	780	-	780	780	-	780	780	-	780	780	-	780	780	-	780	780	-	780	780	-	[illegible]	[illegible]
5. Factory costs	1515	4435	5950	2035	5230	7265	2090	5490	[illegible]	[illegible]	6330	8880	[illegible]	6330	[illegible]	[illegible]	6330	8880	[illegible]	6330	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6. Admin. Costs	-	500	500	-	500	500	-	500	500	-	500	500	-	500	500	-	500	500	-	500	500	-	500	500	-	500	[illegible]
7. Financial Costs	240	135	375	190	140	330	140	140	280	100	80	180	50	40	90	-	-	-	-	-	-	-	-	-	-	-	-
8. Sales and distribution	-	330	330	-	365	365	-	370	370	-	400	400	-	400	400	-	400	400	-	400	400	-	400	400	-	400	[illegible]
9. Total Production Costs	1755	5400	7155	2225	6235	8460	2230	6500	8730	2650	7310	9960	2600	7270	9870	2550	7230	9780	2550	7230	9780	2550	7230	9780	2550	7230	[illegible]
10. Production Costs ex. depreciation + financial costs	[illegible]	(4435)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

D. Commercial Profitability Analysis

It could be argued that a manual on the preparation of industrial pre-investment studies should not go beyond the determination of production costs and the total investment outlay since the evaluation of the project proposal is frequently left to other parties who have less or no vested interests in the project. In addition, it might be argued that several manuals on project evaluation do already exist covering both commercial and national profitability analysis */. In order to make the Manual a self-contained volume on project preparation in a wider sense, it seems, however, appropriate to round it off by adding a description of break-even analysis and the simple and discounting methods applied in commercial profitability analysis and to establish a link between commercial and national profitability evaluation in a final chapter outlining the differences between the two methods of evaluation.

As far as the entrepreneur is concerned, the investment criterion is the financial return on the invested capital, i.e. the profit. Consequently, the investment profitability analysis consists essentially in determining the ratio between the profit and the capital invested.

An entrepreneur, as a rule, finances a project partly through equity capital and partly through borrowed funds. His primary interest is to know the real profitability of the equity capital deducting from the gross profit interest on the borrowed capital as well as taxes. However, when preparing a feasibility study, one may not know exactly how the project will be financed. So, the analysis of the profitability of the equity capital can sometimes be only tentative. In addition, it is sometimes necessary to choose among several project alternatives with even different capital structures. For these reasons it is advisable to also prepare the profitability analysis of the total invested capital, e.g. on the basis of gross profit (after depreciation but before interest and taxes). Such a calculation can be a basis for ranking project alternatives on their own merits regardless of the source of financing. Besides, after estimating taxes, one can compare the profitability of the total capital with the rate of interest in the capital market, and thus assess whether the project can stand the assumed financial charges and at the same time give a satisfactory return on equity capital.

Commercial profitability calculations are always based on expected market prices of inputs and outputs. All calculations are made ex-ante (by definition) always at the end of each year and preferably over a period which is determined by the life-time of the project.

*/ Manual for the Evaluation of Industrial Projects in Arab Countries, UN, New York, 1977
Manual of Industrial Project Analysis, Volume I, OECD, Paris 1972 (rev.ed.)

1. Selection of project alternatives

As already indicated earlier each project under preparation has to take account of possible alternative ways of fulfilling the same need. In case project preparation does not follow the rule of searching for alternatives at the opportunity, pre-feasibility and even feasibility stage, the ultimate project solution might become very costly if the project concept has to be dropped during the investment phase in favour of another technical alternative due to insufficient preparatory work.

Project alternatives should be regarded as different technical solutions which are excluding each other, i.e. which cannot be implemented at the same time. Generally such alternatives stem from

(a) different production processes either for the same final product which in turn are influenced by the technical process, the machinery and equipment as well as the materials and inputs used or for different types of intermediate, final and by-products;

(b) differentscales of production;

(c) different locations and sites;

(d) different project implementation scheduling e.g. caused by scarcity of funds.

Obviously the number of alternatives to be considered can become very large and considerable funds may have to be spent to analyse and compare all possible alternatives. As already pointed out earlier, supporting studies have to be undertaken parallel to the pre-feasibility and feasibility studies in order to pre-select alternatives and in particular to restrict them in number. Contrarywise, it would be highly unsatisfactory to rely on the other extreme and to present only one alternative for selection. In this case, the choice can only be positive or negative without providing the assurance that the most economic proposal was actually considered.

In the subsequent parts of this chapter the question of project selection from the commercial point of view will be dealt with. Quantitative and qualitative criteria will receive particular attention.

2. Simple methods of commercial profitability calculation

The pay-back period and the simple rate of return are usually called simple methods since they do not consider the entire life-time of the project but only brief periods of one year. In addition, the annual data used are taken at their actual and not at the discounted value. For the periods considered, it is assumed that the project is operating at full capacity which in fact means that normally only the third, fourth or fifth year of operation can be taken for these calculations.

Pay-back period

The pay-back period is a financial concept which is defined as the period required to recuperate the original investment outlay through the profits earned by the project, the term profit being defined as net profit after tax and before interest and depreciation.*)
When calculating the pay-back period, the computation usually starts with the construction period during which the initial investments will be made.

Calculation of pay-back period

		(000$)	
1. Total investment outlay (Ttl. investment outlay minus working capital)		10,300	(8,000)
2. Annual net profit plus interest plus depriciation	Amount paid back	Balance at the end of a year	
year 1 (construction period)	-	10,300	(8,000)
year 2 (construction period)	-	10,300	(8,000)
year 3	870	9,430	(7,120)
year 4	2,030	7,400	(5,090)
year 5	2,330	5,070	(2,760)
year 6	3,500	1,570	
year 7	3,500		

*) Data are derived from Schedules 10-3/1 and 10-9

year	3	4	5	6	7
Net profit **)	-280	920	1270	2540	2630
Interests **)	+370	330	280	180	90
Depreciation	+780	780	780	780	780
"Profit"	870	2030	2330	3500	3500

**) Figures are rounded off

The original investment outlay will be recovered after not quite 6.5 years, the construction period being included. The same result can also be obtained with the help of the "Cumulative net cash flow". Schedule 10-13 shows that the initial investment outlay of $10,300 will be repaid shortly before 6.5 years.

There are two alternative ways of calculating the pay-back period: one is a modified version of the preceding one in as much as it does not include the construction period. In this case, the pay-back period would be after 6.5 - 2 = 4.5 years. The second alternative method would be to deduct the value of land ($300) and of working capital ($2,000) from the total investment outlay on the assumption that these values could be fully regained at the end of the project time. Thus only $8,000 of investment outlay must be recovered constituting mainly fixed assets such as plant and equipment as well as buildings and civil works. In this case the pay-back period would be five years and 2,5 months. Respective figures are given in brackets in the above example. If the construction time is disregarded, the pay-back period would be shortened to three years and 2,5 months.

A single project proposal will be accepted if the pay-back period is smaller or equal to an acceptable time period which is mostly derived from past experience with similar projects.

The major merit of the pay-back period is its easy calculation. It is particularly useful for risk analysis which is of relevance in countries with political instability and in branches of industry with rapid technological obsolescence. The shortcomings of this method is that it does not consider what will happen once the project has been repaid and that it overemphasizes quick financial returns. Furthermore, this method does not measure the profitability of the project proposal but is mainly concerned with its liquidity. In summary, this method is not a reliable criterion for project selection, but in some cases it can be useful as a supplementary tool.

Simple rate of return method

The simple rate of return relies on the operational accounts and is defined as the ratio of the profit in a normal year of full production to the original investment outlay (fixed assets, pre-production capital costs and working capital).*/ This ratio can be computed either for the total investment outlay or for the equity capital, depending on whether the real profitability of the total investment outlay or only of the invested equity capital after paying taxes on profits and interests on borrowed capital is to be assessed. Consequently, the simple rate of return becomes either

$$R = \frac{NP + I}{K} \quad \text{(with outside financing)}$$

or

$$Re = \frac{NP}{Q}$$

---

*/ Without going into too much detail, the reader should be reminded that the single rate of return method is based on accounting conventions which frequently change from country to country according to the valid legislation and which does not allow to reflect the real profitability of the project. On the other hand, the valid legislation has to be taken into consideration as far as the profitability from the point of view of the project promoter, entrepreneur and shareholders are concerned in order to be able to assess the project under actual conditions.

The Net Income Statement (Schedule 10-9) shows the various types of profits (gross, taxable and net) derived by applying accounting conventions. If depreciation allowances should be shown separately, production costs (line 2) would simply have to be reduced by them and gross profit would become sales minus production costs without depreciation charges. Taxable income would in turn become gross profit minus depreciation.

"Accounting" profits become only a meaningful means for project evaluation if compared with invested capital. Here again several definitions are possible: equity capital, equity + reserves, equity + reserves + long term loans = permanent capital, total investment outlay = fixed assets + pre-production capital costs + working capital.

In conclusion, the simple rate of return really depends on how the terms profit and capital are defined. Therefore, the ratio has to be explained before a final judgement is taken. Applying the figures of the case under consideration, the following rates of return could also be considered for year 6, the first year of full capacity and for year 8, after the expiration of tax holidays:

	year 6	year 8
a) $\frac{\text{Gross profit or taxable profit}}{\text{Total investment outlay}}$	$= \frac{2,544 \cdot 100}{10,300} = 24.6\%$	$\frac{2,720 \cdot 100}{10,300} = 26.4\%$
b) $\frac{\text{Net profit plus depreciation}}{\text{Total investment outlay}}$	$= \frac{3,324 \cdot 100}{10,300} = 32.2\%$	$\frac{2,140 \cdot 100}{10,300} = 20.7\%$

This ratio explains the relationship between the net current cash flow (net profit + depreciation) and the total investment outlay.

where

R = simple rate of return on total investment outlay

Re = simple rate of return on equity capital

NP = net profit (after depreciation, interest charges and taxes)

K = total investment outlay (fixed assets, pre-production capital costs and working capital)

Q = equity capital

Applying the above case for year 6, the first year of full capacity production and year 8, after expiration of the tax holidays:

year 6:

$$R = \frac{(\$2,544 + \$176) \cdot 100}{10,300} = 26,4\%$$

and

$$Re = \frac{\$2,544 \cdot 100}{\$5800} = 43,8\%$$

year 8:

$$R = \frac{(1,360 + 0) \cdot 100}{10,300} = 13,2\%$$

$$Re = \frac{1360}{5800} \cdot 100 = 23,4\%$$

There is also the less common practice of applying a value for the total investment outlay based on the average lifetime of the project, with the reasoning that the original total investment outlay is gradually recovered through depreciation (which is reinvested) and that, on the average, only one half of the depreciable fixed assets plus the salvage values for land and working capital is engaged during the life of the project. Using the figures from the example where value of land is 300, working capital $2000 and depreciable fixed assets $8000, the average capital outlay will be 6300 and the rate of return i.e.

year 6: $R = \frac{(\$2,544 + \$176) \cdot 100}{\$6300} = 43,2\%$ **year 8:** $\frac{(1,360+0)}{6,300} \cdot 100 = 21,6\%$

The practice, however, prevails to compute the rate of return based on the original investment outlay.

The merit of the simple rate of return is that it is easy to apply.

This method also has serious disadvantages. Which for example, is the normal (representative) year to be taken as basis for computing the rate of return? Owing to the fact that the simple rate of return deals with annual data, it is difficult and often impossible to choose the most representative year of the project. In addition to both the varying levels of production, especially during the initial years, and the payment of interest which can also differ annually, there are certain other factors which cause the changes in the level of net profit in particular years such as tax holidays for instance. Obviously, in years when a tax concession is to be applied, the net profit must be quite different from the years where the profit is subject to normal taxation. This shortcoming of the simple rate of return which is the consequence of its static character can to some extent be alleviated by calculating the profitability of the project for each year.

For this purpose reference is made to Schedule 10-9 "Net Income Statement". The difficulty of choosing the "normal" year is revealed by the varying annual rates of return which are shown in the following table:

Table

Annual rate of return of equity capital

Year	Construction		Start-up and full capacity						
	1	2	3	4	5	6	7	8	9
Net profit after tax	-	-	-280	+918	1271	2544	2632	1360	1360
Equity capital	-	-	5800	5800	5800	5800	5800	5800	5800
Rate of return	-	-	-4,8	15,8	21,9	43,8	45,4	23,4	23,4

However, even after this calculation, the main shortcoming of the simple rate of return remains: it does not take into account the timing of the cash inflows and outflows during the life of the project. Obviously, an income obtained in an early period is preferable to an income obtained later. It is very difficult, however, to choose between two project alternatives which have different profitabilities in a number of years. For instance, how can one of the two alternatives be selected assuming both would have the same total investment outlays:

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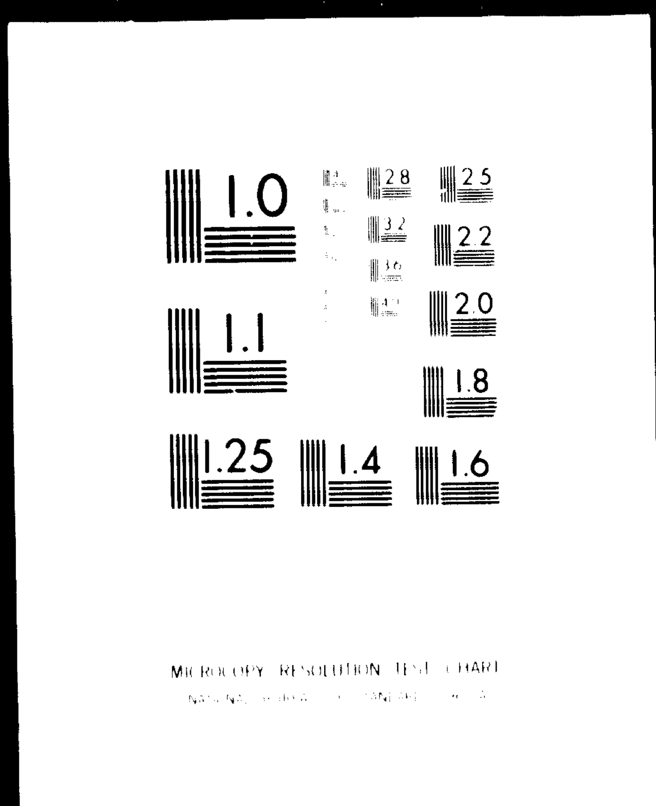

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Year	Profit	
	Project A	Project B
1	50	170
2	60	120
3	120	90
4	160	80
5	200	70
Total	590	530

Obviously, in such a case it is not sufficient to rely on an annual calculation of the profitability. For this purpose it is necessary to determine the overall profitability of the projects which is only possible by using the so-called discounting methods.

In conclusion, it may be said that the simple rate of return method can be used for computing the profitability of the total investment outlay when more or less equal gross profits through the lifespan of the project could be expected. As such, it can be useful for a preliminary evaluation of competing projects and elimination of the poor ones, keeping in mind that each country is applying different legislative rules concerning depreciation and taxation which do not allow an evaluation reflecting the real benefits of the project.

3. Discounting methods

Net Present Value NPV

The net present value of a project is defined as the value which is obtained by discounting separately for each year the difference of all cash outflows and inflows accruing throughout the life of a project at a fixed, pre-determined interest rate to the zero point of time (year 1), i.e. to the point at which the implementation of the project is supposed to start. The NPV's obtained for the years of the life of the project have to be added to receive the project NPV.

Formula:

$$NPV = NCF_1 + (NCF_2 \times a_2) + (NCF_3 \times a_3) + \ldots\ldots + (NCF_n + a_n)$$

where: NCF = net cash flow of a project in years 1, 2, 3, ..., n,

a = discount factor in years 2,3,...,n, corresponding to the applied discount rate. For discount factors see present value tables.

The discount rate (or cut-off rate) should be based on the actual rate of interest prevailing in the capital market. Since capital markets do frequently not exist, the discount rate should reflect the opportunity cost of capital, i.e. the possible return of the same amount of capital being invested in an alternative investment. Expressed differently, this should be the rate which an entrepreneur considers as a minimum return below which it does not pay for him to invest.

The discounting period should be equal to the life of the project. For instance, the useful life of equipment is between 10 and 15 years. Factory buildings of solid material can last 30 or 40 years, vehicles 4 to 5 years, etc. The practical solution is to take the life of the most essential part of the fixed assets. Obviously, in a factory this is the basic equipment. The value of the fixed assets which last longer like, e.g., buildings, must be given at their salvage value at the end of the discounting period. This is also true for the value of land and working capital, which preserve their values during the life of the project. As far as assets with a shorter life are concerned, their replacement must be taken into account during the discounting period. In most cases the discounting period includes the construction period (e.g. 2 years) plus 10 years of project life.

If the NPV is positive, the profitability of the investment is above the cut-off discount rate. If it is zero, the profitability is equal to the cut-off rate. Thus, a project with a positive or zero NPV is acceptable. If the NPV is negative, the profitability is below the cut-off rate. Such a project is to be eliminated.

Using the data of the example, the NPV of the total investment outlay (Schedule 10-13) and the NPV of the equity capital (Schedule 10-14) can be determinated. The relevant schedules are given at the end of this chapter. It is to be noted that depreciation is not taken into account since it does not involve any cash movement. On the other hand, the repayments of credits are considered, since they are cash outflows.

Schedules 10-13 and 10-14 show that the total working capital of 2,000 will be recovered at the end of the project time and that the entire bank overdraft of 1,500 will be repaid (Schedule 10-14). If the overdraft was not to be repaid, the terminal value would only be 500 (which is covered by the equity capital), but in this case interest payments would have to be taken into account (135) throughout the whole discounting period.

The calculation of the NPV for the total investment outlay (Schedule 10-13) is identical with the case where the project will be undertaken without any outside financing. Contrariwise, the calculation of the NPV for the equity capital (Schedule 10-14) corresponds to the case where outside financing (loans) will be involved. In both cases, a supporting table has to be prepared in addition to the cash flow tables to calculate the corporate tax. The "Net Income Statement" (Schedule 10-9) can be used for this purpose keeping in mind that in the case of project financing without outside funds the production costs will not contain any financial costs.

The profitability rates of the total investment outlay as well as of the equity capital are above 10 per cent, since both present values are positive. As mentioned earlier, a project can be accepted if NPV $\geq$ zero.

If one of several project alternatives has to be chosen, the project with the largest NPV should be selected. This selection method, however, needs some refinement since the NPV is only an indicator of the positive net cash flows or of the net benefits of a project. In cases of two or more alternatives, it is advisable to know how much investment will be required to generate these positive NPV's. The ratio of the NPV and the present value of the investment (PVI) required will yield a discounted rate of return which should be used for comparing alternative projects:

$$NPVR = \frac{NPV}{PVI}$$

where:

NPV = Net present value ratio

PVI = Present value of investment

If the construction period does not exceed one year, the value of investment will not have to be discounted. Comparing the two alternative ways of financing the same project example, the following NPVR's are obtained:

	NPV	PVI	NPVR
Schedule 10-13 (end of line D)	1473	2871+3780+928+154+43+94+327 = 8197	0.179
Schedule 10-14	1026	2871 + 1890 + 327 = 5088	0.201

Hence, financing with outside funds is more profitable for the entrepreneur's equity capital than to rely exclusively on own funds. Among alternative projects, the one with the highest NPVR has to be chosen. In case of a single project a positive choice should only be made if NPVR $\geq$ 0.

When comparing alternative projects caution must be exercized that the discounting period as well as the rate of discount are the same for all projects.

In summary, the NPV has great advantages as compared to the pay-back period or the annual rate of return since it takes account of the entire life of the project and of the timing of the cash flows. In addition, the NPV can be considered as a calculative investment rate which should at least be reached by the project's profit rate. The shortcoming of the NPV is the difficulty in selecting the appropriate discount rate and that it does not show the exact profitability rate of the project. For this reason the NPV is not always understood by businessmen who are used to think in terms of a rate of return on capital. Therefore, the internal rate of return should be used.

Internal rate of return (IRR)

The IRR is the discount rate at which the present value of cash inflows is equal to the present value of cash outflows, or put in another way, where the present value of the receipts from the project is equal to the present value of the investment. This means that the net present value must be zero. The procedure is the same as in the case of the NPV. The same kind of table can be used and instead of discounting cash flows at a pre-determined cut-off rate, several discount rates may have to be tried until the rate is found at which NPV will be zero. This rate is called the internal rate of return and it represents the exact profitability of the project.

The main shortcoming of the IRR is that its computation is time consuming since it must be arrived at by a process of trial and error. With some practice this work can be reduced to three or four attempts.

The procedure is as follows:

At first a cash flow table is prepared like in the case of the NPV. The probable discount rate is then used to discount the net cash flow to the present value. If the NPV is positive, a higher discount rate has to be applied. If the NPV is negative at this higher rate, the IRR must be between these two rates. If the higher discount rate gives, however, still a positive NPV, the discount rate must be increased until the NPV becomes negative.

The closer the positive and negative NPV's are to zero, the more precise and less time consuming will it be to arrive at the exact IRR with the help of linear interpolation, applying the following formula:

$$i_r = i_1 + \frac{PV\,(i_2 - i_1)}{PV + NV}$$

where:

i_r = IRR

PV = NPV (positive) at lower discount rate

NV = NPV (negative) at higher discount rate

i_1 = lower discount rate

i_2 = higher discount rate

It is to be noted that i_1 and i_2 should not differ by more than 1 or 2 per cent. The above formula will not yield realistic results if the difference is too large since the discount rate and the NPV are in reality not related in a linear way.

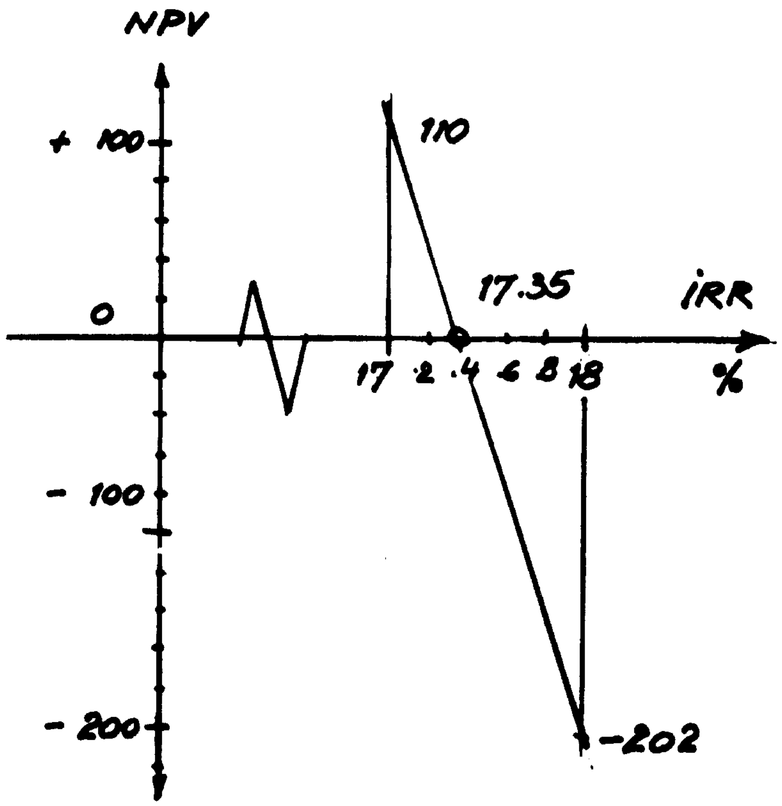
In the project example without outside financing (Schedule 10-13) the NPV = + 1473 at a 15 per cent discount rate. In order to find the IRR, several discount rates $>$ 15 per cent have to be tried until the NPV = 0.

Year	Net cash flow Schedule	Discount factor at 17%	NPV	Discount factor at 18%	NPV
1	- 3300	.854	- 2818	.847	- 2795
2	- 5000	.730	- 3650	.718	- 3590
3	- 535	.624	- 334	.609	- 326
4	1755	.533	935	.516	906
5	2240	.456	1021	.437	979
6	3270	.389	1272	.370	1210
7	3500	.333	1165	.314	1099
8	1140	.284	324	.266	303
9	2140	.243	520	.225	482
10	2140	.208	445	.191	409
11	2140	.177	379	.162	347
12	5640	.151	851	.137	773
			+ 110		- 203

Discounted at 17 per cent, the net cash flow is still positive (110), whereas it becomes negative (- 203) at 18 per cent. Consequently, the IRR must lie between 17 per cent and 18 per cent. For practical purposes this would be sufficient; to calculate the exact IRR the above given formula of a graphical intrapolation method should be applied.

$$i_r = 17 + \frac{110\ (18 - 17)}{110 + 203} = 17{,}35\%$$

The graphical method uses the positive and the negative NPV's which are plotted on the co-ordinate whereas the respective discount rates are plotted on the abscissa.



The connecting line between the negative and the positive NPV cuts the abscissa (NPV = 0) at a discount rate which is the IRR, in the example slightly above 17.3 per cent.

The IRR indicates the actual profit rate of the total investment outlay or, if also needed, of the equity capital. The IRR of the total investment outlay can also be used to determine the conditions of loan financing since it indicates the maximum interest rate which could be paid without creating any losses for the project proposal. In order not to endanger the liquidity of the project, it would be necessary, however, to adjust the loan repayment schedule to the cash inflows.

The investment proposal is accepted if the IRR > cut-off rate, which is the lowest acceptable investment rate for the invested capital. If several alternatives have to be decided upon, the project with the highest IRR will be selected if IRR > cut off rate[1/].

4. <u>Breakeven Analysis</u> (Risk analysis)

Any feasibility study is a forecast, based on certain assumptions which for different reasons may not always be fulfilled. One of the reasons can be errors in estimation while preparing the feasibility study. Changes may also be due to extraneous factors which could not be covered or anticipated by such a study. No feasibility study, no matter how carefully prepared, can fully eliminate uncertainty in the various factors determining the profitability of a project.

In chapter 3 the likely uncertainty in achieving the scheduled levels of production and sales revenue were discussed. Such uncertainties are, of course, also pertinent to production costs. It is therefore useful to review the project proposal in order to assess the possible consequences, if the assumptions made in the feasibility study regarding the level of output and of production costs are not being met. The determination of the "break-even point", which is either defined by the physical units produced, the sales revenue or the level of capacity utilization at the point where sales revenue equals production costs, is an appropriate measure in this context.

1/ The IRR has to be applied continously in cases where major negative net cash flows occur repeatedly during the later life of the project. Although this is very seldom, e.g. , in the oil and mining industry, it should be known that the NPV may alter between positive and negative more than once when applying different discount rates. More than one IRR may exist and the one to be applied for the project may not be possible to determine.

Prior to calculating the break-even point, a number of conditions are to be observed:

i) production costs are a function of the volume of production (or of sales as the utilization of equipment);

ii) volume of production equals volume of sales;

iii) fixed operating costs are the same for each volume of production;

iv) variable unit costs vary proportionally; total production costs are consequently changing proportionally to the volume of production;

v) the unit sales prices fo one product or the product mix are the same for all levels of output (sales) and over time; the sales value is therefore a linear function of the unit sales prices and the quantity sold;

vi) data from a normal year of operation are to be taken;

vii) the level of unit sales prices, variable and fixed operating costs stays constant;

viii) a single product is manufactured or if several similar ones are produced, the mix should be convertable into a single product;

ix) the product-mix should remain the same overtime.

It has to be noted that these conditions will not always prevail in practice and that in turn the results of break-even analysis may be influenced negatively. Therefore, break-even analysis should only be considered as a supplementary tool in project evaluation in support of other evaluation methods.

Algebraic determination of the break-even point

When expressing the break-even point in physical units produced, the basic assumptions can be put into the following equations (annual data):

sales value = production costs (1)

or: sales value = sales volume x unit sales price (2)

production costs = fixed costs + variable unit costs x sales volume (3)

equation for sales: $y = p \cdot x$ (2a)

equation for production costs: $y = v \cdot x + f$ (3a)

or: $p \cdot x = v \cdot x + f$ (1a)

$$x = \frac{f}{p - v} \quad (4)$$

Symbols: x = production (sales) volume (at the break-even point)

y = sales value = production costs

f = fixed costs

p = unit sales price

v = variable unit costs

In this equation, the break-even point is determined by the relationship between fixed costs and the difference of the unit sales price and variable unit costs which allows to draw several practical conclusions from the break-even analysis:

i) a high break-even point is inconvenient since it renders a firm vulnerable to changes in the level of production (sales)

ii) the higher the fixed costs, the higher is the break-even point

iii) the larger the difference of unit sales price and variable operating costs, the lower the break-even point. In this case the fixed costs are much faster absorbed by the difference between unit sales price and variable unit costs.

Applying the data of the given case, the break-even point would be reached at a production of

$$BE = \frac{3,280,000}{6.25 - 3.25} = \underline{\underline{1,093,333}}$$

Expressed in terms of <u>sales revenue</u>, formula (4) would become:

$$BE = p.\left(\frac{f}{p-v}\right)$$

$$= 6.25 \times \frac{3,280,000}{6.25 - 3.25} = \underline{\underline{\$6,833,331}}$$

The break-even analysis lends itself easily to sensitivity analysis particularly in the modified formula which is used to calculate the rate of capacity utilization at the break-even point:

$$BE = \frac{F}{R - V}$$

where: BE = Break-even point

F = Fixed costs

R = Sales Revenue (at full capacity)

V = Variable production costs (at full capacity)

For the given case the break-even point would be reached at capacity utilization:

$$BE = \frac{3,280}{12500 - 6500} = 55\%$$

This way, break-even analysis can be useful in determining the impact of changes in unit prices, fixed and variable production costs on the break-even point of a project. Detailed calculation see Annex 8.

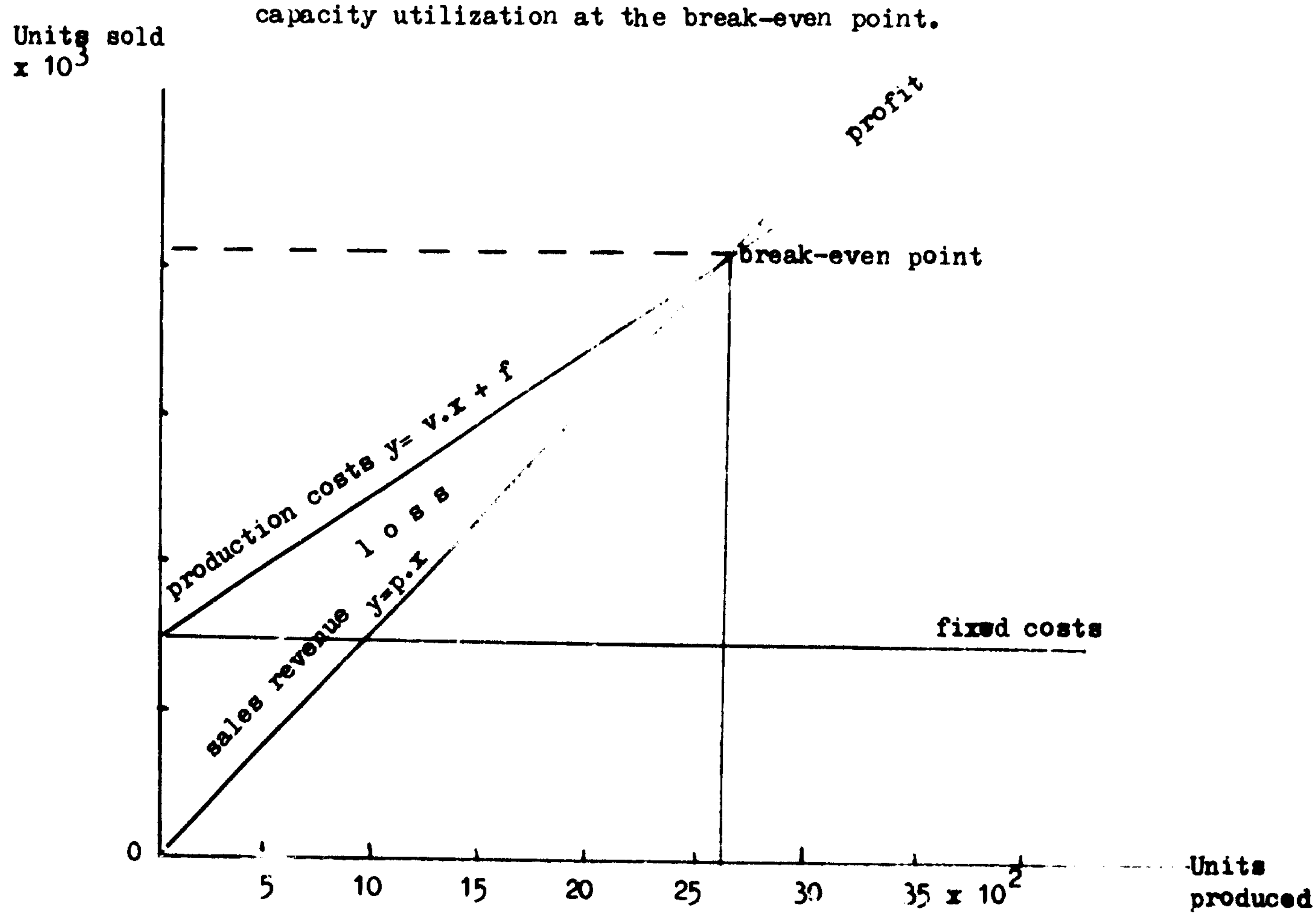
The above approach has the advantage of enabling the project planner to calculate several break-even points, taking into account alternative investment proposals resulting from different installed capacities or alternative technological processes. Changes in the installed capacity cause variations in the fixed costs. Changes in the technological process also have an impact on the variable costs since, e.g., a technologically more advanced (and more costly) process normally leads to lower variable unit costs particularly as far as labour costs are concerned.

Graphical determination of the break-even point

Graphically the break-even point can be determined on the basis of the two equations:

$$y = p \cdot x \qquad \text{and} \qquad y = v \cdot x + f$$

The interaction of both lines is the break-even point which in this case is defined by units of production. Knowing the rated capacity of the project, it is fairly easy to determine the rate of capacity utilization at the break-even point.



Schedule 10-13: Cash flow table and lculation of present value for a pr ect without outside financing (in US$)

	Construction		Start-up and full capacity operation										Salvage value in last year a/	Total
Year	1	2	3	4	5	6	7	8	9	10	11	12		
Production programme (from Schedule 3-3)	0	0	55%	75%	80%	100%	100%	100%	100%	100%	100%	100%		
A) **Cash inflow** 1. Sales revenue (from Schedule 3-1)	0	0	6875	9375	10000	12500	12500	12500	12500	12500	12500	12500	-	113750
B) Cash outflow (1+2+3)	-3300	-5000	-7410	-7620	-7760	-9230	-9000	-11360	-10360	-10360	-10360	-10360	+3500	- 98620
1. Total investment outlay (from Schedule 10-6/2)	-3300	-5000	-1410	- 270	- 90	- 230	-	- 1000	-	-	-	-	+3500	- 7000
2. Production costs (from Schedule 10-3/1)	-	-	-6000	-7350	-7670	-9000	-9000	- 9000	- 9000	- 9000	- 9000	- 9000	-	- 84020
3. Corporate tax b/ (from Schedule 10-9)	-	-	-	-	-	-	-	1360	- 1360	- 1360	- 1360	- 1360	-	- 6800
C) Net cash flow (A-B)	-3300	-5000	- 535	1755	2240	3270	3500	1140	2140	2140	2140	2140	3500	15130
D) Present value (at 15%)	-2868	-3780	- 351	1002	1113	1413	1312	371	608	528	458	398	567	1473
E) Cumulative net cash flow	-3300	-8300	-8835	-7080	-4840	-1570	+1930	3070	5210	7350	9490	11630	-	15130

a/ Salvage value: land 300 2/3 of buildings 1200 Working capital 2000
b/ Tax holidays including year 7.

Schedule 10-14: Cash flow table and calculation of present value for a project with outside financing (in US$)

Year	Construction 1	2	Start-up and full capacity operation 3	4	5	6	7	8	9	10	11	12	Salvage value in last year	Total
Production programme (3-3)	0	0	55%	75%	80%	100%	100%	100%	100%	100%	100%	100%		
A) **Cash inflows**														
1. Sales revenue (from Schedule 3-1)	-	-	6875	9375	10000	12500	12500	12500	12500	12500	12500	12500	-	113750
B) **Cash outflows** (total)	-3300	-2500	-6975	-8277	-9149	-10226	-10138	-11360	-10360	-10360	-10360	-10360	+3500	-99865
1. Total investment outlay (fixed inv.)	-3300	-2500	- 975	- 927	-1479	-1226	-1138						+3500	- 9045
a) Equity funds	-3300	-2500											+3500	- 2300
b) Replacement of cars (from 10-8/2)								-1000						- 1000
c) Repayment of supplier's credit a/	-	-	- 600	- 600	- 600	- 600	- 600							- 3000
d) Interest on supplier's credit	-	-	- 240	- 192	- 144	- 96	- 48							- 720
e) Repayment of bank overdraft	-	-	-	-	- 600	- 450	- 450							- 1500
f) Interest on bank overdraft	-	-	- 135	- 135	- 135	- 80	- 40							- [illegible]25
2. Production costs (from Schedule 10-3/1)	-	-	-6000	-7350	-7670	-9000	-9000	-9000	-9000	-9000	-9000	-9000	-	-84020
3. Corporate tax b/ (from Schedule 10-9)	-	-	-	-	-	-	-	-1360	-1360	-1360	-1360	-13[illegible]	-	- 6800
C) **Net cash flow** (A-B)	-3300	-2500	- 100	1098	851	2274	2362	1140	2140	2140	2140	2140	3500	13885
D) **Present value** (at 15%)	-2868	-1890	- 66	627	423	982	886	372	608	529	458	398	567	1026

a/ Depending on the contract, interest payments could already start during the construction period.
b/ Tax holidays including year 7.

E. National economic evaluation

Industrial projects should preferably be subjected also to an evaluation from the national economic point of view. Two different methods were developed by UNIDO which are presented in the

a) UNIDO Guidelines for Project Evaluation
Practical Guide to Project Appraisal */

b) Manual for Evaluation of Industrial Projects in Arab Countries.

The choice which of the two methods to apply is left to the prevailing economic conditions under which a project is prepared and to the discretion of the project planner.

The UNIDO Guidelines for Project Evaluation

1. General philosophy of the UNIDO method

Project evaluation belongs to that branch of economics called welfare economics, where the prime consideration is to maximize aggregate satisfaction. In its turn, aggregate satisfaction is a function of both aggregate consumption and distribution. Evaluating a project will therefore consist in measuring the expected net contribution of the project to aggregate satisfaction by considering its effect on both aggregate consumption and distribution.

In practical terms the Guidelines consider that the raising of aggregate consumption is a fundamental objective for project choice, but that project choice will also be influenced by the objective of distribution. Moreover, since one cannot stay in the ethereal world of welfare economics, project choice will be influenced by still other objectives which might seem particularly important to the national planners. These objectives

*/ This Manual is a more popular version of the UNIDO Guidelines which uses the same methodology.

will have to be combined together through a system of weights. In one sense the method of the Guidelines is a multi-criterion analysis, but the criteria ultimately all boil down to a single one which is the net contribution of the project to the national economy. That contribution is measured in units of present consumption, and for that purpose units of future consumption are all discounted at the appropriate social discount rate into their equivalent in units of present consumption. Consequently the net contribution of a project is called the net (social) present value of the project. The evaluation of the social benefits and costs of a project will be made on the basis of social prices which may differ from registered market prices and for that reason are usually referred to as shadow prices. In general terms, the shadow price of a benefit reflects the consumer willingness to pay for such benefit, and the shadow price of a cost reflects the opportunity cost of the use of the corresponding resource. Since costs are (maximum) benefits foregone, the ultimate basis of estimation in the method is consumer willingness to pay. This is especially true for the objective of aggregate consumption. As concerns other objectives, government preferences substitute to consumer preferences.

2. Application of the method at the project level

At the project level the evaluator will evaluate successively direct benefits, direct costs and indirect benefits and costs. In each case he will first identify benefits and costs and then measure them by the application of the proper shadow prices and weights.

a. Estimation of direct benefits to aggregate consumption

- identify the output of the project and split it up between adding to supply and saving resources.
- estimate the amount that the consumers will actually pay for the additional supply of goods; if markets are not perfect, that estimate will not be the same as the market price; if the additional supply lowers the price, estimate the shape of the demand curve and estimate the consumer surplus which is part of the benefit of the project.

- estimate the amount that the consumers will actually pay for the resources saved or released by the project.
- for goods that substitute for imports or add to exports, estimate the impaot on foreign exchange availability, and use the shadow price of foreign exchange, supplied by the central planners, to convert foreign exchange benefits into units of aggregate consumption in domestic currency.
- convert future benefits of consumption into present values by using the social rate of discount supplied by the central planners.
- add up all these direct benefits to aggregate consumption to arrive at the total in units of current aggregate consumption; the benefits are homogeneous thanks to the use of appropriate shadow prices and the social discount rate

b. Estimation of direct costs to aggregate consumption

The appropriate concept of costs is that of the maximum benefits foregone; costs are therefore measured in much the same way as benefits. The costs of the project consist of its inputs which may be defined as the goods and services withdrawn from the rest of the economy:

- identify the inputs of the project and split them up into reducing the total supply of resources and absorbing resources to keep the input supply constant through expanded production.
- in the case of reduction of total supply, estimate the willingness to pay for these inputs; market prices of inputs must be corrected as markets are not perfect; if the reduction of supply change the price, estimate the demand curve;
- if the absorption of resources in this project is to be compensated by an expansion of supply of these resources from other sources, calculate the actual costs involved in that expansion.
- if some of the resources are imported, or are obtained at the expense of potential exports, calculate the sacrifice of foreign exchange involved, and oorrect by the shadow price of foreign exchange
- direot future costs are discounted at the appropriate social rate of discount.
- for each project add up all direct costs related to the aggregate - consumption objective.

c. Estimation of indirect benefits and costs to aggregate consumption

There are two main categories of indirect effects, namely external effects and effects due to the redistribution of income through the project.

When the operation of a project results in a net gain (or loss) to society, but not a direct gain (or loss) to those who acquire the project output, this gain (or loss) will not be reflected in the willingness to pay for this output. These effects fall within the category of what is commonly named externalities or external effects. They may be benefits (e.g. training of labour force) or costs (e.g. nuisances). They must be included in the evaluation because the approach to social benefit-cost analysis presented in the Guidelines consists in attempting to measure as many of the impacts of a project on the economy as possible.

When the level of savings is judged insufficient, a unit of investment is valued more than a unit of consumption. In such a situation it becomes essential to evaluate the over-all effect of a project on the mix of consumption and investment in the economy. This will be done by considering the distribution of gross benefits and costs (including transfers) between various economic groups, and then applying the propensities to save of the respective groups, and the shadow price of investment.

d. Redistribution of income as a separate objective

The effect of a project on the mix of consumption and investment is to be distinguished from the redistribution of income as a separate objective. In the latter case some relative weights will be attached to the net benefits accruing to various groups in the economy. The choice of the weights is made at the planning level. The evaluation is concerned only with the measurement of the amounts of net benefits realized by the various groups, the evaluator must examine all the aggregate-consumptions benefits and costs - direct and indirect - of a project, as well as the accompanying cash transfers, and determine to what extent each item affects each group.

e. Other objectives

Other objectives, if of an economic nature, are implicitly contained in the objectives of aggregate consumption and redistribution. If, however, their importance to the national economy is not determined by individuals in their capacity as consumers, they are called "merit wants", and can be incorporated in the evaluation process through weights defined at the planning level. The method is flexible enough to take account of a multiplicity of objectives, the only limitation been the ability to estimate appropriate weights at the planning level.

3. Application of the method at the planning level

a. Role of national planning

The method of the Guidelines clearly shows the role of the planning agency in project evaluation. The planning agency will provide the evaluator with such national parameters as are necessary for the evaluation of specific projects. These national parameters reflect characteristics of the national economy (factual parameters) and socio-political choices (weights). The calculations of national parameters is normally beyond the power of the project evaluator and can best be done by the planning agency.

A well-formulated plan provides a consistent forecast of future economic development and defines a strategy of development, within which project formulation and evaluation are tactical elements. The method does not rely on optimality assumptions, so that factual parameters will reflect characteristics of the pattern of development as it will be and not as it ought to be.

The most important national parameters are the shadow price of labour, the shadow price of foreign exchange, the shadow price of investment and the social rate of discount.

b. Shadow price of labour

The shadow price of labour employed to construct or operate a project is not the money wage unless (1) the money wage is equal to the output forgone elsewhere in the economy by hiring workers for the project and (2) the creation of jobs on the project in question does not reduce the level of investment elsewhere in the economy. The second condition would not be necessary if investment and consumption were marginally equally valuable.

Thus, in normal circumstances, the shadow price of labour depends on two factors (1) the output foregone by moving workers from their previous employment to the project and (2) the shift in the composition of national output from investment to consumption by the distribution of wages. The importance of the second factor in turn depends on the shadow price of investment, which in turn is dependent on the social rate of discount.

c. Shadow price of foreign exchange

By definition the shadow price of foreign exchange is the contribution one unit of foreign exchange makes to aggregate consumption. When foreign exchange is valued solely for its contribution to aggregate consumption, this shadow price is a factual parameter which does not depend directly on value judgements or weights, though of course the present and future allocation of foreign exchange is sensitive to value judgements and weights incorporated in the economic policy of the Government. It is a different story when foreign exchange is valued in order to reduce dependence on foreign sources of capital, in which case it becomes a "merit want" characterized by a weight. Except in that case the value of a unit of foreign exchange is a shadow price, not a weight. This shadow price can be calculated by the weighted average of the ratios of domestic market-clearing prices in national currency to c.i.f. prices in foreign exchange. The appropriate weights are the fractions of foreign exchange allocated at the margin to the various imports.

d. Shadow price of investment

The shadow price of investment, p(inv) , . is by definition the present value of the aggregate consumption stream generated by one unit of marginal investment. It is measured by the ratio of the social marginal productivity of capital to the social rate of discount.

If all returns from marginal investment were assumed to be immediately consumed, the social marginal productivity of capital would be represented by "q" the marginal rate of return to investment, and p(inv) would be equal to q/i, where "i" is the social discount rate. In the more realistic assumption when a portion of returns from marginal investment is reinvested, proper social accounting requires us to value this portion at the shadow price of investment. Thus, the social marginal productivity of capital becomes $(1-s)\ q+p^{inv}.sq$ where "s" is the marginal propensity to save in the economy. The formula for p(inv) then becomes:

$$p(inv) = \frac{(1-s)\ q+p^{inv}.sq}{i} = \frac{(1-s)q}{i-sq}$$

This parameter is an intermediate nature between a factual parameter (such as q) and a value judgement (i).

e. Social rate of discount

Should we assume that units of benefits and costs are of equal value whenever they occur, there would be no need for a social rate of discount. If this is not the case, however, we want to compute these benefits and costs in units of present aggregate consumption and to do so we will have to use a social rate of discount. Typically we attribute decreasing weights to units of aggregate consumption which are further away in the future. These weigths are present worth factors permitting to calculate the present worth of future benefits and costs. If the rate of discount "i" is zero, there is no discounting and the present worth factor is equal to one.

The logic of willingness to pay is not applicable to the choice of a social rate of discount. Even if all borrowers paid 10% and all savers earned 10%, the social rate of discount would not necessarily be 10%. Equally unsatisfactory as a basis are observed rates of capital productivity. The latter indicate the present value of the consumption foregone when investment is displaced but this present value is relevant as a cost, not as a discount rate. Since neither individual market-revealed preferences nor observed rates of capital productivity determine the social rate of discount, policy makers must determine this parameter by making an implicit or explicit value judgement with respect to the intertemporal distribution of increments to consumption. This difficult choice can be largely avoided by treating the social rate of discount as an unknown of the planning problem. The suggested procedure is to find the value of the discount rate which will switch the present value of a project from positive to negative. When aggregate consumption is the only objective, this procedure is the same as the calculation of the internal rate of return of a project for financial evaluation. The significance and interpretation are different, however, expecially when additional objectives like redistribution and "merit wants" enter the picture. When several parameters are involved, the switching value of the social rate of discount can be interpreted only with reference to given values of the other parameters and conversely the switching values of other parameters can be interpreted only with reference to a given value of the social rate of discount.

4. Practical procedure

The steps for the practical application of the method of the Guidelines by the evaluator can be summarized as follows:

(1) establish the framework for national economic evaluation by:
- identifying the flows (benefits or costs) relevant to the national economy;
- distinguishing the flows representing net release or use of resources from those representing transfers within the national economy;
- isolating as many flows as there are different shadow prices and weights to apply.

(2) apply relevant shadow prices and weights to all the flows shown in the framework.

(3) find the present value of the project by summing, and discounting at the given rate of discount, or find the value of the discount rate for which the present value of the project switches from positive to negative. If the present value is positive, or the switching value of the discount rate larger than a stated minimum, then the project is worth undertaking.

The procedure is particularly well suited to calculations with computers and sensitivity/risk analysis. The framework can be expressed in the form of a series of equations to which various values of market forecasts, shadow prices and weights can be applied. In that case it is practical to proceed line by line (in a framework where years are heads of columns) and ultimately sum up in order to get the present value of the project.

The Manual for Evaluation of Industrial Projects in Arab Countries

The Manual provides a comprehensive operational, step-by-step methodology for evaluation of industrial projects in Arab countries as well as in any other developing country. The simplicity and applicability in the day to day practice under the prevailing conditions in developing countries were among the leading considerations as the Manual was drafted. It is addressed to the average project evaluator from national planning agencies, ministries dealing with investment projects, banks, industrial development organizations, private entrepreneurs and consulting firms; it is applicable to both public and private sector projects.

This Manual differs from the Guidelines for Project Evaluation both conceptually and in terms of simplicity. The Manual translates the multiple national objectives at the macro-level into a set of basic, additional and supplementary criteria at the project level. It does not advocate a single aggregate criterion. The Manual assumes that a fundamental ultimate aim of an investment project is to contribute as much as possible to the national income. The translation of national income at project level is net value added. The Manual, however, goes a step further - the portion of the value added which is repatriated abroad as wages, interest, dividends, rents, insurance, royalties, etc., does not add to the national income and therefore should be excluded from the value added. In other words, the soundness of an investment project, along with other criteria, should be appraised on the basis of the net national value added it is expected to generate.

Along with the basic criterion - net national value added - the Manual advocates a set of additional indices - employment effect, distribution effect, net foreign exchange effect, international competitiveness, as well as some supplementary considerations.

The Manual basically recommends the utilization of actual market prices on the domestic and/or foreign markets. It advocates the application of only two national parameters, i.e. social rate of discount and adjusted rate of foreign exchange, providing relatively simple operational methods for their derivation. The Manual recommends operational approach for assessment of both direct and indirect effects of an investment project.

The Manual advocates an integrated approach in project evaluation; the importance of both commercial and national profitability analysis is strongly emphasized, the former being a stepping stone towards the latter. It also recommends evaluation of investment projects both under conditions of relative certainty and under uncertainty, providing simple approaches for uncertainty analysis.

Being addressed to project evaluators from developing countries which differ considerably among themselves, the Manual provides a choice of criteria and approaches. It is up to the project analyst to select the most appropriate ones suited to the conditions of a country.

The Manual suggests a set of model formats, indicating the essential minimum of data needed for project evaluation and the way this data could be appropriately organized.

A consistent illustrative example from a hypothetical project has been developed throughout the Manual. On the basis of the same initial information commercial and national profitability analysis have been applied, followed by the application of uncertainty analysis. It is hoped that this contributes towards better understanding of the Manual's approach. The Manual is also supplemented by three case studies - textile mill, urea plant and cement plant, hwere the suggested operational, step-by-step approach for project evaluation is consistently applied.

ANNEX 1

Outlines of general opportunity studies

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

1) The basic features of the area: the area size and leading physical features, with maps showing the main characteristics;
2) 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;
3) Leading exports from and imports to the area;
4) Basic exploited and potentially exploitable production factors;
5) Structure of existing manufacturing industry utilizing the local resources;
6) Infrastructural facilities especially of transport and power conducive to development of industries;
7) A comprehensive checklist of industries which may be developed on the basis of the available resources and infrastructural facilities;
8) Revised checklist purging the one under (7) 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.

9) 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 (8);

10) 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;

11) Estimated capital costs of selected industries (lump sum) taking into account:

   a) Land

   b) Technology

   c) Equipment

      - production equipment
      - auxiliary equipment
      - service equipment
      - spare parts, tear and wear parts, tools

   d) Civil engineering works

      - site preparation and development
      - buildings
      - outdoor works

   e) Project implementation

   f) Pre-investment capital expenses

      - preparatory investigations

   g) Working capital requirements

12) Major input requirements

For each project approximate quantities of essential inputs should be estimated and added up to obtain the total input requirements. Sources of inputs should be stated and classified as to

- local,
- shipped from other areas of the country,
- imported.

Inputs should be classified as follows:

a) Raw materials

b) Processed industrial materials

c) Manufactures

d) Auxiliary materials

e) Factory materials

f) Utilities

g) Manpower

13) Estimated production costs to be derived from (12);

14) Estimated annual sales revenue;

15) Project sponsor(s) organizational and management aspects, potential enterprise;

16) An indicative time-schedule for implementation;

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

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

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

20) Commercial profitability: approximate pay-off period, approximate rate of return.
Enlargement of product-mix, increased profitability and other advantages of diversification (if applicable);

21) A tentative 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.

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 analysisists would be found sufficient.

In fact, the two major distinctions between the opportunity studies, on the one hand, and of pre-feasibility and feasibility studies on the other, are:

(i) The area 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.

B. The outline of a sub-sector opportunity study (such as building materials industries) may take the following form:

1) The place and role of the sub-sector in industry;
2) The size, structure and growth rate of the sub-sector;
3) 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;
4) Rough projections of demand for each item;
5) Identification of the items in short supply, which have future potential of growth and/or exports;
6) A broad survey of the raw materials indigenously available;
7) Identification of opportunities for development based on (2), (5) and (6), and over-riding factors, such as transport costs, available or potentially available infrastructure.

Items (10) to (21) listed under area opportunity studies are to be added after item (7) of the sector opportunity studies, since the structural requirements of the studies are the same once the investment opportunities have been identified.

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

1) The characteristic of the resource, the prospected and proven reserves, the past rate of growth and the potential for future growth;
2) The role of the resource in the national economy; its utilization: demand in the country and exports;
3) 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;
4) Major constraints and conditions in the growth of industries based on the resource;
5) Estimated growth in demand and prospects of exports of identified items which may be based on the subject resource;
6) Identification of investment opportunities based on (3) to (5);
7) Items (11) to (21) listed under area opportunity studies are to be added after item (6) of the resource-based opportunity studies since the structural requirements of the studies are the same since the investment opportunities have been identified.

ANNEX 2

Outline of a pre-feasibility study

1. Executive summary

   Synoptical review of all essential findings of each chapter.

2. Project background and history
   - Project sponsor(s)
   - Project history
   - Cost of studies and/or investigations already performed

3. Market and plant capacity

   3.1 Demand and market
   - The estimated existing size and capacities of the industry (specifying market leaders), its past growth, the estimated future growth (specifying major programmes of development), the local dispersal of industry, its major problems and prospects, general quality of goods
   - Past imports and their future trends, volume and prices
   - The role of the industry in the national economy and the national policies, priorities and targets related or assigned to the industry
   - The approximate present size of demand, its past growth, major determinants and indicators

   3.2 Sales and marketing
   - Anticipated competition for the candidate project from existing and potential local and foreign producers and supplies
   - Localization of market(s)
   - Sales programme
   - Estimated annual sales revenues from products and by-products (local/foreign)
   - Estimated annual costs of sales promotion and marketing

3.3 Production programme

Approximate production programme of

1) Products,
2) By-products,
3) Wastes.
   - Estimated annual cost of waste-disposal

4. Material inputs

Approximate input requirements and their present and potential supply positions

1) Raw materials
2) Processed industrial materials
3) Manufactures
4) Auxiliary materials
5) Factory supplies
6) Utilities, especially power

Rough estimate of annual costs of material inputs (local/foreign)

5. Location and site

Pre-selection of

- Location and
- Site - if appropriate -
- Estimate of cost of land

6. Project engineering

6.1 Preliminary determination of scope of project

6.2 Technology(ies) and equipment

- Possible technologies and processes which may be adopted in relation to capacity size
- Rough estimate of costs of technology(ies) (local/foreign)
- Rough layout of proposed equipment (major components), classified as to
  1) Production equipment
  2) Auxiliary equipment
  3) Service equipment
  4) Spare parts, tear and wear parts, tools

- Rough estimate of investment cost of equipment (local/ foreign), classified as above

6.3 Civil engineering works

- Rough layout of civil engineering works, arrangement of buildings, short description of construction materials to be used, all classified as follows:
  1) Site preparation and development
  2) Buildings and special civil works
  3) Outdoor works
- Rough estimate of investment cost of civil engineering works (local/foreign), classified as above

7. Company organization and overhead costs

7.1 Rough organizational layout

- Production
- Sales
- Administration
- Management

7.2 Estimated overhead cost

- Factory
- Administrative
- Sales

8. Manpower

- Estimated manpower requirements, classified as to labour and staff and major categories of skills (local/foreign)
- Estimated annual manpower costs, classified as above, including overheads on wages and salaries

9. Project implementation

- Proposed rough implementation time schedule
- Estimated implementation costs in line with implementation programme

10. Financial analysis

10.1 Total investment outlay

- Rough estimate of working capital requirements
- Total investment outlay, by summing-up estimated investment cost items from chapters 2 - 10.1

10.2 Project financing

- Proposed capital structure and proposed financing (local/foreign)
- Interest

10.3 Production cost

- Summary of estimated production costs from chapters 2 to 10.2, classified as to fixed and variable costs

10.4 Commercial profitability, based on above estimated values

- Pay-off period
- Simple rate of return
- Break-even point
- Internal rate of return

11. National economic costs and benefits

- Rough evaluation tests
  - . Project exchange rate
  - . Effective protection
- Approximate cost-benefit analysis, using estimated weights and shadow-prices (foreign exchange, labour, capital)
- Economic industrial diversification
- Estimate of employment creation effect
- Estimate of foreign exchange savings

Note: Additional information may be taken from detailed check-lists and schedules for each chapter given in the corresponding chapters of Part II - The feasibility study.

Annex 3

Project opportunity (A) and pre-feasibility study (B):
A comparison of study components highlighting the increasing precision of data while proceeding from (A) to (B).

Item	(A) PROJECT OPPORTUNITY STUDY

A.1 GENERAL ECONOMIC DATA

A.1.1 General characteristics

Country data sheet (not produced here)

A.1.2 Economic characteristics

- GNP at 1972 factor cost prices (million $)

	1971	1972	1973	1974
Totals	x xxx	x xxx	x xxx	x xxx
Rate of increase	2,5%	3,7%	4,4%	8,3%

GNP per capita in 1974: $551

Ratios of GNP at market prices in 1974

Gross investment	14%
Gross savings	10%
Balance of payments current account deficit	4%
Government revenues	23%

- Balance of payments situation and development (million $)

	1971	1972	1973
Exports	x xxx	x xxx	x xxx
Imports	x xxx	x xxx	x xxx
Trade balance	- 288	- 280	+ 244
Over-all balance	- 200	- 116	- 116

- Gross foreign exchange reserves (million $; end of period)

	1972	1973	1974	1975 (June)
Total	288	300	312	-
Central bank	120	176	160	108

Total external debt outstanding	million $ 1,400
Rate of debt service ratio to export earnings	7,6%

A.1.3 Economic system

Indicate national planning, private and public sector

A.1.4 Economic policy

Government declaration, trade and tariff policies, regulations concerning foreign investors, foreign exchange policies (all not produced here)

A.1.5 National economic justification of projects considered

Range of preference: foreign exchange diversification saving - job creation - profitability - product

(B) PRE-FEASIBILITY STUDY	Item B.1

B.1 GENERAL ECONOMIC DATA

B.1.1 General characteristics

See: A.1.1

B.1.2 Economic characteristics

See: A.1.2

B.1.3 Economic system

B.1.4 Economic policy

See: A.1.4

B.1.5 National economic justification of projects considered

Range of preference: import saving - job creation - profitability

Forms A.2./3. /4/5/6/ (A) PROJECT OPPORTUNITY STUDY (contd.)

A.2 **PROJECT SPONSOR:** State Paper Corporation and Industrial Development Bank

A.3 **MARKET AND DEMAND FOR SPECIFIC PRODUCT**

- About 30,000 tons paper have been imported in recent years.

B

- Demand was not fully covered and is rising at a rate of about 5 - 10% p.a.
- Additional capacity of 12,500 tons p.a. paper board under construction.
- Further capacity addition of 10,000 to 20,000 tons p.a. recommendable, mainly printing and writing paper as well as packaking paper.
- Fixed local sales prices about 1,000$/ton, import price about 720$/ton.

A.4 **SUPPLY OF RAW MATERIAL INPUTS**

- Plenty of straw available, not used so far.
- Waste paper available in all towns, no separate collection and not re-used so far.

A.5 **APPROXIMATE LOCATION AND SITE**

- Several districts, all major wheat growing areas and consequently good supply of straw availabbe.

A.6 **PROJECT ENGINEERING**

A.6.1 **Approx. capacity** = 15,000 p.a. (50 tons per day). Output expected approx. 80 - 100% of capacity, i.e. 12,000 - 15,000 tons p.a.

A.6.2 **Existing process:**

several different processes are known, they are fully developed and require normal skill in operation only.

A.7 **MANPOWER AND MANAGEMENT**

- Approx. labour: 800 - 900 men.

B.2 **PROJECT SPONSOR:** State Paper Corporation and Industrial Development Bank

B.3 **MARKET AND DEMAND OF SPECIFIC PRODUCT**

- Market balance 1973:

Consumption	39,000 tons
Local production	10,000 tons
Imports	29,000 tons

- New local production capacity under construction 12,500 tons p.a.
- Consumption restricted by import regulation. Assumed open demand in 1973 about 10,000 tons.
- Yearly increase of consumption in the past about 7% p.a., (printing, writing and packaging paper) similar increase to be expected in the near future.
- Additional capacity of about 15,000 tons p.a. would find market outlays since sales price of locally produced product is fixed at about 1,000$/ton vs. about 720$/ton for the imported good.

B.4 **SUPPLY OF MATERIAL INPUTS**

- Several districts allow straw collection of 50,000 to 100,000 tons p.a. within a range of about 50 km. Estimated price free centrum about 26$/ton.
- Waste papter collection facourable in capital. Cost for collection and transport assumed to be about 80$/ton.
- Supplementary pulp: local hemp straw available in near future, imports as far as necessary.

B.5 **LOCATION**

-Suitable construction sites - town A + B, village C Town B has comparatively best basic process preconditions; favourably placed within wheat growing area, no housing problems for staff, power line connections to factory easily possible.

- Approx. basic process pre-conditions: water (sufficient quantity/quality), disposal facilities of waste waters, power supply, road connections, low humidity, good construction ground.

B.6 **PROJECT ENGINEERING**

B.6.1 Anticipated capacity + production programme: output = 100% of capacity

1. Printing paper	= 4,000 tons p.a.	(Printing press A)
2. Writing paper	= 5,000 tons p.a.	(Stationery factory B)
3. Packaging paper	= 6,000 tons p.a.	(Packaging composition)
Total	15,000 tons p.a.	

B.6.2 **Approx. processes**

- Sodac sulphate and sulphide process, chemicals for caustic soda process available locally to a large extent, caustic soda process might produce comparatively best paper products (specific consumption figures not produced here).

B.7 **MANPOWER AND MANAGEMENT**

Items A.7/8/9 (A) PROJECT OPPORTUNITY STUDY (contd.)

A.7 MANPOWER AND MANAGEMENT

- Approx. labour: 800 - 900 men.

A.8 PROJECT SCHEDULING

A.9 FINANCIAL ANALYSIS

A.9.1 Investment Cost

- Estimated total cost = about 35 million$, of which some 18 million$ in foreign exchange (specific investment about 400,000$/day/ton equipment, civil construction but excluding infrastructure).

A.9.2 Financing

- Equity of sponsor = 35%
- Foreign capital aid = 35%
- Supplier's credit = 30%

A.9.3 Production costs

still to be added

(B) PRE-FEASIBILITY STUDY (contd.) B.7/8/9

B.7 MANPOWER AND MANAGEMENT

Foreign supervisors	about	2 men
Skilled staff	about	200 men
Unskilled labour	about	600 men
Total	about	800 men

B.8 PROJECT SCHEDULING

- Total construction time about 4 years.

B.9 FINANCIAL ANALYSIS

B.9.1 Investment cost

- Subdivided cost estimate: (million $)

	Local currency	Foreign exchange	Total
LAND and site preparation	0.2	-	0.2
Civil works	3.5	-	3.5
Machinery ready erected	4.5	12.0	16.5
Licence + techn. assist.	2.4	-	2.4
Overheads	2.4	3.2	5.6
	13.0	15.0	28.2
Contingency	1.3	1.5	2.8
	14.3	16.7	31.0
Working capital	2.5	-	2.5
	16.8	16.7	33.5

B.9.2 Financing

- Proposed financing: (million $)

	Local currency	Foreign exchange	Total
Equity9	11.7	-	11.7
Foreign aid	-	11.7(*)	11.7
Supplier's credit	-	10.1	10.1
	11.7	21.8	33.5

(*) partly used for local works

B.9.3 Production costs

A.9.4 Commercial profitability

a) Rate of return

Sales revenue	15,000 x 1,000	15.0 million $
- Operating cost		9.0 million
= Operating profit		6.0 million
- Depreciation (6.7% p.a.)		2.4 million
= Gross profit		3.6 million
- Interest (Average 6% p.a.)		1.1 million
= Net profit before tax		2.5 million
- 50% corporate tax		1.25 million
= Net profit		1.25 million

$$\text{Rate of return} = \frac{\text{net profit + interest}}{\text{total investment outlay}} =$$

$$= \frac{1.25 + 1.1}{35} \times 100 = 6.7\%$$

b) Pay back period

$$\text{Pay back period} = \frac{\text{total investment outlay}}{\text{net profit + interest + depreciation}} =$$

$$= \frac{35 \times 100}{1.25 + 1.1 + 2.4} = 7.4 \text{ years}$$

B.9.4 Commercial profitability

a) Rate of return (average)

Sales revenue	= 15.0 million $
- Operating cost	
Straw	- 0.8 "
Pulp	1.8 "
Waste paper	0.2 "
Chemicals	2.0 "
Others + power	1.2 "
Labour	0.5 "
Administration	0.7
Distribution	0.5 "
Sales tax	0.6 "
= Operating profit	6.7 "
- Depreciation (6.7% p.a.)	- 2.2 "
= Gross profit	= 4.5 "
- Interest (6% p.a. average)	- 1.0 "
= Net profit before tax	= 3.5 "
- 50% corporate tax	- 1.75 "
= Net profit	= 1.75 "

$$\text{Rate of return} = \frac{1.75 + 1.0}{33.5} \times 100 = 8.0\%$$

$$\text{b) Pay off period} = \frac{33.5}{1.75 + 1.0 + 2.2} \approx 6.8 \text{ years}$$

c) Specific investment cost of plant

(33.5 - 2.5) million $: 15,000 tons = 2,066 $/ton/year

d) Specific production cost

Operating cost	= 8.3 million $
Depreciation	= 2.2 "
Interest (6% p.a.)	= 1.0 "
	11.5 "

11.5 million $: 15,000 tons = 756 $/ton/year

A.10. <u>National economic benefits</u>

- Job creation, specific capital requirement:

Total	$\frac{35 \text{ million \$}}{850}$	= about 41,000 $/job
Foreign exchange	$\frac{16.7 \text{ million \$}}{850}$ =	20,000 $/job

- Foreign exchange savings:

Import substitution (15,000 x 720)		10.8 million $
Depreciation (*)	2.4 million $	
Interest	1.1 million $	
Current imports	<u>3.8 million $</u>	<u>7.3 million $</u>
Foreign exchange savings p.a. =		<u>3.5 million $</u>

Foreign exchange saving
(*) On foreign exchange parts only

- Enumeration of social costs and benefits
  (not produced here)

B.10 <u>National economic benefits</u>

- Job creation, specific capital requirements

Total	$\frac{33.5 \text{ million \$}}{800}$ =	42,000 $/job
Foreign exchange	$\frac{16.7 \text{ million \$}}{800}$ =	20,000 $/job

- Foreign exchange savings:

Import substitution			10.8 million $
Export		-	-
Depreciation	(*)	2.2 million $	
Interest	(*)	1.0 "	
Current imports		<u>2.7 "</u>	= <u>5.9 million $</u>
			<u>4.9 million $</u>

(*) Based on world market prices

- Cost/benefit evaluation

Revenue 15,000 x 720 (*)		10.8 million $
Operating cost (**)		
Straw	- million $	
Pulp	1.2 "	
Wastepaper	- "	
Chemicals	1.8 "	
Others + power	1.0 "	
Labour	0.2 "	
Administration	0.3 "	
Distribution	0.3 "	
Sales tax	-	<u>4.8 million $</u>
		6.0 "
Depreciation		<u>2.8 "</u>
		3.8 million $

Rate of return $\frac{3.8}{0.5 \times 33.5}$ = <u>22%</u>

(*) Based on world market prices
(**) Social costs

ANNEX 4

Types of decisions to be taken during different pre-investment stages

DECISION CENTRE	ANALYSIS TOOL/ STUDY	DECISION GOAL
1. Identification	General or project opportunity studies	1. Identify opportunity 2. Determine critical areas for support studies 3. Determine area for (a) pre-feasibility study (b) feasibility study
2. Preliminary analysis	A) Support studies	1. Determine which of the possible choices are more viable 2. Identify the choice of the project criteria
	B) Pre-feasibility study	1. Determine provisional viability of the project 2. Appraise if the feasibility study should be launched
3. Final analysis	A) Feasibility study	1. Make the final choices of project characteristics 2. Determine the feasibility of the project and selected criteria
	B) Support studies	1. Investigate in detail selected criteria requiring in-depth study
4. Project evaluation	Evaluation study	1. Make final investment decision

Annex 5

Contents of a feasibility study based on the UNIDO Manual for industrial feasibility studies

NOTE

A complete set of black-line summary sheets and schedules

Annex 6

Demand forecasting techniques

1. Trend (extrapolation) method

The use of this technique, which is relatively common, requires the extrapolation of past data on the assumption that the past pattern will continue to hold good in the forecast period. The method involves:

(a) determination of a trend; and

(b) identification of its parameters.

The method most frequently used is the arithmetic (linear) trend. Some of the alternative trend curves for forecasting are the following:

(i) Arithmetic (linear) trend:

This is given by $Y = a \pm bT$; 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 $\text{Log } Y = a + bT$. 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 asumes a constant elasticity (=b) every period.

(v) Auto-regression method:

The variable under forecast is regressed on a 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.

Annual demand figures are bound to be fluctuating, and since a long-term trend has to be identified, it is necessary to go backwards for a considerable period. In many developing countries, the production and import figures for a period of 10 to 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. A period of at least 5 years without abnormal oscillations should be considered the minimum.

The first step to reveal a trend would be to take a moving average of 2-3 years which would correct major annual fluctuation. Where such a moving average results in a smooth curve, a growth pattern is discernible. It is, however, possible that distortions may relate to a period longer than a year, such as equipment for power generation when this is undertaken as an intensified programme. These will require to be corrected. Sometimes, figures for a particular year may be missing, in which case statistical interpolation may be necessary. The periodic change is then applied to the periods preceding and following the midpoint, starting from the average at midpoint. A straight-line trend can then be calculated, which can be projected mathematically or graphically. A trend line (of the observed past years) may, however, lead to a point in the current year which is either too high or too low, when compared to the actuals, and in such event, the average of the last 2 to 3 years may be adopted as the base for future projections.

2. Consumption level method

This method is related to the level of consumption, using standard and defined coefficients, and can be usefully adopted when a particular product is directly consumed. The demand for cars, for example, may be estimated by determining the ratio of cars per 1,000 inhabitants or the coefficients of car-ownership among identified income levels, industrial units and government. Once the total requirements are known, the existing car population may be deducted to arrive at the new demand, while replacement requirements can be added to this projection.

A major factor determining the consumption level of products is the consumer income which, among other things, influences the family budget allocations that consumers are willing to make for the subject product. The income level is a major indicator of consumption levels of several products and with 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 varieties of food, cloth, paper, etc.

Income elasticity of demand

The extent to which demand changes in response to variations in incomes, is measured by the income elasticity of demand. The income elasticities differ not only between products but also between different income groups and different regions for the same product. 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 capita 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 in the following example:

Year	Per capita income	Increase in per capita income (as compared to base years)	Increase in demand for paper	Per capita demand for paper	Popu- lation	Demand for paper
	$	%	%	kg	million	000 t
Base Year						
1975	90.0	-	-	2.00	540	1,080
projection Years						
1976	91.8	2	4	2.08	557	1,158
1977	94.5	5	10	2.20	571	1,256
1978	94.5	5	10	2.20	585	1,280
1979	99.1	10	20	2.40	601	1,442
1980	104.4	16	32	2.64	616	1,636

*/ A centre for utmost caution, which is often ignored in many demand studies, is that the income elasticity of demand of products changes from income level to the other. Products, which are supposed commonly to have negative correlation with incomes, show positive correlation 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.

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

$$E_I = \frac{\operatorname{Log} Q_2 - \log Q_1}{\operatorname{Log} I_{P_2} - \log I_{P_1}} \quad \text{or:} \quad \frac{Q_2 - Q_1}{I_{P_1} - I_{P_2}} \cdot \frac{I_{P_1} + I_{P_2}}{Q_2 + Q_1}$$

where E_I 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_{P_1} is the per capita income in the base year, and

I_{P_2} is per capita income in the subsequent observation year.

If the data on per capita incomes and per capita demand for paper in 1975 and 1978 as given in the preceding table were available, the income elasticity of paper in the given country would be

$$E_I = \frac{\log (2.20) - \log (2.00)}{\log (94.5) - \log (90.0)} = 2.0$$

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 1980 is 15% higher than in the base year 1975, the per capita consumption of paper in 1980 would be 30% higer over the per capita consumption in 1975. The per capita consumption may then be applied to the consuming population to arrive at the absolute size of demand.

Price elasticity of demand

The determination of the price elasticity coefficient of demand for a particular product is a valuable adjunct of demand projections. The price elasticity of demand, the ratio of relative variations in the volume of demand to the relative variation in price may be expressed as a coefficient (E)

$$E_P = \frac{Q_1 - Q_0}{Q_1 + Q_0} : \frac{P_0 - P_1}{P_0 + P_1} = \frac{Q_1 - Q_0}{P_0 - P_1} \cdot \frac{P_0 + P_1}{Q_1 + Q_0}$$

where E_P is the price elasticity coefficient

Q_1 is the new demand at the new price,

Q_0 is the existing demand at the present price,

P_1 is the new price,

P_0 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.

Thus, if it is known that the price will decrease by 5% only, it can be predicted that the demand will increase by 5 X 1.22 or by 6.1%

It is often assumed that the price of the end-product of a proposed project shall remain constant. In real life, this is seldom true and it is necessary that the volume of demand estimated for future years is directly related to price changes in the product through application of the price elasticity coefficient. Such coefficient is a very useful tool for studying elasticity coefficient. Such coefficient is a very useful tool for studying sensitivities in the economics of a project by applying variable prices which might prevail in future. Price variations not only effect sales revenues directly, but have a significant impact on market size, and consequently on production levels, which in turn effect production costs. It, however, 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, but also by the price of complementary or substitute products and it is often necessary to identify the products the price variation of which may effect the demand of the product under consideration. This is determined by the cross elasticity. The cross elasticity of product A to product B is determined by the following formula:

$$C_{AB} = \frac{QA_2 - QA_1}{QA_2 + QA_1} : \frac{PB_2 - PB_1}{PB_2 - PB_1}$$

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 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 application.

		t	t_2	% Change
(X)	Price of petrol (per litre)	\$0.40	0.50	+ 25
	demand for cars (000)	200	160	- 20
(Y)	Price of electric shavers (average)	\$ 25	\$ 30	+ 20
	Demand for safety razors	6	9	+ 50
(Z)	Price of mil (per litre)	0.20	0.25	+ 25
	Quantity of cloth (million metres)	100	100	0

Now ${}^{C}AB$ in

$$\text{Case } X = \frac{-20}{220} \times \frac{225}{25} = 0.8$$

$$\text{Case } Y = \frac{50}{150} \times \frac{220}{20} = +3.3$$

$$\text{Case } Z = \frac{0}{200} \times \frac{225}{25} = 0$$

Since ${}^{C}AB$ is less than 0 in case x, it establishes that demand for cars is complementary or positively dependent on the price of gasoline. Since ${}^{C}AB$ is longer than 0 (in fact, as high as 3.3) in case Y, it establishes that safety razors are a sensitive substitute of electric shavers. Since ${}^{C}AB$ is 0 in the case of Z, there is no cross elasticity between mil 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 a complementary or substitute product.

3. <u>End-use or consumption coefficient method</u>

This method is particularly suitable for intermediate products. The demand is obtained by totalling the demand of all users of the product. This can be done by:

(a) identifying all possible uses of a product such as, for example, input of other industries, direct consumption demand, imports and exports; and thereafter

(b) obtaining or estimating the input-output coefficient with respect to the product in question and the industries using the product. It would then be possible to derive the demand for direct consumption of a product plus its exports and net of imports, from the projected output levels of the consuming industries. Thus, for forecasting the demand for methonal, for instance, the industries using methanol would initially be identified such as formaldehyde, fertilizers, pharmaceuticals and DMT and the planned manufacturing programmes for these four industries would define the future requirements of methanol, after allowing for proportionate demand from other users which could be clubbed together. A similar approach could be adopted for certain machinery products such as compressors or industrial turbines. This technique can also be used for consumer products and for mixed types of products. For example, the demand for cement can be assessed by estimating the requirements for various construction activities such as private and public housing, factories, dams, public works and other constructions.

The end-use method has to employ consumption coefficients and therefore, it may also be styled as the consumption coefficient method. The identified 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)

	Selected projection years					
	1975		1980		1985	
Type of vehicles	Vehicles (000)	Gasoline Consump 10^6 l	Vehicles (000)	Gasoline Consump 10^6 l	Vehicles (000)	Gasoline Consump 10^6 l
Private cars	110	352	150	480	210	672
Taxis	40	344	60	546	90	774
Commercial v.	80	996	110	1232	140	1568
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 ir determining past and in projecting future coefficients.

In case of intermediate products, coefficients may vary with the size of the consuming unit or with 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.

As a result of the divergences in consumption coefficients, a considerable amount of skill is required in projecting the coefficients and consequently the size of demand, although the data may enjoy a high degree of precision and dependability.

In summary, this forecasting technique can be utilized fairly effectively, provided adequate projections are available in respect of the consuming industries. This is not often available and can constitute a serious constraint to the use of this method. To the extent that such projections can be obtained from national plans, these can be utilized with advantage.

4. Regression models

In this technique, forecasts are made on the basis of estimated relationship between the forecast variable (dependent variable) and explanatory variables (independent variables). Once the independent variables are projected, the method can be applied, and different combinations can be tested till the appropriate forecast equation can be arrived at. The forecasting of the independent variables is, however, difficult and can prove erroneous in which case the forecast equation would not hold true for the future. This technique is rarely used in developing countries for demand forecasting in feasibility studies.

5. 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 that e.g. demand for electric fans lagged behind investments on housing by various agencies by about two years. The use of these indicators for forecasting purpose necessitates:

(a) identification of the appropriate leading indicators; and

(b) determination of the relationship between the leading indicator and the variable being forecast.

This method obviates the need for forecasting the explanatory variable, but it is not always possible to determine the leading indicator, and the lead time may not be stable while the relationship itself may change with time. The method is utilized only to a limited extent.

Annex 7

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.

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.

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) Scrutiny of collected data;

(viii) Organization of field work;

(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 fr 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 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.

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 statisticians'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 refrigerator, this is a matter 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.

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.*/ 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.

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*/ 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 6,600 owners selected on a rational but random sample basis, the sample.

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 500 (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.

A 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 suspicion 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 suspicion of the respondents.

Annex 8

Risk analysis

To calculate the impact of changes in unit sales price and variable production costs, fixed production costs i.cluding depreciation on the break-even point.

Sales revenue: 12,000; units produced: 2,000; fixed production costs: 3,280 of which depreciation: 780; variable production costs: 6,500 (all in 000$); break-even point: capacity utilization.

Formula (5): $\text{break-even point} = \frac{\text{Fixed production costs}}{\text{Sales revenue - variable production costs}}$

a) change in unit price: from $6.25 to $5.75 and later on to $5.50

$$BE_{p1} = \frac{3,280}{11,500 - 6,500} \cdot 100 = 65\%$$ (or 1,300 units =$7,475 sales)

$$BE_{p2} = \frac{3,280}{11,000 - 6,500} \cdot 100 = 73\%$$ (or 1,460 units =$8,030 sales)

Applying formula (1a) $p \cdot x = v \cdot x + f$ it is, of course, also possible to find out the selling price at which the project breaks even:

$$2,000 \cdot p = (\$3.25 \cdot 2,000) + 3,280$$
$$p = \$4.89$$

In other words, the project will face losses if a selling price of $4,89 cannot be reached. Comparing the break-even price with the calculated sales price at full capacity utilization, the envisaged project has a safety margin of

$$\frac{6.25 - 4.89}{6.25} \cdot 100 = 21.8\%$$

which can be used for price manipulations particularly during the initial market penetration period of the project. The safety margin in terms of output is of course determined by the rate of capacity utilization at the break-even point and the envisaged full capacity utilization (100% - BE). In the above example the margin = 100% - 65% = 35% for BE_{p1} and 100% - 73% = 23% for BE_{p2}.

b) changes in variable production costs: (i) increase by 10%, depreciation and fixed operating costs remain the same

$$BE_{v1} = \frac{3,280}{12,500 - (6,500 + 650)} \cdot 100 = 61\% \text{ (or 1,220 units = \$7,625 sales)}$$

(ii) decrease by 10%, depreciation and fixed operating costs remain the same

$$BE_{v2} = \frac{3,280}{12,500 - (6,500 - 650)} \cdot 100 = 49\% \text{ (or 980 units = \$6,125 sales)}$$

c) changes in fixed production costs: (i) increase by 10%, depreciation and variable operating costs remain the same

$$BE_{f1} = \frac{2,500 + 250 + 780}{12,500 - 6,500} \cdot 100 = 59\% \text{ (or 1,180 units = \$7,375 sales)}$$

(ii) decrease by 10%, depreciation and variable operating costs remain the same

$$BE_{f2} = \frac{2,500 - 250 + 780}{12,500 - 6,500} \cdot 100 = 50\% \text{ (or 1,000 units = 6,250 sales)}$$

d) changes in depreciation: depreciation charges are disregarded, other fixed and variable production costs remain the same

If the residing production costs cannot be recovered by the project, it has to close operations.

$$BE_{d} = \frac{2,500}{12,500 - 6,500} \cdot 100 = 42\% \text{ (or 820 units = \$5,125 sales)}$$

Minimum production is therefore 820 units or $5,125 sales. Considering the total output of 2,000 units, the project will have to recuperate at least $9,000 of production costs at a unit sales price of not less than $4.50 (according to formula 1a) in order to break even.

The break-even analysis is also a useful tool for financial planning. If funds for annual loan repayments have to be secured, an additional break-even point can be calculated taking account of such fixed repayments. If in the latter case, e.g. $600 of annual instalments are assumed, the new break-even point will be at 65% capacity utilization or 1,300 units = $8,125 sales.

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