UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

08219

Manual for the Preparation of Industrial Feasibility Studies

UNITED NATIONS

MANUAL FOR THE PREPARATION OF INDUSTRIAL FEASIBILITY STUDIES

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna

MANUAL FOR THE PREPARATION OF INDUSTRIAL FEASIBILITY STUDIES

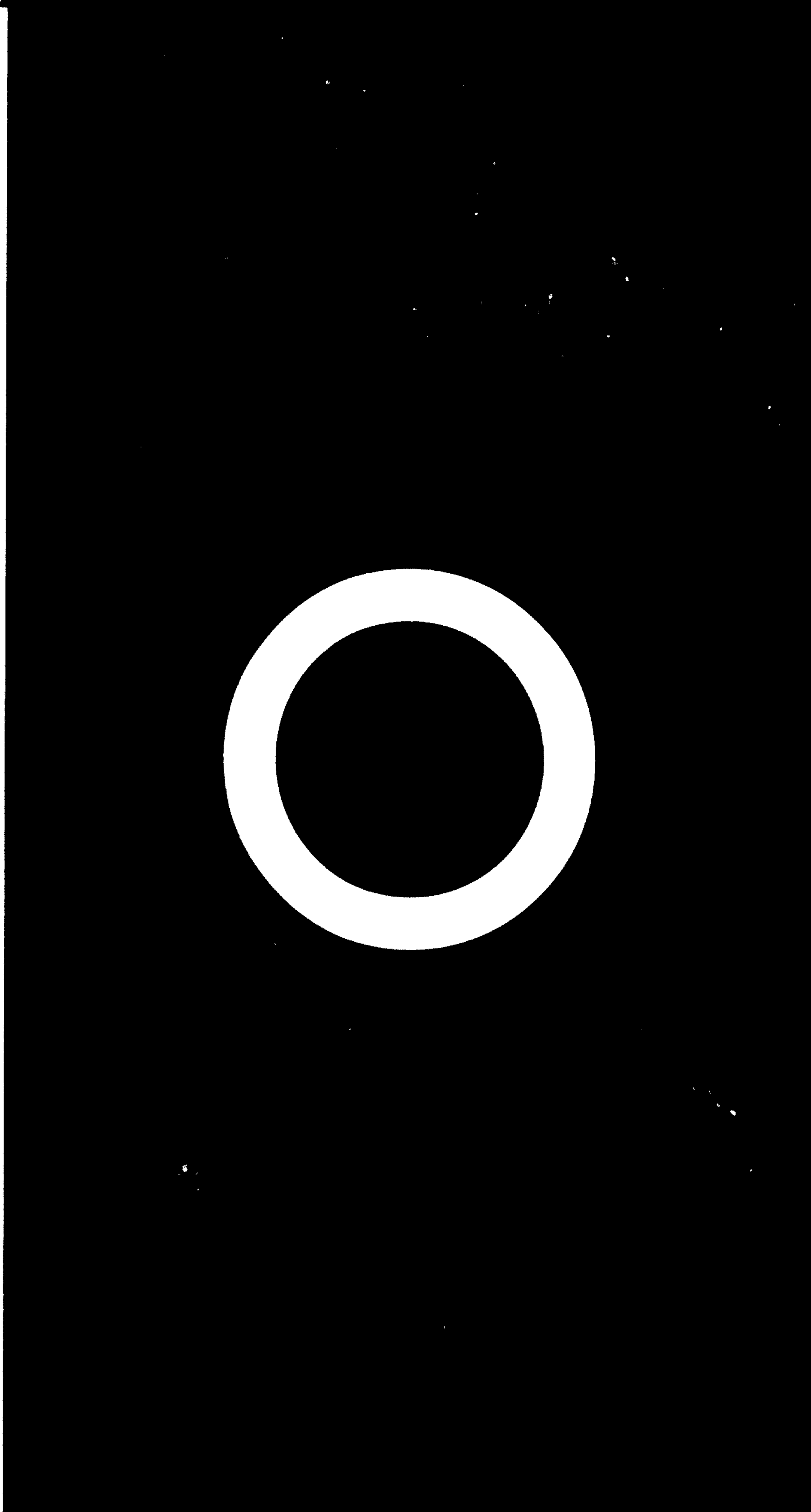
UNITED NATIONS
New York, 1978

ID/206

UNITED NATIONS PUBLICATION

Sales No.: E.78.II.B.5

Price: $U.S. 9.00 (or equivalent in other currencies)



Acknowledgement

This *Manual* was prepared by the International Centre for Industrial Studies of UNIDO. Valuable contributions related to the structure of the *Manual* and selected chapters (particularly chapter V) were made by Friedrich Giersig. R. S. Mohnot contributed to the early development of the *Manual* and the text of chapter III, and Rana K. D. N. Singh provided material, particularly on engineering aspects and choice of technology. Advice was also given by several colleagues and experts working in the field of industrial feasibility studies, for which great appreciation is expressed.

EXPLANATORY NOTES

References to dollars ($) are to United States dollars, unless otherwise stated.

A full stop (.) is used to indicate decimals.

A comma (,) is used to distinguish thousands and millions.

References to "tons" are to metric tons, unless otherwise specified.

The following economic abbreviations have been used in this publication:

c.i.f.	cost, insurance, freight
f.o.b.	free on board
ISIC	International Standard Industrial Classification

Foreword

As manifested in the Lima Declaration and Plan of Action, it is the express intention of the international community that the developing countries should attain by the year 2000 a 25 per cent share in world industrial production. Among many other considerations, this endeavour is in my view closely dependent on the developing countries' ability not only to negotiate successfully the new distribution of industrial capacities with Governments and industrialists of the developed world, but also, and at least equally important, to select investments commensurate with their development objectives and targets. It is, therefore, imperative that the developing countries continue their efforts to improve the development strategies and policies which constitute the framework within which investments take place. The selection of sound investment projects has to be undertaken in this context so as to ensure the optimum utilization of scarce human and capital resources towards meeting social objectives and economic growth.

With the publication of the Manual for the Preparation of Industrial Feasibility Studies *UNIDO is aiming at providing the developing countries with a tool to facilitate the preparation of projects that are technically, financially and economically sound. Through the* Manual, *a contribution is also being made towards the standardization of industrial feasibility studies which, as experience has shown, in the past have frequently been not only incomplete but also inadequately prepared.*

The Manual *should be used in conjunction with the* Guidelines for Project Evaluation. *Both publications constitute an approach to the difficult task of project preparation and evaluation; an approach that, it is hoped, will find acceptance with all concerned in the attainment of the Lima target.*

Dr. Abd-El Rahman Khane
Executive Director

CONTENTS

		Page
Introduction		1
Part one.	**Aspects and categories of pre-investment studies**	5
Part two.	**The feasibility study**	31
Chapter		
I.	Executive summary	31
II.	Project background and history	34
III.	Market and plant capacity	38
IV.	Materials and inputs	71
V.	Location and site	83
VI.	Project engineering	98
VII.	Plant organization and overhead costs	123
VIII.	Manpower	129
IX.	Implementation scheduling	141
X.	Financial and economic evaluation	151
Annexes		
I.	Outlines of general opportunity studies	220
II.	Outline of a pre-feasibility study	223
III.	Project opportunity study (A) and pre-feasibility study (B): A comparison of study components highlighting the increasing precision of data while proceeding from (A) to (B)	226
IV.	Types of decisions to be taken during different pre-investment stages	236
V.	The status of an existing industrial enterprise	237
VI.	Demand forecasting techniques	242
VII.	Market surveys	248
VIII.	Financial statements required by industrial development banks	251
Index		255
Figures		
I.	Project development cycle	6
II.	Information flow chart for the preparation of industrial feasibility studies	21

		Page
III.	Flow scheme of plant inputs and outputs	68
IV.	Origin of cost items for profitability calculation (return on equity)	173
V.	Graphical determination of break-even point	186

Schedules

No.		
2	Estimate of investment cost: pre-investment studies and preparatory investigations	36
3-1	Estimate of sales revenues	41
3-2	Estimate of production cost: sales and distribution costs	42
3-3	Production programme	43
3-4	Estimate of production cost: emissions disposal	44
4-1	Estimate of production cost: materials and inputs	73
4-2	Summary sheet production cost: materials and inputs	74
5-1	Estimate of investment cost: land	86
5-2	Estimate of production cost: land	87
6-1	Estimate of technology costs	101
6-2	Estimate of investment cost: equipment	102
6-3	Summary sheet investment cost: equipment	103
6-4	Estimate of investment cost: civil engineering works	104
6-5	Summary sheet investment cost: civil engineering works	105
6-6	Estimate of production cost: civil engineering works	106
6-7	Summary sheet production cost: civil engineering works	107
7	Overhead costs	124
8-1	Manning table labour	131
8-2	Estimate of production costs: wages	132
8-3	Manning table–staff	133
8-4	Estimate of production costs: salaries	134
9	Estimate of investment cost: project implementation	143
10-1/1	Initial fixed investment costs	190
10-1/2	Fixed investment costs	191
10-2/1	Preproduction capital expenditures, by category	192
10-2/2	Preproduction capital expenditure, by year	193
10-3/1	Calculation of working capital	194
	I. Minimum requirements of current assets and liabilities	194
	II. Annual production-cost estimate	194
10-3/2	Calculation of working capital: working capital requirements	195
10-4	Estimate of payments	196
10-5	Estimated monthly receipts and payments	196
10-6/1	Total initial investment costs	197
10-6/2	Total investment costs	198
10-7/1	Total initial assets	198
10-7/2	Total assets	200
10-8/1	Sources of finance	202
10-8/2	Sources of initial funds	204
10-8/3	Cash-flow table for financial planning	206

No.		Page
10-9	Net income statement	208
10-10	Projected balance sheet	209
10-11	Total production costs	210
10-12	Production-cost schedule	212
10-13	Cash-flow table and calculation of present value for a project without outside financing	214
10-14	Cash-flow table and calculation of present value for a project with outside financing	216
FP-1	Net income statement	251
FP-2	Cash-flow table for financial planning	252
FP-3	Projected balance sheet	254

INTRODUCTION

Developing countries aim to increase their industrial output over the next decades and new industrial investments can be expected on a massive scale. In consequence, the number and size of industrial pre-investment studies are increasing. Industries will become more complex not only because of the sophistication of final products but also because of the technological alternatives of production.

The quality of pre-investment studies has not kept pace with the more elaborate demands made on them. The standard and depth of studies are often not of a sufficiently high level to ensure rational decision making at the successive stages of the pre-investment process. This deficiency has resulted in misallocation of resources, long gestation periods, investment cost over-runs, high rates of industrial mortality or lopsided growth.

Because developing countries vary considerably as to their stage of industrial growth, a wide variety of private and public-sector groups have a need for pre-investment studies.

In countries relying on industrial development planning, pre-investment studies are not only a tool for investment decisions and project implementation but also assist in the identification and selection of projects in other sectors of the economy. The broad indicators regarding sectoral requirements that emerge from the planning process form a base on which pre-investment studies can be undertaken for specific projects. In such countries fairly definitive sectoral requirements can be derived from the broad development plan, with priorities suggested by a country's overall objectives. These in turn are disaggregated into specific investment propositions, which are then studied in depth through pre-investment studies and evaluated in terms of defined priorities.

In countries that do not place great emphasis on public-sector planning, the initiative for industrial promotion and development is left largely to the private sector. State institutions and agencies concentrate on initiating such activities in selected branches, such as those of petroleum and primary petrochemicals, and capital goods. Pre-investment activities, including market surveys and other studies, are mainly undertaken by the entrepreneurial and corporate sector within the government policy framework, which influences prices and material inputs and outputs, wages and foreign exchange availability.

Experience shows that a well-formulated industrial development plan is not necessarily a prerequisite for industrial project identification; the market mechanism can also bring about satisfactory industrial growth rates.

However, a general scheme of planning and the establishment of well-defined industrial priorities is undoubtedly valuable for channelling resources in directions that promote the growth desired. Irrespective of whether a detailed planning mechanism is resorted to or not, pre-investment studies remain a basic prerequisite for investment decisions.

In developing countries with poor or inadequate planning the need for such studies is even greater. In such countries, the interrelationships between various inputs and production aspects need to be more specifically defined than in those where the planning mechanism itself provides adequate information.

The experience gained by developing countries in the preparation of pre-investment studies has been mixed. Such studies were frequently motivated by equipment sales or were a part of a turnkey project and the specific problems and difficulties that were likely to be encountered in the project were not sufficiently stressed. In other cases, such studies were largely based on earlier experience with similar projects in developed countries, and then proved inadequate in the prevailing conditions. The costs of some studies have tended to be disproportionately high compared with the investment for the projects. There has been continuing dependence on foreign consultants in some developing countries and national consultancy services have developed only to a limited extent: this has left gaps in knowledge and experience of the prevailing conditions.

Despite the increase in industrial activities and projects, the components of pre-investment studies tend to be conceptually similar: although the determination of viability of a cement plant would be substantially different to that of a plant to produce diesel engines, or a unit designed to produce simple consumer goods, the categories of pre-investment information would be similar in all cases. A single format and set of procedures could probably be applied to a wide spectrum of industrial projects.

Since project planning is an interdisciplinary task requiring a team of engineers, economists, social scientists, businessmen and governmental administrators, this *Manual* is aimed at readers with different educational backgrounds and professional experiences from both developing and developed countries. The *Manual* is practical in approach; it aims to put the various feasibility studies into a similar framework with a view to making them more comparable than in the past. Industrial development centres, investment promotion centres, industrial development banks and public and private consulting firms in developing countries should benefit especially from the *Manual*. The numerous individual experts assigned to project planning authorities in developing countries should also be able to take advantage of it.

The *Manual* has three parts: the first one concerns the different types of pre-investment study that can be applied to the industrial sector as a whole, and shows the information required at the various stages of decision making in the project selection process. The implications of undertaking one of the different types of pre-investment study can thus be determined fairly clearly against the need in each case. The second part constitutes the core of the *Manual* and its outline corresponds to the framework 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 basis of a 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. Together 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. The concluding chapters are on implementation scheduling, financial analysis and issues related to economic evaluation. A bibliography is provided for each chapter, as is an index of main topics covered.

To ensure clarity, each chapter in the second part of the *Manual* is presented in three parts: brief introductory remarks, a data and information section, and detailed explanatory notes.[1]

The data and information section, which constitutes the backbone of the feasibility study, is emphasized in the *Manual* by a grey line, such as the one printed at the margin of this page. If all the marked parts are arranged according to the table of contents given in part one the reader can assemble the complete feasibility study. When preparing the data and information section, the user of the *Manual* should proceed as follows:

(a) Describe briefly the data of the chapter; show the data processing required to arrive at possible alternative solutions, as appropriate; explain the formulae used and justify their application;

(b) Select the best alternative for further consideration in the study and describe it in detail; state the method of, and reasons for, its selection;

(c) Estimate, as far as necessary, the investment and annual production costs for the duration of the project at full feasible normal capacity.

The notes given in each chapter are intended to acquaint the reader with the conceptual problems to be faced in completing the study. These notes have as much detail as is possible in a manual dealing with the many multidisciplinary problems of a feasibility study. The bibliographies point the way to further study of individual issues raised in the *Manual*.

This format allows a stage-by-stage analysis of the various study components, with the sets of figures generated for each component gradually converging to the most important totals. This method also allows any single component of the entire study to be dealt with separately, within the overall logic of the study. The format was designed in this way because the true evaluation of an investment proposal can only be done correctly if data are collected properly during the preparatory stage.

Although the *Manual* is chiefly concerned with project preparation, the need for the wider application of cash-flow analysis in project evaluation prompted the addition of a presentation of the discounting and simple evaluation methods applied in financial evaluation. 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 an accounting of all the major inflows and outflows of funds needed for financial evaluation and planning.

The concept used for the *Manual* can be developed further, for example in the design of computer programs for project preparation, and particularly to facilitate the assessment of the numerous project alternatives. Rather than attempt to break any new academic ground, all that is intended 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. Finally, the *Manual* should be considered an attempt to reconciliate financial and economic viewpoints in project evaluation.

For a number of reasons the *Manual* is not addressed to problems related to industrial-sector planning and economic evaluation. First, both subjects would

[1] This does not apply to chapter I and chapter II.

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 focused 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.

An important reason why industrial sector planning and economic evaluation are not part of this *Manual* is that the UNIDO *Guidelines for Project Evaluation*, the *Guide to Practical Project Appraisal* and the *Manual on the Evaluation of Industrial Projects in Arab Countries* covered both at great length, and paid particular attention to the interaction of macro-economic planning and socio-economic project choice. Only in the final chapter is the value of subjecting any major profitable investment proposals to economic evaluation emphasized in order to promote an awareness of the significance of economic evaluation among private and public investors.

The *Manual* is the latest in a series of publications dealing with project preparation and evaluation. However, as yet, project preparation has only been treated in an informal UNIDO document and to a limited extent in the *Profiles of Manufacturing Establishments* (four volumes), and the *Extracts of Industrial Feasibility Studies*. Both the *Extracts* and the *Profiles* were conceived mainly as a collection of reference data covering 24 feasibility studies and over 500 industrial establishments in developing countries. The present *Manual* thus bridges and complements the *Extracts* and the *Profiles*, and the publications on project evaluation.

PART ONE

Aspects and categories of pre-investment studies

The project development cycle (figure I) comprises the pre-investment, the investment and the operational phases. Each of these three major phases is divisible into stages, some of which constitute important industrial activities. The major objective of this *Manual* is to give a better understanding of the problems encountered in carrying out the various tasks under the pre-investment phase of industrial projects.

Several parallel activities take place within this phase and even overlap 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 leaving, however, the main thrust to the final evaluation stage and the investment phase.

Before dealing with the pre-investment phase, the various stages of the investment and operational phases are considered briefly together with promotional activities as these have a bearing on the nature and scope of pre-investment studies. No single pattern can be defined as industrial activities take innumerable forms ranging from a small-scale unit producing a particular product or component to a large multi-product complex.

Investment (implementation) phase

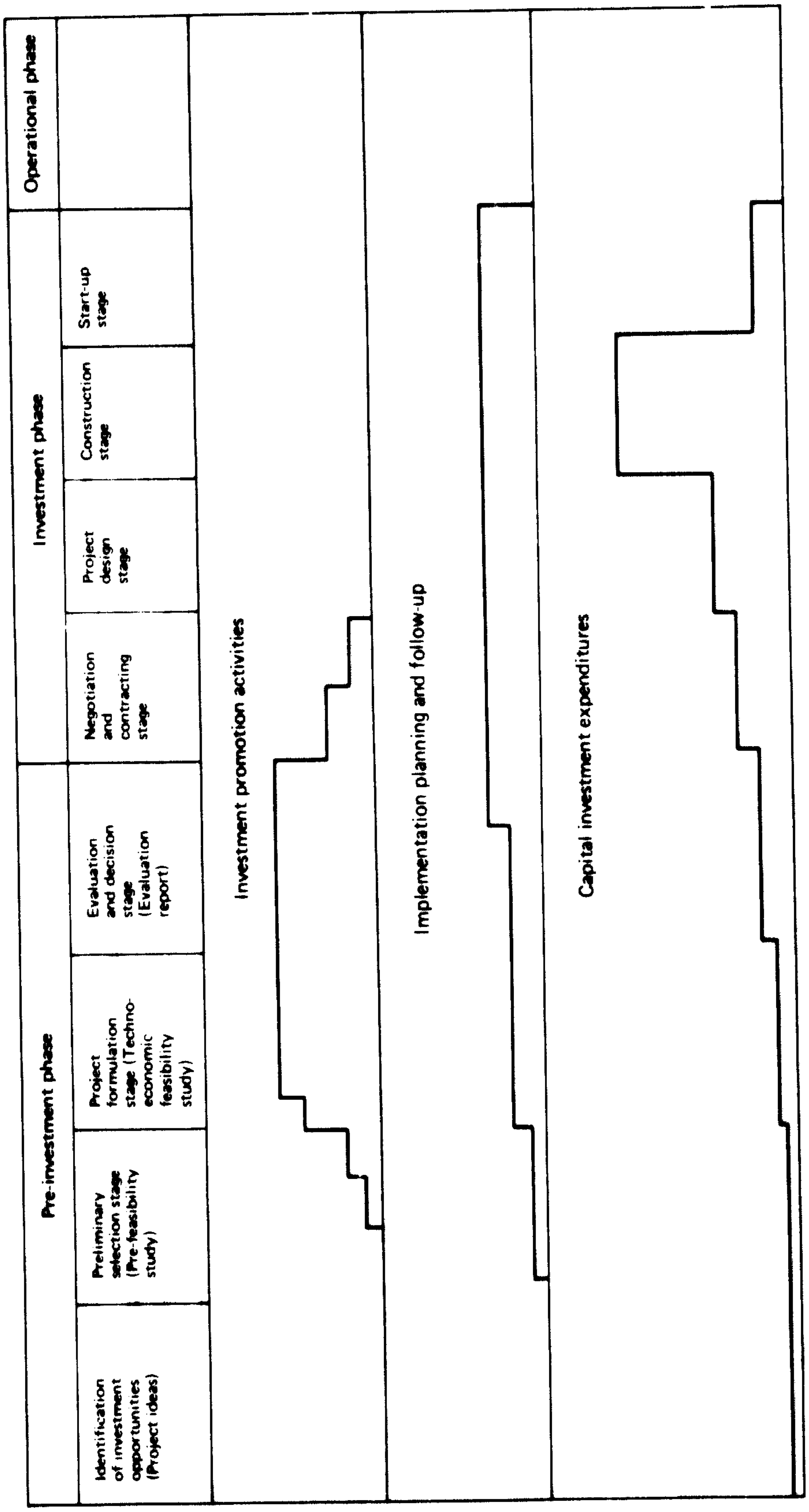
The project investment or implementation phase for a large steel plant bears little relation to the setting-up of a small-scale unit for the production of castings or precision parts and components. Assuming, however, that a projected industrial activity involves the construction of a factory and the installation of machinery and equipment, the project investment phase could be divided into the following broad stages: *(a)* project and engineering designs; *(b)* negotiations and contracting; *(c) construction; (d)* training; and *(e)* plant commissioning.[2]

The preparation of project and engineering designs includes time-scheduling, site prospecting and probing, preparation of blueprints and plant designs, detailed plant engineering and a final selection of technology and equipment.

Negotiations and contracting define the legal obligations in respect to project financing, acquisition of technology, construction of buildings and services, and

[2] Most of these topics have been covered in UNIDO publications (see bibliography).

Figure I. Project development cycle



supply of machinery and equipment for 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, and collaborators and suppliers of input materials and utilities on the other. This stage involves a host of procedures that often present serious problems for developing countries. Negotiations and contracting take place at all stages of the investment phase with the exception of turnkey contracting, a less troublesome but more expensive way of implementing projects. Pre-investment studies provide the base for the activities of the investment phase. The decisions at the investment phase, however, do not necessarily follow the recommendations of the pre-investment studies. Direct negotiations and contracting reveal the need for modifications and provide new ideas for project improvement that often lead to unforeseen increases in investment costs.

The construction stage involves site preparation, construction of buildings and other civil works together with the erection . nd installation of equipment ir accordance with proper programming and scheduling.

The training stage, which should proceed simultaneously with the construction stage, may prove very relevant to the rapid growth of productivity and efficiency in plant operations.

The plant commissioning or start-up (delivery stage) is normally a brief but technically critical span in project development. It links the preceding phase and the following operational phase. The success achieved at this point demonstrates the effectiveness of the planning and execution of the project and is a portent of the future performance of the programme.

The investment phase involves heavy financial commitments and major modifications of the project have serious financial implications. Bad scheduling, delays in construction and delivery, start-up etc. inevitably result in an increase of investment costs and affect the viability of the project. In the pre-investment phase, the quality and dependability of the project are more important than the time factor but in the investment phase, the time factor is critical.

Operational phase

The problems of the operational phase need to be considered from both a short- and a long-term viewpoint. The short-term view relates to the initial period after commencement of production when a number of problems may arise concerning such matters as the application of production techniques, operation of equipment or inadequate labour productivity as well as the lack of qualified staff and labour. Most of these problems should, however, be considered in relation to the implementation phase and necessary corrective measures should pertain principally to project implementation. The long-term view relates to production costs, on the one hand, and income from sales, on the other, and these have a direct relationship with the projections made at the pre-investment phase. If such projections prove faulty, the techno-economic feasibility of an industrial activity will inevitably be jeopardized and if such shortcomings are identified only at the operational phase, remedial measures will not only be difficult but may prove highly expensive.

The above outline of the investment and the operational phases of an industrial project is undoubtedly an over-simplification for many projects and, in fact, certain other aspects may be revealed that have even greater short- or long-term impact. The wide range of issues that needs to be covered during these phases highlights the complexities of the pre-investment phase which constitutes the base for the subsequent phases. The adequacy of pre-investment study and analysis largely determines the ultimate success or failure of an industrial activity provided there are no serious deficiencies at the implementation and the operational phases. If the pre-investment study is ill-based, the techno-economic rectification of the project will be very difficult however well it may have been executed and operated.

Promotional activities

Project promotion starts with the decision to identify potential sources of finance, marketing and other 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 as soon as possible once the opportunity study or, even better, the pre-feasibility study has demonstrated preliminary project viability (figure I). This initial evaluation of the technical, financial and economic aspects of a project is carried out in broad terms and on its outcome depend decisions to go ahead with promotional activity and a full feasibility study.

In industrial financing and investment promotional activity there is a lack of integration with the other equally vital elements of the project cycle, in particular with the project identification and project formulation stage (figure I). This lack has caused a number of feasibility studies showing positive results either to remain unimplemented or, if implemented, to become not viable. 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 that arises, however, is that third parties who are vital in providing finance very often insist 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 feasibility study. The net effect of these demands is a waste of resources involved in the initial feasibility study; these difficulties may be compounded if, in the repeat study, there is not a preliminary agreement among the parties involved in any subsequent jointly financed/managed project. One of the functions of efficient promotion is to facilitate such initial agreement.

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 is 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 to be financed by the Government or by development agencies.

Pre-investment phase

The pre-investment phase comprises several stages: identification of investment opportunities (opportunity studies); preliminary project selection and definition (pre-feasibility studies); project formulation (feasibility studies); the final evaluation and investment decision. Support or functional studies are a part of the project formulation stage. These are usually done separately, one common reason being that the agency carrying out the feasibility study may not have the qualified manpower or expertise to conduct studies in the areas concerned. These stages assist a potential investor in the decision-making process and provide the base for project decision and implementation.

To differentiate between an opportunity, a pre-feasibility and a feasibility study is not an easy task in view of the frequent, inaccurate use of these terms. In this *Manual* therefore definitions are made general enough to be widely accepted and applied in developing countries.

Opportunity studies

Unlike the situation in developed countries, the identification of industrial opportunities that can be developed into investment projects is a major constraint in a number of developing countries, especially those in the earlier stage of industrial growth. With increasing industrialization, more and more of such identification is being undertaken by the business sector, both public and private, but there is still a need for governmental and institutional agencies to identify the opportunities that may exist at different stages of development.

In countries that practise industrial planning, the task of initial project identification is easier as the planning mechanism provides fairly detailed economic indicators together with sectoral priorities based on well-defined criteria. Selectivity in defining investment opportunities can then be exercised and industrial investments sought and channelled into sectors having priority or into probable production gaps. 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 business sector is not strong, mere publication of such a list, however, may not prove sufficient and more specific data may be required before adequate business interest can be evoked.

An opportunity study should identify investment opportunities or project ideas, which will be subject to further scrutiny once the proposition has been proved viable, by analysing the following:

(a) Natural resources with potential for processing and manufacture such as timber for wood-based industries;

(b) The existing agricultural pattern that serves as a basis for agro-based industries;

(c) The future demand for certain consumer goods that have growth potential as a result of increased population or purchasing power or for newly-developed goods such as synthetic fabrics or domestic electrical products;

(d) Imports in order to identify areas for import substitution;

(e) Manufacturing sectors successful in other countries with similar levels of development, capital, labour, natural resources and economic background;

(f) Possible interlinkage with other industries, indigenous or international;

(g) Possible extension of existing lines of manufacture by backward or forward integration such as a downstream petrochemical industry for a refinery or an electric arc steel plant for a steel rolling mill;

(h) Possibilities for diversification such as a pharmaceutical industry for a petrochemical complex;

(i) The possible expansion of existing industrial capacity to attain economies of scale;

(j) The general investment climate;

(k) Industrial policies;

(l) Cost and availability of production factors;

(m) Export possibilities.

Opportunity studies are rather sketchy in nature and rely more on aggregate estimates than on detailed analysis. Cost data are usually taken from comparable existing projects and not from quotations of equipment suppliers and the like. Depending on the prevailing conditions under investigation, either general opportunity or specific project opportunity studies, or both, have to be undertaken.

General opportunity studies. Such studies (annex I) have been implemented in a number of developing countries through state and institutional agencies with the objective of pin-pointing specific investment proposals. There are three types of study:

(a) *Area studies* which seek to identify opportunities in a given area such as an administrative province, a backward region or the hinterland of a port;

(b) *Subsectoral studies* which seek to identify opportunities in a delimited subsector such as building materials or food processing;

(c) *Resource-based studies* which seek to reveal opportunities based on the utilization of a natural, agricultural or industrial produce such as forest-based industries, downstream petrochemical industries and metalworking industries.

Specific project opportunity studies. These should follow the initial identification of general investment opportunities in the form of products with potential for domestic manufacture, and an investment profile should be circulated to potential investors. While, in some developing countries, a governmental agency is doing this work, in fact, it is most often the prospective investor or entrepreneurial group who undertakes this task.

A specific project opportunity study, which is more common than a general opportunity study, may be defined as the transformation of a project idea into a broad investment proposition. Since the objective is to stimulate investor response, a specific project opportunity study must include certain basic information; the mere listing of products that may have potential for domestic manufacture is not sufficient. While such a list - derived from general economic indicators such as past imports, growing consumer demand or from one of the general opportunity studies relating to areas, sectors or resources - can serve as a starting point, it is necessary, first, to be selective as to the products so identified, and secondly, to incorporate data relating to each product so that a potential investor, either domestic or foreign, can consider whether the possibilities are attractive enough to proceed to the next stage of project preparation. Such data can be supplemented with information on basic policies and procedures that may be relevant to the production of the particular product. A broad investment profile would then emerge that would be adequate for the purpose of stimulating investor response.

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

Pre-feasibility studies

The project idea must be elaborated in a more detailed study. However, formulation of a techno-economic feasibility study that enables a definite decision to be made on the project is a costly and time-consuming task. Therefore, before assigning funds for such a study, a preliminary assessment of the project idea must be made in a pre-feasibility study (annex II), the principal objectives of which are to determine whether:

(a) 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;

(b) The project concept justifies a detailed analysis by a feasibility study;

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

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

A pre-feasibility study should be viewed as an intermediate stage between a project opportunity study and a detailed feasibility study, the difference being primarily the detail of the information obtained (annex III). Accordingly, it is necessary even at the pre-feasibility stage to examine, perhaps broadly, the economic alternatives of:

(a) Market and plant capacity: demand and market study, sales and marketing, production programme, and plant capacity;

(b) Material inputs;

(c) Location and site;

(d) Project engineering: technologies and equipment, and civil engineering works;

(e) Overheads: factory, administrative and sales;

(f) Manpower: labour and staff;

(g) Project implementation;

(h) Financial analysis: investment costs, project financing, production costs, and commercial profitability.

The structure of a pre-feasibility study (annex II) should be the same as that of a detailed feasibility study.

When a project opportunity study is conducted in respect of an investment possibility, the pre-feasibility stage of the project is often dispensable. The pre-feasibility stage is also occasionally by-passed when a sector or resource opportunity study contains sufficient project data to either proceed to the feasibility stage or determine its discontinuance. A pre-feasibility study is, however, conducted if the economics of the project are doubtful unless a certain aspect of the study has been investigated in depth by a detailed market study, or some other functional study, to determine the viability. Short-cuts may be used to determine minor components of investment outlay and production costs but not to determine major cost components. The latter 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.

Example. To determine working capital, for example, one short-cut would be to assume operational cash outflows (for raw materials, manpower, utilities, overhead costs, sales promotion and packaging costs, maintenance and repairs, and spare parts inventory) for a certain period. This period should correspond to the operational cycle in which working capital recirculates. It is customary to use a two- to four-month period for this purpose. In other words, if the total annual cash outflows amount to $12 million, the working capital requirements may be placed at $3 million. Similarly, the cost of overseas shipping, insurance, clearing and handling, and inland transportation may be estimated by applying a percentage figure (say, 8 per cent: overseas shipping 5 per cent, insurance 0.75 per cent, clearing and handling 1 per cent and inland transportation 1.25 per cent) of the f.o.b. value. The cost of installation of plant and equipment may also 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 2 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 two years, involving term loan financing of the order of $5 million and attracting 8 per cent interest, the rule of thumb would yield an interest charge of $0.4 million, i.e. 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 from area to area. Prudence is needed when applying them.

Support (functional) studies

Support (functional) studies in industrial programming cover one or more but not all aspects of an investment project and are required as prerequisites for, or in support of, pre-feasibility and feasibility studies, particularly large-scale investment proposals. They are classified as follows:

(a) Market studies 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, which are carried out to the extent necessary to determine the suitability of particular raw materials;

(d) Location studies, particularly for potential projects where transport costs would constitute a major determinant;

(e) Economies of scale studies, which 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 extend to the intricacies of technology. The principal task of these studies is to evaluate the size of plant that would be most economic after considering alternative technologies, investment costs, production costs and prices. The studies normally take several capacities of plant for analysis and develop the broad characteristics of the project, computing results for each capacity size;

(f) Equipment selection studies, which are required when large plants with numerous divisions are involved and the sources of supplies and the costs are widely divergent. Equipment indenting, including preparation of bids, invitations for bids, their evaluation, indenting and deliveries, is normally carried out during the investment or implementation phase. When 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 operational efficiency of the project is a direct function of the selected equipment. In such cases, where standardized costs cannot be obtained, equipment selection studies become imperative as a support to techno-economic feasibility studies.

The contents of the support study vary, depending on the nature of the study and the projects contemplated. Since, however, it relates to a vital aspect of the project, the conclusions should be clear enough to give a direction to the subsequent stage of project preparation.

In most cases, the abridged contents of a support pre-investment study, when undertaken either before or together with a feasibility study, form an integral part of the latter and lessen its burden.

Support studies are carried out before commissioning a pre-feasibility or a feasibility study when, for example, a basic input may be a decisive factor in determining the viability of a project and the support study may show negative results. Support studies are commissioned separately but simultaneously with a pre-feasibility or a feasibility study when detailed work required for a specific function is too involved to be undertaken as part of the feasibility study. A support study is undertaken after 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.

The cost of a support study must relate to that of the feasibility study as one purpose of such studies is to economize during the feasibility stage. If it is assumed, for example, that a pre-feasibility study is completed at a cost of $20,000 for a projected plant for the production of electric motors and that the likely cost of a detailed feasibility study for this project would be $100,000, it would make little sense also to commission a market study for approximately $100,000. In such a case, it would 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 make the support study, and proceed to the feasibility study only if the market study is positive. It is necessary to emphasize the cost of such supplementary studies as a number of them have been undertaken in developing countries at a high cost, only to be followed by feasibility studies at an even higher cost.

Feasibility study

A feasibility study must provide a base technical, economic and commercial for an investment decision on an industrial project. It should define and analyse the critical elements that relate to the production of a given product together with alternative approaches to such production. Such a study should provide 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.

To reach this objective, an iterative process has to be launched with a cycle of feedbacks and interlinkages covering possible alternative solutions for production programmes, locations, sites, technology, plant, mechanical, electrical and civil engineering and organizational set-up that have to be harmonized in order to minimize investment and production costs. If the resulting data show a non-viable project, several parameters and the production programme, material inputs or technology should be adjusted in an attempt to present a well-defined, viable project. 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 integration of the selected partial alternatives. If, however, the project is not viable despite all alternatives reviewed, this should be stated and justified in the study.

Final estimates on investment and production costs and the subsequent calculations of financial and economic profitability are only meaningful if the scope of the project is defined unequivocally in order not to omit any essential part and its pertaining cost. The scope should be defined in drawings and schedules which should then serve as a supporting structure during further project work.

Most feasibility studies have the same or similar coverage, though there may be considerable differences in orientation and emphasis depending on such factors as the nature of the industry, the magnitude and complexity of the production unit contemplated, and the investment and other costs involved. By and large, however, a satisfactory feasibility study must analyse all the basic components and implications of an industrial project and any shortfall in this regard will limit the utility of the study.

The term feasibility study is often misunderstood and often deliberately misused by suppliers of equipment or technology. Frequently, an outline of a project primarily oriented to the supply of equipment or the choice of particular techniques is called a feasibility study. Sometimes, production or sales estimates are based on experience gained in an industrialized country and bear little relation to the conditions within which a project has to operate in a developing country. As these studies are unrelated or unadapted to local production factors, they can be misleading and can result in the misapplication of resources, as has often occurred in developing countries. A feasibility study must be related to available production factors, local market and production conditions and this involves an analysis which has to be translated into costs and income.

A feasibility study may be either market-oriented or based on material inputs, i.e. it derives its initiative from an assumed or existing demand or from available material inputs such as raw materials or energy. In either case, the sequence of chapters in the preceding table of contents can be maintained. In view of the determinant position of the demand and market analysis within the feasibility study, it is ranked before material inputs. It should be kept in mind, however, that all chapters of the feasibility study are interrelated and that their ranking within the study is not indicative of the actual sequence of their preparation.

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

Example. A feasibility study for the production of transformers identifies a large potential domestic market that can be served by an initial capital investment of approximately $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 viewpoint, this would result in inadequate market coverage, a lower level of domestic integration and possible continuance of imports to cover the balance of demand. From a commercial viewpoint, however, such an investment decision may make good sense in that the overall financial outlay would be reduced. Because the size of the market would be much larger than the production contemplated, it could be possible to obtain higher prices and higher profitability. 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 envisaged 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 plant size lends itself more to scale economies. Also there may exist divergences between the conclusions of the feasibility study and the investment decision, which may mean substantial revision of the feasibility study. Such revision can be minimized to some extent, if the feasibility study can test the "sensitivity" of various factors, including the volume of capital investment.

Investment decisions have to be taken during various pre-investment stages (annex IV) and the implications of a particular investment must be analysed with great care prior to such decisions being taken.

Because of the enormous range of industrial activities, no uniform approach or pattern can be adopted for all types of industrial projects which can be of various categories and magnitudes and the emphasis on, and consideration of, different components vary from project to project. However, for most industrial projects a broad format (see Contents at the end of part one) can be prescribed bearing in mind that the larger the project the more complex will be the information required—within which a feasibility study should be prepared.

Scope of the project

The scope of the project must be clearly understood in order to accurately forecast investment and production costs. As industrial projects frequently extend beyond the boundaries of the production plant site, it is necessary to define the project widely in accordance with these extensions and to include 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; the auxiliary operations related to the production, extraction, off-site transport and storage of inputs and the off-site transport and storage of outputs (e.g. final products, by-products, wastes and emissions); and such off-site ancillary activities as housing schemes and educational, training and recreational facilities.

The main reason for this arrangement is to force the project planner to look at the material and product flow not only during the processing stage but also during the preceding and succeeding stages. In addition, it can be decided whether storage and off-site transport of inputs and outputs and the corresponding investments are to be provided by the project or by such third parties as the supplier of inputs or the distributors of the final product.

To better understand the structure of the project and to facilitate the calculation of investment and production costs, the project planner should next divide the entire project into functional, easily calculable components such as production sheds, storage buildings, administrative buildings and such auxiliary facilities as networks for water, gas and electricity, a sewage system, telephones, internal connecting roads etc. Even major equipment (e.g. a rotary kiln for a cement factory or a large vertical-turret boring machine for a heavy engineering firm) may be considered as components.

To facilitate the calculation of equipment and production costs, it may often be necessary to subdivide such components since they may cover several departments (cost centres). This subdivision should be based on the physical layout of the project which shows the dimensions of its components. The computation of project costs can be further facilitated by treating the components as "sub-projects", the sum of which will yield the investment and production costs of the entire project.

The procurement of data for a feasibility study

Although investment and production costs should be estimated as accurately as possible, the costs and time involved in obtaining data are not always justified and it may therefore sometimes be necessary for the project team to rely on assumptions. When this is the case, it should be so stated in the study.

Investment cost estimates, which may be ranked according to their accuracy and the costs and time required to obtain them, are made by:

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

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

(c) Using the unit cost parameters derived from comparable operational projects, e.g. measured in cost per cubic metre of enclosed space or cost per square metre of built-up area;

(d) Estimating the totals for groups of equipment or functional project parts based on the costs of comparable, existing projects. The degree of accuracy decreases, and the chance of omitting essential project parts increases, with the increase of coverage of the lump sums.

Investment cost estimates based on cost parameters and on lump sums should be adjusted taking into account, among other things:

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)
Accessibility of the construction site.

The accuracy of production cost estimates depends on the availability of data on such input requirements as 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 the case of imports, through tenders from suppliers abroad. The prevailing labour legislation, the local labour productivity etc. have to be accounted for in the case of labour inputs. When estimating input requirements use should be made of the following:

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

One important data source for feasibility studies is reference data published by industrial associations, equipment manufacturers, development banks and international organizations. They have to be applied carefully, taking into account their date of collection, plant size and possible economies of scale, country of origin and applied technical and economic conversion factors.

Frequently, data on location, site, locational conditions and civil engineering are collected in the field and it is recommended that the sources or groups of related data be identified in order to verify or complete them. The date of collection, the person or team in charge of the collection and/or samples and the method used should be obtained. If laboratory tests or pilot plant processing were required, they should be described briefly and the results communicated.

Verification of alternatives and assumptions

The preparation of a feasibility study is often made difficult by the number of available alternatives (regarding the choice of technology, equipment, capacity, location, financing etc.) and assumptions on which the decision-making process has to be based.

If there are alternatives, the ones for solving a current problem should be outlined, one selected and the methods and formulae used for the selection should be given. Similarly, assumptions should be justified by stating what they are and why they had to be made.

Proposed cost structure

Definition of terms

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 product or service.

Incomes are an inflow of cash and they originate from the sales of products or services within a given period. The terms incomes and expenditures correspond with one another.

Revenues, on the other hand, correspond with costs and originate from the sales of a product or service irrespective of the period of the actual cash inflow.

A distinction has to be made between investment and production expenditures if the financial outflow is to be considered, and investment and production costs if the total costs of the investment and the total costs required to produce a specified amount of goods are to be calculated.

The difference between the terms "costs" and "expenditures" and "revenues" and "incomes" becomes clearer if the expenditures and the utilization of values (e.g. costs of raw material) for a product within a specified period (e.g. one year) are compared. With regard to raw materials the difference lies between the purchase and processing that occur at different times or that overlap; 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 accordance with the 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 to cash-flow analysis and related discounting methods (internal rate of return) with the reservation 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 of the investment.

The term "costs" should only be used in the context of unit costs or total costs.

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 difference between annual expenditures and incomes is on average the same as between annual costs and revenues. As it is too difficult to apportion expenditures and incomes exactly to the period in which they occur, calculations of internal rates of return are frequently based on average annual revenues and costs (minus depreciation).

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 "Scope of project". Only investment costs for technology, equipment and civil works should be computed by project components and department or section (= cost centres).

Investment cost items are dealt with in various chapters, as follows:

Total investment:	*Chapter*
Fixed investment	V and VI
Land and site preparation	V and VI
Technology	VI
Equipment	VI
Production	
Auxiliary	
Service	
Spare parts, wear and tear parts, tools	
Civil works	VI
Site preparation and development	
Buildings	
Outdoor works	
Pre-production capital expenditures	II and X
Preliminary and capital issue	
Pre-production	
Trial runs, start-up and commissioning	
Working capital	X
Evolution of investment expenditures (cash flow)	X

Total production or manufacturing costs

Production cost estimates should be based on the requirements of the feasible normal capacity that is achievable under normal working conditions taking into account 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 as well as the management system. The feasible normal capacity is the number of units produced during one year under the above conditions that are available for sale. The figures should correspond to those derived from the market study.

Conversely, 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 wear and tear parts would be necessary which would inflate the normal level of production costs.

Production costs items are dealt with in various chapters, as follows:

Total production:	*Chapter*
Factory costs	
Material inputs (variable)	IV
Manpower (mostly variable)	VIII
Factory overheads (fixed)	VII
Administrative overheads (fixed)	VII
Sales and distribution costs (variable)	III
Operating costs (factory costs plus administrative overheads plus sales and distribution costs)	X
Financial costs (fixed)	X
Depreciation (fixed)	VII
Total production and manufacturing costs (operating costs plus financial costs and depreciation)	X

Schedules

Each chapter contains several schedules for the calculation of investment and production costs. Mostly, 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 lead into chapter X in which total investment and production costs are summed up and their occurrence is projected with a view to evaluating the viability of the project. Figure II shows the flow of data and the linkage of all schedules.

Local and foreign exchange

In most developing countries the financing of investments for new industrial projects requires local and foreign currency. Funds in local, mostly non-convertible, currency are required for local purchases, and foreign, mostly convertible, currency is required for imports and foreign services.

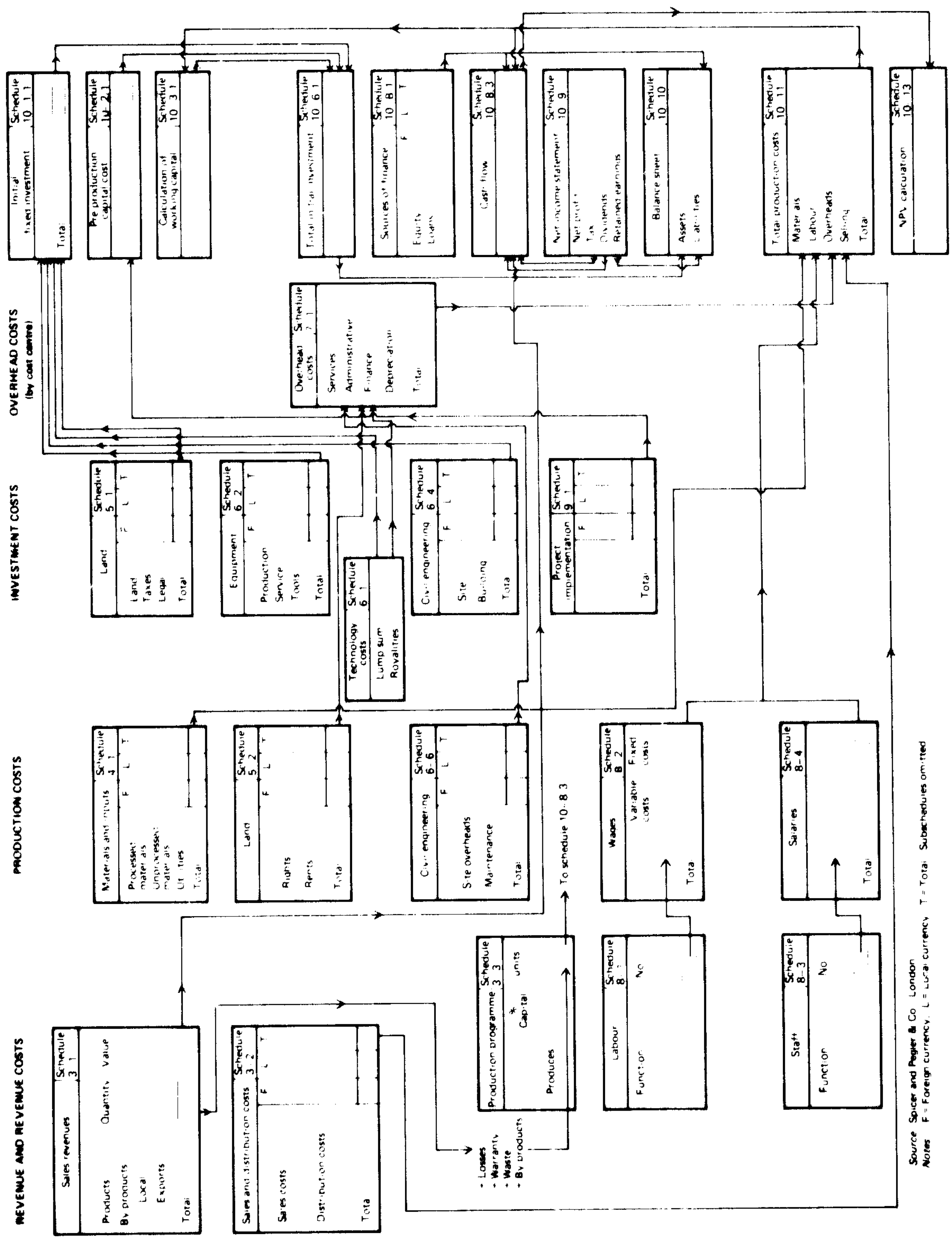
Most of the non-convertible currencies have suffered from higher inflation than most of the convertible currencies. Moreover, many foreign investors or bankers are less familiar with the value and the changes of the numerous non-convertible currencies and therefore prefer to read and analyse financial data and projections expressed in widely known "governing" currencies such as the United States dollar.

When financial institutions indicate an interest in financing part of a new venture, their regulations concerning the selection of the currency to be used for presenting financial data in feasibility studies should be taken into account. This means, in practice, that all local costs (mainly in non-convertible currency) will have to be converted into an agreed governing currency.

Contingencies and inflation

Two types of contingencies, physical and financial, are usually encountered when planning an investment project.

Figure II. Information flow chart for the preparation of industrial feasibility studies



Source: Spicer and Pegler & Co, London.
Notes: F = Foreign currency, L = Local currency, T = Total. Subschedules omitted.

Physical contingencies affect the precision of forecasting sales, engineering requirements, material and other inputs. As it may not be possible to determine precisely the amount of raw materials required utilities, in particular energy requirements, manpower etc. the deficiency is compensated for by adding a certain percentage (e.g. 5-10 per cent) to the physical volumes. Although the errors of estimation will vary from item to item, the common practice is to apply a standard across-the-board rate. This is probably the best approach although it should not be emphasized as it is felt that it would only encourage sloppy planning in the hope that in this way mistakes would be evened out. Therefore, all items should be estimated as precisely as possible and the degree of reliability indicated, for which reason no provision for contingencies was made in anv of the schedules or pro formas.

The financial contingencies (inflation) that occur during the life of this project have a much stronger bearing on its financial viability than the physical contingencies as they influence the amount of fixed investments, working capital, production costs and sales. It is very difficult to estimate the impact of inflation on these four items, as normally sales, wages, salaries, prices for equipment, utilities etc. will increase at varying rates.

The impact of inflation on investment costs is especially strong in the case of projects with implementation periods extending over several years. In order to adjust the financing plan for expected inflation, the estimated annual or semi-annual disbursements of the total investment cost (including physical contingencies, if applied) should be increased cumulatively by an estimated inflation factor. The same approach applies to production costs.

Concerning prices for particular investment items, e.g. equipment and civil engineering works, prices for imported equipment will be rather difficult to forecast and should be made separately, according to the country of origin. Prices of locally produced equipment and of civil engineering works may be easier to project but care should be taken with the import content of local equipment and buildings, which may affect the rate of price increases. In any case, equipment and civil works should be inflated separately and where possible, allowance should be made for the inflation of imported goods. A similar approach should be taken with regard to costs of material and labour inputs. Account should be taken however of increases in labour productivity.

Frequently overlooked in feasibility studies is the change of fixed costs as production increases. Better utilization of machine capacity through the introduction of shift work, for example, requires more maintenance and supporting administration.

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

As far as sales forecasts are concerned it will not be sufficient to project the quantities of sales but also price changes must be anticipated.

To summarize, it is recommended that different inflation rates be applied according to country for the components of production costs, fixed investments, working capital and sales. As the margins of error are wide, it is difficult to make valid projections and it is therefore recommended to subject them to a sensitivity analysis (chapters III and X).

In view of the large number of computations required to prepare the income statement, the cash-flow table and the projected balance sheet based on these different inflation rates, it is suggested that computerized investment evaluation programmes be followed, such as the one developed by the Austrian Industry Administration Limited (Österreichische Industrieverwaltungs-AG), for large-scale projects.

When reviewing a project proposal under conditions of inflation, two factors should be borne in mind: gearing (ratio of borrowed to owner funds) and the real rate of return. With regard to gearing, if a project is financed by a mixture of equity and loans the equity holder gains by inflation. If a fixed-term loan has to be paid back, it is easier with inflation as the real cost of the loan declines. It may be observed therefore that inflation frequently encourages a disproportionately high rate of loan financing. As far as the real rate of return is concerned, it should be noted that if the internal rate of return (IRR) is calculated using constant prices, then the IRR should be compared with the real cost of money, i.e. if the borrowing rate is X per cent and the inflation rate Y per cent, the real cost of capital is X minus Y per cent.

The project team

It is advisable to have a feasibility study conducted by a team of experts although frequently, because of such constraints as paucity of funds and non-availability of expertise at the right level and time, only a single expert may be available. However, 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 team should be selected to cover the major substantive fields of the project. Depending on the situation any large project would ideally comprise at least the following team members:

- One industrial economist (preferably as team leader)
- One market analyst
- One (or more) technologist/engineer specialized in the appropriate industry
- One mechanical and/or industrial engineer
- One civil engineer (if needed)
- One industrial management/accounting expert

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

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

The team leader is also the counterpart of the investor who plays 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 opportunity study and can therefore be considered a major source of information on the background and history of the project. During the preparation of the study many decisions (e.g. on marketing and production programmes, the selection of alternatives) are to be taken by the investor.

Expansion projects

The *Manual* is concerned with new industrial projects but it may equally be applied to the expansion of existing production plants by:

(a) An increase in the quantitative output of products and by-products without changing the production programme;

(b) A change in the production programme by adding new products of the same line;

(c) A combination of these two.

The quantitative expansion may be achieved by:

(a) Introducing shiftwork;

(b) Raising the capacity of the weakest sections of a production line in order to increase its total capacity;

(c) Updating the technology and/or increasing the capacity of entire production lines.

The introduction of new products may lead to the installation of new production lines within the existing plant or, depending on their scale, to the erection of new production facilities on a separate location. Such expansion should, however, be treated as a new project. The procedure for the preparation of a feasibility study for expansion projects of the same product line is analogous to that given in the *Manual* taking into account the determinant factors of the existing enterprise.

In order to formulate a comprehensive project proposal it is necessary to amalgamate the data of the expansion project with those of the existing enterprise. Depending on the size of the expansion project, it should be clear from the new proposal whether the existing internal organizational structure and supporting facilities (e.g. utilities, administration, sales department) will be sufficient or will need adjustments, or whether the expansion proposal should allow for a new structure that will absorb all existing ones. The extreme case may even be the selection of a new location.

To make a financial evaluation of an expansion project:

(a) Expand the cash-flow table in line with the additional cash inflows (e.g. increased sales and financial resources if required) and outflows (e.g. fixed assets, working capital, production costs). In so doing it will become apparent whether the existing project dominates the expansion project or vice versa;

(b) Undertake break-even and sensitivity analyses.

A list of data to be collected on an existing enterprise is provided in annex V. In order to facilitate the integration of these data into the feasibility study, the check-list is structured in the same way as the feasibility study.

Cost of studies

There are no established norms governing the costs of pre-investment studies; these differ from project to project and from study to study and depend on such factors as the magnitude and nature of the project, the type, scope and depth of the pre-investment study, the agencies commissioning and undertaking the study, and the time and effort required to collect and assess the necessary material. Generally, however, it is sought to relate the costs of studies to the estimated number of man-months required. Costs per man-month should be calculated in each individual case and cover salaries, travel, living allowances, drawings, mapping, writing, printing as well as office overheads. 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 costs are a vital determinant of various types of pre-investment studies, it is preferable to indicate the order of magnitude of the costs if such studies are undertaken by outside agencies. Investment costs of pre-investment studies are approximately:

An opportunity study, 0.2-1.0 per cent
A pre-feasibility study, 0.25-1.5 per cent
A feasibility study, related to the magnitude of the project from 1.0-3.0 per cent for small industries to 0.2-1.0 per cent for large industries with sophisticated technology.

The costs of support studies and tests cannot be related to the project investment costs but have to be estimated according to their proposed extent and duration.

The above percentage figures must be treated with caution, as a rough guide. The actual fees charged by a consulting engineering firm may vary considerably because of such variables as:

(a) The experience of the consultant;

(b) The scope of work to be covered. A consultant could cover the requirements of the tender inquiry perfunctorily or with full consideration of various alternatives (product-mixes, technologies, locations etc.);

(c) The complexity of the industrial subsector. Process plants with a number of variables require greater engineering inputs than relatively straightforward operations;

(d) Cost conditions in the consultant's country. An experienced consultant from a developing country with low living and other costs would present a competitive bid and often offer services more suited to the needs of the country concerned;

(e) Competition between consultants and the condition of their order books. When business is lean, lower fees may be quoted;

(f) The consultant's interest in further work on the project which could prompt him to submit a low bid for the initial feasibility study;

(g) The technical competence of the client in negotiating with the consultant and in providing strong support that could facilitate the consultant's task and also lower his costs.

Accuracy of cost estimates

The accuracy of estimates of investment and production costs increases as the project progresses from one stage to the next. If compared with the respective ideal average value, which changes from stage to stage, the approximate ranges of accuracy are:

	Percentage
An opportunity study	±30
A pre-feasibility study	±20
A feasibility study	±10

These averages are empirical values that may differ from project to project and according to the applied method of cost estimates.

When preparing a feasibility study it is incorrect to estimate costs by adding 30 per cent to the estimated costs of the opportunity study without checking all relevant facts and ascertaining their impact on the project and on costs.

For an opportunity study and for a pre-feasibility study the ideal average value is based partly on assumptions and can thus change from one stage to the next and may even indicate that the profitability of the project is no longer assured. However, the ideal average value will not differ very much from the actual value for the feasibility study as, in the latter case, the accuracy of cost estimates is not only determined by the ratio of facts to assumptions but also by the methods applied that may range from global lump-sum estimates to detailed calculations.

Agencies commissioning and conducting pre-investment studies

Pre-investment studies are commissioned by various agencies. Project opportunity studies are often commissioned in developing countries by governmental institutions with a view to attracting investments, domestic, foreign or a joint venture. In certain cases, pre-feasibility studies have also been commissioned by public bodies, including investment promotion organizations and industrial development banks, and by private companies.

Feasibility studies are generally commissioned by the organization, domestic or foreign, that is directly interested in the investment. This may be a domestic industrial enterprise interested in expansion and diversification or an industrial development bank. Also governmental departments and institutions can and have sponsored feasibility studies, particularly in countries where industrial development is mainly to be accomplished as a matter of policy through public enterprises.

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

CASE STUDY

The case study below has been worked out to facilitate the presentation in the *Manual* of the concepts involved, particularly when calculating fixed and working capital and when preparing cash-flow tables for financial planning and evaluation. All schedules and calculations in chapter X will contain data taken from this case. However, to minimize statistics, no data were put into the schedules attached to chapters I-IX and, for the same reason, inflationary impacts were not considered.

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

			Thousands of dollars
(a)	Fixed investment		8 300
	Land	300	
	Buildings	1 800	
	Equipment (including 500 for pre-production capital expenditures)	5 200	
	Cars	1 000	
	(Replacement of cars in year 8) (1 000)		
(b)	Working capital		2 000
(c)	Other current assets		400
(d)	Sources of financing: total		10 700
	Current liabilities (accounts payable)	400	
	Supplier's credit (terms: repayment of credit over five 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
(f)	Production costs in year 8: variable 6,500 and fixed 3,280 of which depreciation (linear) = 780 calculated as follows: buildings 30 years; equipment 10 years; cars 5 years. For an exact breakdown see schedule 10-3/1.		9 780

(g) Construction time: two years

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

(i) 4% dividend on equity capital

(j) Start-up schedule of production:

Year	*Capacity utilization (percentage)*	*Annual sales revenue*	*Annual operating 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

The following is the format of the table of contents of a feasibility study.

Contents

Chapter[3]

I	Executive summary
II	Project background and history
III	Market and plant capacity Demand and market study Sales and marketing Production programme Plant capacity
IV	Material inputs Materials and inputs Supply programme
V	Location and site Location Plant site and local conditions Environmental impact
VI	Project engineering Layout and physical coverage of project Technology and equipment Civil engineering
VII	Plant organization and overhead costs Plant organization Overhead costs
VIII	Manpower Labour Staff
IX	Project implementation
X	Financial and economic evaluation Total investment outlay Project financing Production cost Commercial profitability National economic evaluation

Annexes

[3] The numbering of both the chapters of a feasibility study and of the *Manual* is the same.

Bibliography

Bryce, Murray D. Industrial development: A guide for accelerating growth. New York, McGraw-Hill, 1960.

Lewis, W. A. Development planning. New York, Harper and Row, 1966.

Organisation of Economic Co-operation and Development. Development Centre. Manual of industrial project analysis in developing countries, v. 1. Rev. ed. Paris, 1972.

Solomon, Morris J. Analysis of projects for economic growth. New York, Praeger, 1970.

United Nations. Contract planning and organization (ID/117)
Sales no.: 74.II.B.4.

________ Guidelines for contracting for industrial projects in developing countries. (ID/149)
Sales no.: 75.II.B.3.

________ Industrial planning. (Industrialization of developing countries: Problems and prospects, v. 17)
Sales no.: 69.II.B.39, Vol. 17.

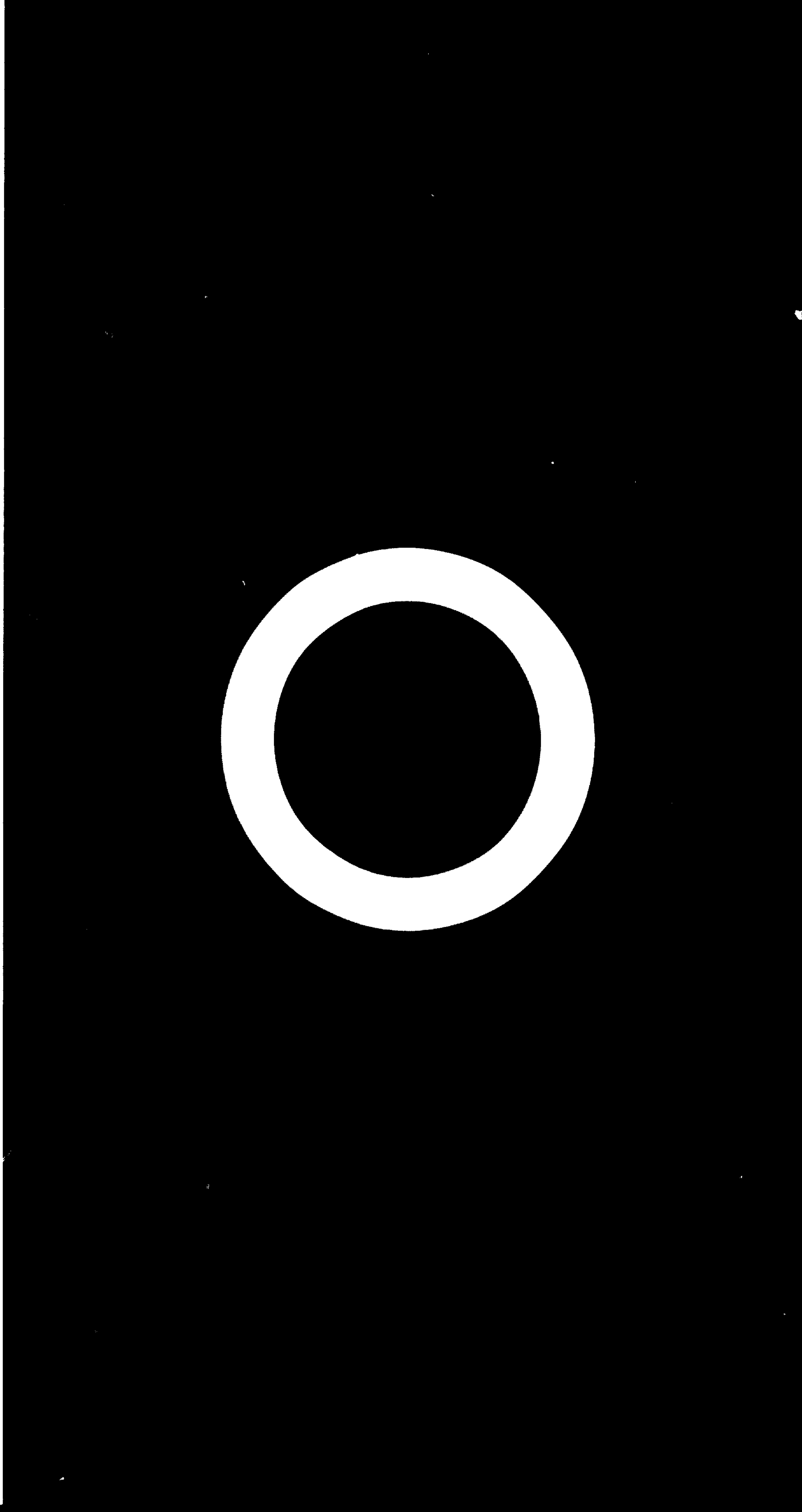
________ Manual on economic development projects.
Sales no.: 58.II.G.5.

________ Manual on the establishment of industrial joint-venture agreements in developing countries. (ID/68)
Sales no.: 71.II.B.23.

________ Profiles of manufacturing establishments. Industrial planning and programming series. 4 v.
Sales nos.: 67.II.B.17, 68.II.B.13, 71.II.B.12 and 74.II.B.13.

United States Agency for International Development. Office of Engineering. Feasibility analysis procedures manual. Washington, D.C., January 1976.

________ Handbook 3: Project assistance, cost estimating methods. Washington, D.C., January 1976.



PART TWO

The feasibility study

I. EXECUTIVE SUMMARY

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

Project background and history (chapter II)

State:

- Name and address of project promoter
- Project orientation: market or raw material oriented
- Market orientation: domestic or export
- Economic and industrial policies supporting the project
- Project background

Market and plant capacity (chapter III)

List annual data on:

- Demand
- Projected sales
- Production programme
- Plant capacity

Materials and inputs (chapter IV)

Describe general availability of:

- Raw materials
- Auxiliary materials
- Factory supplies
- Utilities

List annual supply requirements of material inputs

Location and site (chapter V)

Describe location and state plant site

Project engineering (chapter VI)

Describe layout and scope of the project
State technology finally selected
Summarize equipment selected
Describe required civil engineering works

Plant organization and overhead costs (chapter VII)

Manpower (chapter VIII)

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

Implementation scheduling (chapter IX)

Duration of plant erection and installation
Duration of production start-up and running-in period

Financial and economic evaluation (chapter X)

Total investment costs

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 costs

Project financing (assumed)

Sources of financing
Impact of cost of financing and debt servicing on project proposals
Public policy and regulations on financing
Financing institutions
Required financial statements
Financial ratios

Total production or manufacturing costs (at feasible normal capacity)

List annual data for

Factory costs
\+ administrative overheads
\+ sales and distribution costs

= operating costs
\+ financial costs
\+ depreciation

= total production or manufacturing costs

Financial evaluation

Net present value
Internal rate of return

Pay-back period
Simple rate of return
Break-even analysis
Sensitivity analysis

National economic evaluation (chapter X)

Appraise the project proposal from the national economic point of view

Conclusions

Major advantages of project
Major drawbacks of project
Chances of implementing the project

Bibliography

United Nations. Extracts of industrial feasibility studies, v. 1. Industrial planning and programming series, No. 7. ID/SER.E/7
Sales no.: 73.II.B.4.

II. PROJECT BACKGROUND AND HISTORY

To ensure the success of the feasibility study, it must be clearly understood how the project idea fits into the framework of the economic conditions and the general and industrial development of the country. The product should be described in detail and the sponsors identified together with the reasons for their interest in the project.

Project background

Describe the project idea

List the major project parameters that served as the guiding principles 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

Highlight the economic, sectoral and subsectoral project coverage

Project promoter and/or initiator

Name(s) and address(es)

Financial possibilities

Role within the project

Other relevant information

Project history

Historical development of the project (dates of essential events in project history)

Studies and investigations already performed (title, author, completion date, ordering party)

Conclusions arrived at, and decisions taken, from these former studies and investigations for further use within this study

Feasibility study

Author, title

Ordering party

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

Pre-investment studies
- Opportunity studies
- Pre-feasibility studies
- Feasibility study
- Partial studies
- Experts, consultant and engineering fees

Preparatory investigations, such as:
- Land surveys
- Quantity surveys (quantification of building materials)
- Quality (laboratory) tests
- Other investigations and tests

Others

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

Schedule 2 follows

Schedule 2. Estimate of investment cost: pre-investment studies and preparatory investigations

(Insert total in schedule 10-2/1)

ESTIMATE OF INVESTMENT COST

Pre-investment studies and preparatory investigations

No.	Quantity	Unit	Item description	Local	Foreign	Unit cost	Cost		
							Foreign	Local	Total
1.			Pre-investment studies						
2.			Preparatory investigations						
			Total						

Bibliography

Delaume. Transnational contracts. New York, Oceana, 1976.

International Centre for Settlement of Investment Disputes. Investment laws of the world: the developing nations. New York, Oceana, 1972.

Kubr, M., ed. Management consulting; a guide to the profession. Geneva, International Labour Office, 1976.

Meron, Th. Investment insurance in international law. New York, Oceana, 1975.

Organisation of Economic Co-operation and Development. Development Centre. Investing in developing countries. Rev. ed. Paris, 1972.

Svenska Technologforeningen. General conditions of fees for consulting engineers and architects work. Stockholm.

United Nations. Manual on the use of consultants in developing countries. (ID/3/Rev.1)
Sales no.: 72.II.B.10.

III. MARKET AND PLANT CAPACITY

Before the project is formulated, the size and composition of the present effective market demand, by segment, should be determined in order to estimate the possible degree of market penetration by a particular product. Also, the income from sales should be projected taking into account technology, plant capacity, production programme and marketing strategy. The latter has to be set up during the feasibility study giving due consideration to product pricing, promotional measures, distribution systems and costs.

Once the sales projects are available, a detailed production programme should be made 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.

Demand and market study

- Data and alternative projection methods
  - List and describe 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 a method of data evaluation and state reasons for selection
  - Detail the methods of data evaluation and demand determination to be used for the project under consideration
- 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 segment)
    - The demand projections for the market (total and by segment) for the lifetime of the project
    - The estimated market penetration by products

Sales forecast and marketing of products and by-products

- Data and alternatives
  - Describe data required in addition to the results of the demand and market study
  - Describe possible alternative sales and marketing programmes
- Selection of sales programmes and marketing strategy
- State reasons for selection of sales programme
  - Detail the sales programme
  - Presentation of the programme (descriptively, using tables, graphs and maps as appropriate to show development throughout the life of the project)

State reasons for selecting of marketing strategy

- Detail the marketing strategy
- Presentation of 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

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

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)

Production programme

Data and alternatives

Describe the data required to set up a production programme
Describe possible alternative production programmes
When preparing the production programme, keep in mind among other things:

- Anticipated sales
- Minimum storage requirements
- Expected wastage
- Parameters of plant capacity
- After-sales requirements
- Reserves due to operational reasons

Selection of production programme

State reasons for selection
Describe in detail the production programme
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

For emissions such as:

Wastes and effluents (to be treated or not) dust, fumes, noise etc.
Quality of emissions

Quantities of emissions
Time schedule
Means of treatment

Estimate costs of emissions disposal

Treatment (as far as not 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)

Plant capacity

Data and alternatives

Describe data for the determination of plant capacity (feasible normal as opposed to nominal maximum capacity)
List possible alternatives on plant capacity

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
- The main departments (semi-finished products)

Schedule 3-1. Estimate of sales revenues

Products By-products			Year 1						Year 2						Year 3						Year N					
Description	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			total
Grand total																										

Notes: 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 in the cash-flow tables to which the sales data have to be transferred (schedules 10-8/3, line A.2; 10-13, line A.1; 10-14, line A.1).

This schedule can be expanded to suit particular requirements.

Schedule 3-2. Estimate of production cost: sales and distribution costs

(Insert total in schedule 10-11 (10-3/1))

ESTIMATE OF PRODUCTION COST									
Sales and distribution costs									
No.	Quantity	Unit	Item description	Local	Foreign	Unit cost	Cost		
							Foreign	Local	Total
1.			SALES COSTS						
			Training of salesmen and merchants						
			Advertising						
			Travel expenses						
			After sales services communication						
			....						
2.			DISTRIBUTIONS COSTS						
			Containers and packaging						
			Freight						
			Commissions						
			....						
			....						
Total									

Schedule 3-3. Production programme

(Insert total in schedules 10-8/3, 10-13, 10-14)

Products, by-products, wastes	Units at 100% capacity	Year 1		Year 2		Year 3		Year N	
		Capacity (%)	Units	Capacity (%)	Units	Capacity (%)	Units	Capacity (%)	Units

Note: This schedule can be expanded to suit particular requirements.

Schedule 3-4. Estimate of production cost: emissions disposal

(Insert total in schedule 10-11)

ESTIMATE OF PRODUCTION COST

Emissions disposal

No.	Quantity	Unit	Item description	Local	Foreign	Unit cost	Cost		
							Foreign	Local	Total
1.			Emissions treatment (if not covered under equipment and civil works)						
2.			Disposal in dumps and sewage system						
3.			Payments to neighbours						
			Total						

NOTES ON MARKET AND PLANT CAPACITY

Demand and market analysis

Effective demand represents the total quantity of a specific product purchased at a given price in a particular market over a given period. A market can be viewed in narrow terms as a set of consumers, existing and potential, or, in broad teims, as the consumers plus such influences as the government policies obtaining in a particular country or region. Demand and market considerations are closely linked in developing countries in which governmental policies and institutions are of particular importance. Consequently, no clear distinction has been maintained between these categories in this *Manual* and demand and market aspects have, by and large, been considered as interchangeable.

Nature of demand analysis

The first step in project analysis, is, in most cases, a detailed estimate of the size, structure and demand characteristics of the product to be manufactured. In almost all cases a certain amount of primary data have to be generated since secondary data in the requisite detail do not exist or are not available. Also producers are reluctant to devulge information on operational aspects of industry and consumers reluctant to reveal information on family budgets, personal incomes, buying habits, preferences and market responses. This reluctance plus frequent changes in socio-economic living patterns often render the available historical data irrelevant for industrial programming. Sometimes these difficulties are encountered especially when a new product, either not domestically produced or imported in large quantities, is introduced. On the other hand, the market and demand analysis in developing countries may be easier during the earlier stages of development since the majority of industrial projects in such countries is geared, at the beginning, to import substitution, and the amount of imports constitutes an indicative parameter. Often the first entrepreneurs are former importers of such products who are fairly well acquainted with existing market conditions.

Certain products and projects may be exceptions to the general rule of initiating feasibility studies with estimates and analysis of domestic demand though certain special aspects of demand would nevertheless need to be studied in such cases. This would be the case, for instance, if a project were based on an abundantly available natural resource, and if it were obvious that international markets existed. For example, in a large agricultural country, a broad market analysis may not be necessary for a fertilizer plant for whose product there would obviously be sizable unsatisfied effective demand, but the pattern of demand growth for different types of fertilizers and the implications of market absorption for each type would require study.

The critical factor in demand and market analysis is an estimate of the demand for a specific product during the life span of a proposed project keeping in mind that the viability of the project is dependent, among other things, on the projected sales or income. The size of demand, at any given time, is a function of several variable factors such as the composition of the market, the competition from other sources of supply of the same product and substitutes, income and price elasticity of demand, market responses to socio-economic patterns, distributive channels, and consumption growth levels. Consequently, demand appraisal is more complex than is commonly assumed and is made more so by the need not only to estimate the demand for a particular product, but also to identify its components (product-mix) and segments or consumer groups, and the social and institutional constraints on its growth and sensitivity. Inadequate or inaccurate analysis of the demand/growth pattern and degree of market penetration usually results in either excess production capacity and poor capacity utilization, as is often the case in developing countries, or plant capacity that is insufficient to meet market needs and unable to take advantage of the economies of scale.

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 information required should be summarized as follows:

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

(b) Market segments identified by:

(i) End-use (e.g. consumers);

(ii) Consumer groups (e.g. different income levels of consumers);

(iii) Geographical division (e.g. regional, national and export markets;

(c) The demand projections of the overall market and of the segments over a certain period, preferably the first 10 years, of the operational life of the project;

(d) The market penetration ratio that the proposed project is expected to achieve over the projected period in the context of developing domestic and international conpetition and changing consumer responses;

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

The conditions of sales promotion, including, when 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 later in this chapter.

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

Though a study should usually have as a starting point a product with definitive characteristics, it may be necessary, in the course of such analysis, to modify the specifications of the product, design, performance, packaging etc.[4] in order to suit

[4] In the case of engineering goods industries, including machinery products, the product should be categorized in great detail. Thus, for a machine-tool project, a break-up of the market should be provided for different types of lathes, milling machines or any other machine-tool category. The market analysis for the production of refrigerators or electric fans should relate to different sizes and such different types of electric fan as ceiling, table or pedestal. In respect of product design, specifications and performance, certain approved standards that may be required as for boilers, pipes and other engineering goods should be defined so that the product can be adopted accordingly. For consumer goods, as for various engineering goods, consumer preference for certain brands or the familiar types of packaging, should be identified.

the local, national or export market to be served. Such modifications should not change the basic character of the product while the project is being formulated.

Size and composition of present effective demand

The initial objective of demand and market analysis for a feasibility study is the determination of current effective demand.[5] The base for estimation is the actual consumption figure during the relevant period. It may, however, not be easy to obtain consumption figures for most products. A beginning has to be made with "apparent consumption" of a product which, for 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_0) is given by:

$$C_0 = P + (I - E) + (S_0 - S_c)$$

where P is the production during the period; I is the imports; E is the exports; S_0 is the level of stocks at the commencement of the period; and S_c is the level of stocks at the close of the period.

Adjustments should be made for consumption of the product by the producers. Also, provision should be made for abnormal factors, to the extent that these can be gauged at all, by inflating or deflating the final figures. Where such factors cannot be identified it may be necessary to resort to an average of the previous two or three years with appropriate adjustments. As with the consumption of the current year (C_0) the consumption of past years ($C_{-n} \ldots C_{-1}$) may be estimated. Any gaps in the series will have to be filled by interpolation.

In a competitive market current consumption can be equated with current effective demand but not in most developing countries as there are various restrictions on consumption and imports of manufactured goods.[6] In estimating the demand for a product, it is necessary to allow for various factors that might have remained suppressed through rationing or exchange restrictions. The amount allowed will depend on each individual product, the nature of the market and the size and structure of the industry. Another possible factor is the existence of monopolistic or oligopolistic imperfections restricting domestic production by plan targets or the non-availability of inputs, domestic or imported.

Apparent consumption must be recognized as being indicative only, and it is necessary to check the apparent consumption of the year and the trend with secondary data. In demand studies, the factors not quantifiable have to be provided for on the basis of assumed discounts and escalators. When such factors are not of significant magnitudes, there is no need to inflate or deflate the demand estimates; nevertheless, these factors should be clearly brought out in the study.

[5] The estimate of current effective demand is usually based on data from the year preceding the one in which the study is made, or, if these data are insufficient, from the year before that. Sometimes, the base year is the one in which the project is expected to start commercial production but this is to be avoided as the figures would need to be projected. Moreover, for certain projects, a feasibility study starts too early to be able to project, with any precision, the completion date of the project. Whether the year selected is a fiscal, a calendar or a commercial financial year depends on when most data are available. This, if the analysis is of 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.

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

Analysis by segment

Demand analysis, whether present or potential, by volume or 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 can commence with one segment and end with another. Sometimes it is necessary to estimate the component sectors in order to arrive at the whole.

Once current demand has been estimated for the entire market, it becomes necessary to segment the market to make future projections and to determine the acceptable product-mix. Market segments can be identified by the nature of the product (qualities and end-uses), by consumer group or by geographical division of the market. The rationale for segmenting a market by consumer characteristics is that demand varies from one segment to another as a result of several conditions. Consumer habits in one case may change more rapidly than in another, and, for instance, a high income segment may show greater response in accepting a higher-priced product. Or, some segments may grow faster 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 is that in most cases the appraisal and projection of market size can be made only by analysing separately each market segment.

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

Demand projections (domestic and export)

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

(a) The forecast of potential demand for the particular product or products;

(b) The estimates of potential supplies;

(c) An estimate of the degree of market penetration that the proposed project is likely to achieve;

(d) The characteristics of potential demand spread over a period. Quantitative and qualitative figures on these various aspects are needed.

The first task is to project the potential demand for a product over a reasonable period. Except for products that are wholly or substantially export-oriented, such projections should deal, in the first instance, with national markets. Export possibilities also need to be assessed but are different in emphasis and detail and have consequently been dealt with separately in this *Manual*.

The basic steps necessary for projections of national demand are:

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

(b) To classify such consumption data by market segment;

(c) To identify the principal determinants of past demand and their influence on it;

(d) To project the future development of the determinants and their influence on demand;

(e) To forecast demand through extrapolation of the determinants by a method or combination of methods.

In the case of new products, demand projections are more difficult and may have to be viewed against demand growth trends in other countries at the related level of product development, and together with economic and other factors. For example, the projected demand for television sets in a particular country or region where television has just been introduced may have to be related to experience in other countries during such a stage, but a more important determinant would be the general income levels and living standards in the area in question.

The determinants of future demand depend a great deal on the type of product and its end-uses. The determinants tend to differ widely between non-durable and durable consumer goods and between intermediate products and capital goods and also single-use and multi-use products. Certain products, principally consumer goods, may be directly related to general economic indicators such as the size of population and its structure, income levels, growth and distribution, and urbanization. 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 is directly related to growth rates in the principal industries that use machines. 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. The demand for petrol pumps at service stations depends on the vehicular population and on the number of service stations. It is not possible, therefore, to generalize as to the determinants for demand growth and there is no alternative but to identify the major growth determinants in relation to the product under consideration.

Forecasting techniques

There are various techniques for forecasting effective demand ranging from relatively simple ones 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 product, the nature of the market it is intended to serve and the principal determinants of demand growth. The various forecasting techniques (annex VI) are described briefly in this *Manual* so that it is possible, both in the preparation and evaluation of feasibility studies, to assess the suitability of the method used. The following techniques may be used for demand forecasting:

(a) The trend (extrapolation) method;

(b) The consumption level method (including income and price elasticities of demand);

(c) The end-use (consumption coefficient) method;

(d) The leading indicator method.

Regression models may also be used.

Market surveys

A market survey is an expensive and time-consuming way to forecast demand for a particular product. It also involves extensive fieldwork, the extent depending upon how detailed the survey needs to be. Market surveys can either cover a broad field of inquiry or be related to a specific product (annex VII). The procedure followed in both cases is fairly similar though it differs widely in detail. Usually, limited market surveys are undertaken as part of a demand and market analysis, insofar as specific products are concerned, to cross-check the results of forecasts made on the basis of one of the forecasting techniques given above. Thus, if by use of the trend or end-use technique the market for electrical motors in the higher ranges is defined over a period, the results can be cross-checked through a survey of the principal industrial sectors that would be purchasing such motors.

Competition from domestic and foreign suppliers

As opposed to alternative, and combinations of, techniques that can be adopted for forecasting demand, projections of supply of a product are a matter of judgement as they depend on the availability of a product through increased domestic production or imports. Domestic production can take the form of expansion of existing enterprises or the establishment of new industrial units in the same line of production. Existing domestic enterprises have an obvious advantage in that their production capacity can be increased with less capital outlay than is needed for a new unit. In countries where a formal or informal system of industrial licensing or governmental approval operates, 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 has to be made. The availability of a product in a particular market is also determined by governmental policies relating to imports.

Export projections

The possibility of extending the market to other countries should be explored for most projects of any size as export sales have 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, nevertheless it may have export capability either immediately on commencement of production or within a reasonable period during which productive skills can be developed in order to be able to offer a product of international quality standard at a competitive price. For example, a petrochemical or fertilizer plant can enter export markets much easier after commencement but the export of heavy electrical equipment 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 therefore the determination of possible export markets is an essential feature of demand forecasts.

The evaluation of export markets has a somewhat different emphasis than that of domestic markets.

For products that have been, or are currently being, exported, the starting point is the collection and evaluation of data relating to the quantities exported, units, unit price for exports, countries to which exports took place or are taking place, 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 are enforced for engineering goods and other products and these need to be identified for particular products. Such information can generally be obtained either from the exporter or from the importing country and should then be related to the products to be manufactured and to the nature of the proposed enterprise. Then a further survey has to be undertaken of the size of the market in the countries already importing the proposed product and in other countries in a similar category of development, import policies, shipping costs etc.

In the case of products that developing countries are contemplating, or have just started, manufacturing and these would be the majority of goods and services from developing countries the starting point should be an analysis of past imports into the home country, the unit cost of such imports, the exporting countries and the characteristics of the imported product. Such information is necessary, even from the viewpoint of domestic production.[7] First, the price and quality of the product in the international market should be defined, which is not difficult. When related to export incentives and facilities provided by the home country, the pricing factors can be identified.

Secondly, the geographical divisions of possible exports should be defined in the context of a particular product. While there is an international market for most products, some are less popular than others and various obvious constraints have to be taken into account. The market for such consumer products as cameras, colour television sets, stereo equipment and electronic calculators is international but highly competitive. However, if a proposed product is considered to be internationally competitive in terms of quality and technological inputs, the global market should be tackled step by step. 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 countries is necessary and the export market survey can start with certain principal markets to be penetrated initially and gradually extended to other countries as plant capacity is expanded to meet increased market demand.

[7] Except for small projects designed solely for local markets, there is a close relationship and interaction between the domestic and foreign manufacture of a product. Domestic products are frequently in competition with imported products except in countries imposing severe import controls, but even then, the price, quality and delivery of equivalent imported products has a considerable impact on the price and quality of domestic products. In some countries, a direct relationship is established in the matter of pricing, and domestically manufactured products have to sell at a certain percentage (approximately 20-25 per cent) below equivalent imported products. Even in the case of public sector projects, it is attempted to relate product pricing to the pricing of comparable imported products.

For some products, scale economies may prove a determining factor in defining export markets. A plant contemplating an annual production of from 30,000 to 50,000 motor cars in an Asian country cannot expect to compete effectively in external markets with other manufacturers producing more than 300,000 motor cars annually. However, the possibility of exporting trucks is much greater as adequate scale economies operate at a much lower level of production and an export market survey could be undertaken starting with neighbouring markets and gradually penetrating other markets.

In the case of intermediate products and the products of process industries, export could be determined by transport costs, assuming that such products are comparable in quality, which is usually the case. For capital goods products, export markets have to be gauged in terms of the possible acceptability of particular products by principal users. The number of such users is much smaller than in the case of consumer goods products and greater stress is normally laid on quality and reliability as related to prices, together with such aspects as availability of spares and after-sales services. Machine tools produced in India are presently being exported to the United States of America in small quantities, but to set up a full-scale machine-tool assembly plant oriented solely to such exports may not prove feasible, despite the fact that the United States market for machine tools is very large. Projections of exports have to be related to the degree of penetration considered practicable in any particular market.

After delineation of the geographical divisions of possible export markets 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 a survey would vary depending 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 rarely and only when export prospects of a particular product justify such an expensive course.

Information on imports and sources of imports into developed countries can generally be obtained without too much difficulty. In the case of developing countries, such information may be more difficult to obtain from published sources and visits to selected countries may be necessary. Most developed countries have agencies to collect and collate economic data on possible export markets and similar agencies may have to be established by developing countries contemplating exports of new and non-traditional products.

While an assessment of potential exports is essential to demand forecasts, a word of caution is necessary on the scope of such studies and on their reliability over a period. Because of rapid technological development, the market prospects in developed and developing countries tend to alter over a few years and it is far more difficult to accurately foretell such developments in foreign markets than it is in domestic ones.

Total demand

Total demand, present and projected, should therefore cover both the national and export markets and relate to the phasing of market penetration for a particular product. The demand or market study should also highlight the broad requirements of such markets in terms of product pricing, quality, technology and special characteristics such as consumer preference for particular brands. Any marketing strategy necessary for these markets should also be broadly defined. It is only then that the demand study can serve an effective purpose in determining plant capacity and the strategy to be followed in project formulation and implementation.

Market penetration

An essential feature of demand projections is an estimate of the market penetration that is possible for a particular product. This would be related to *(a)* the degree of competitiveness, either domestic or foreign; *(b)* consumer response; and *(c)* the amount of substitution that would be possible. These aspects have to be considered for the product to be manufactured and an assessment made of which share of the market can be assumed. Also, the conditions of market penetration must be defined, such as product quality, packaging, marketing and distribution arrangements, after-sales services for machinery and other products, as part of the overall marketing strategy to achieve a target of sales and income. Where a particular product is to be manufactured in a country for the first time and a system of licensing and import controls is operating, consumer reaction and the possibility of product substitution would be the determinant factors. For instance, the market penetration of the first synthetic fabrics produced in a country would depend on the substitution of such fabrics for natural fibres. As successive units are established, however, the competitive element would be the principal determinant factor and price considerations would be dominant, although other aspects, such as quality and brand name would still operate to a lesser extent.

Sensitivity analysis

Whatever method or combination of methods is used, projections necessarily involve various assumptions and probabilities. A number of factors relating to demand are not apparent and can never be fully accounted for. Unpredictable events, such as the energy crisis, alter the demand pattern for a wide range of products.

In brief, estimates and forecasts may go wrong because of:

(a) Errors in base data;

(b) Inadequacy of data;

(c) Unforeseen economic and socio-political developments;

(d) Limitations of statistical methods;

(e) Unknown or suppressed factors and relationships;

(f) Unquantifiable factors and relationships;

(g) Unrealistic or imprecise assumptions;

(h) Technical and technological changes;

(i) Changes in economic relationships and structure.

Some of the uncertainties to be reckoned with are:

(a) The rate of increase of national and per capita incomes;

(b) Technological developments inside or outside the subject industry or in the production of inputs;

(c) The emergence or disappearance of a dominant competitor;

(d) Perceptible changes in the structure of family budgets;

(e) The emergence of a substitute;

(f) Changes in cross-elasticity of demand;

(g) The signing of bilateral or multilateral trade agreements or the formation of regional customs groups such as the European Economic Community (EEC); or industrial co-operation among neighbouring countries;

(h) The discovery of new sources of raw materials or substitutes for the subject industry;

(i) Changes in transportation costs;

(j) Changes in tariff barriers;

(k) Inflationary price rises (or declines) distributed unevenly over different commodities; increases in input costs;

(l) The discovery of new applications of the product.

It is only by a systematic approach that uncertainty is reduced to a minimum. This approach is provided by statistical sensitivity analysis, by which calculations are made of the degrees of uncertainty.

The objective of sensitivity analysis is to determine the impact on the size of demand, aggregate or by segment, if the factors influencing demand turn out to be more or less favourable than has been assumed. If the growth rate of demand has been identified at 6.5 per cent over a period, with rates of annual growth ranging from 2.5 per cent to 10 per cent, alternative projections may be made on the basis of growth rates at mid-points between the lowest and highest rates on the one hand and an average growth of 6.5 per cent on the other. Similarly, if an income elasticity coefficient of 1.2 has been identified on the basis of past data, demand should be assessed with income elasticities of 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 retail prices by 25 per cent (since the product supplies were obtained wholly by imports). In fact, the existing producers may be provoked into reducing, or may be obliged to reduce, the prices by that level and increase supplies. The investor will need to know the impact of these changes on his sales. By applying the possible sensitivities, i.e. assuming higher or lower values of analysis, the more optimistic and pessimistic estimates of future demand are made. The range provides a safety margin for the determination of 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) but often the change must be assessed on the basis of various permutations of changes. This may involve considerable arithmetic and the use of computer facilities but yields a wide range of forecasts that fall under the categories of optimistic, pessimistic or realistic. The latter forecast could then constitute the basis for determination of market size over a certain period.

The degree of sensitivity to be applied to export market surveys should be greater than in the case of national markets since such difficult items as changes in tariff rates or in foreign exchange rates of domestic and competitive currencies have to be taken into account. As far as exports are concerned, it is more prudent to underestimate rather than overestimate plant capacity.

Precautions for statistical analysis

The application of demand forecasting techniques requires the utmost caution or definitive data can lead to highly misleading results. Some of the points to be cautious of are:

(a) The definitions of characteristics should be precise and scrupulously adhered to. While analysing the demand for industrial gases, distinctions between different gases (oxygen, nitrogen) should be strictly maintained. Each one has a different process of production and the ratios of demand vary;

(b) When identifying averages, norms, standards, trends and coefficients a fairly large number of observations amenable to statistical tests of significance should be taken into account. A trend established over a four-year period, however marked, should not be assumed to be valid for a long-term projection;

(c) Data and coefficients associated with one market or a market segment should not be transplanted to others. The income elasticity of demand for low-income groups is not the same as that for high-income groups;

(d) The assumptions made in the analysis and application of data and formulation of coefficients and correlations should be distinctly expressed without reservations;

(e) The selection of statistical techniques for estimation, analysis and forecasting should be appropriate to the nature of the product, market and data pattern;

(f) Application of reference data should be used with the necessary adjustment. For example, the salary/wage levels of a small sugar factory cannot be transplanted to a steel plant;

(g) 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 unit. The price elasticity may be 1.2 in accounting for demand for printing paper in 1960, it may be only 0.8 in 1975;

(h) When identifying trends, coefficients and relationships, abnormal or extraordinary cases should be eliminated;

(i) Simple averages should be avoided in preference to weighted averages;

(j) It is sometimes advocated that when data are not available, the analyst may be content with a few rough estimates. In fact, the purpose of market and demand studies is to generate statistical information when it does not already exist and to analyse and process what does exist. There is, therefore, no justification for making rough estimates unsupported by dependable data especially since these may mislead the investor.

The degree of precision required in demand analysis, which is correlated with the 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 and vulnerability of the products to substitutes. The criteria may include the operational economics of the industry itself. An initial sales forecast, for example, may indicate a demand of 900,000 and 1,000,000 units of a product by a given year. With greater precision the forecast of sales might be estimated at 970,000 units, but such precision may not be necessary. Also too much concern with precision and the use of advanced econometric models and techniques may 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 wasteful. The margin of error may be too great at the base for a precise statistical appraisal.

Data for demand and market analysis

The material required for demand and market analysis, and the extent to which this is readily available in many developing countries, should be considered. Such information falls into two categories, basic data and specific market data for a particular product. The basic data required for most market studies include:

(a) General economic indicators having a bearing on product demand such as population, per capita income, growth of gross domestic product and income distribution;

(b) 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 and foreign exchange regulations;

(c) The existing level of domestic production by volume and value over a period of from three to five years including production for internal consumption of the product, which is not placed on the market;

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

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

(f) Data on major or critical inputs and complementary products;

(g) Production targets in national plans, where these are defined together with those of substitute products;

(h) The volume of exports, if any;

(i) Behavioural data such as consumer habits and responses, individual and collective, and trade practices;

(j) Legal information.

The specific demand and market data for a particular product should be identified and its availabilitv for the feasibility study ascertained. The range of this data, however, depends on the nature of the product and the type and degree of market research that it may involve. It is not practicable to make any classification or prescribe any guidelines in this regard. In one case, past production figures may be decisive, in another, they may be misleading. The same holds true for data on imports, past consumption and prices. The determinants in each case should be considered as, in most developing countries, free market forces are hardly operative and varying 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 domestic products, or an artificially high domestic price may be imposed on 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 the specific demand and market data considered necessary in respect of a particular product, the extent to which such data are 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 demand and market study differs. In one case, data over ten years may be barely adequate because of abnormal fluctuations during the period; in another, it may not be possible to cover a period of more than from 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 but this would eliminate some sources in developing countries. It is difficult to classify products for the purpose of fixing periods for data collection. By and large, data on mass consumption products, such as food items, bicycles, and radio and television sets, should be based on a long-term series while for intermediate and capital goods a relatively short-term series may be adequate. In each case, it should be explained what the period is and why it 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; and publications of chambers of commerce. Such data is seldom complete for the purpose of a market study but constitutes an effective starting point. It is common, in many developing countries, for data to be available on general economic indicators but be inadequate or not readily available on existing production figures. In some developing countries such information is considered confidential as far as production in particular industrial enterprises is concerned. Import data are, of course, available from governmental agencies, but are not always accessible. In many cases, a number of items are lumped together; disaggregation is difficult, and figures cannot be identified for detailed product classifications and sub-classifications. Data on inventories are difficult to obtain, except for certain products in respect of which there are official publications. Even to obtain basic data, considerable field research may be necessary.

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, should be further refined and projected in terms of specific sales volume during different periods after a project goes into production. However, estimating sales income is an iterative process that should not be based solely on a further detailed analysis of market and demand data but 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 outline 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 exceeds the envisaged production capacity, the volume of sales tends to balance the quantities produced at various production levels. Thus, the sales volume for a 600 t/day cement factory in an area where cement is in short supply would be between 180,000 and 200,000 t/year 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 on the one hand by the price elasticity of demand for the product and on the other by production costs and distribution facilities. Since the demand for cement is relatively inelastic up to a certain price level, sales would not be affected by the price until the price became high enough to inhibit construction activities. The extent of marketing research and strategy required would be somewhat limited, though adequate distribution outlets would have to be provided and limited promotional activity undertaken.

The situation would be different in cases where a product faces considerable competition, where substitutes exist or where the demand elasticity is 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 important would be: *(a)* product pricing; *(b)* promotional measures, including advertising; and *(c)* the distribution system, including sales, 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, only be felt a considerable time after a project is implemented and most of the measures would be taken in the post-implementation stage. The degree of detail in marketing strategy that can be covered in the feasibility study stage is difficult to specify and would vary from product to product, but in most cases only the basic aspects of such a strategy can be stressed, 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 market data required for a feasibility study. As previously mentioned, it is intended to use fund-flow analysis as the major technique for financial evaluation which means that there are two distinct types of data, namely, the estimated sales revenue and the related sales and distribution costs. Both should be kept separately and not be deducted from each other since both enter into the fund-flow table with different signs: the former as an inflow of funds, the latter as a cash outflow of funds.

Production costs and product-price relationship

Product pricing has a significant impact on the volume of sales and on the income from such sales. The base of any pricing policy should be the production costs and the market structure for a particular product. From the viewpoint of the enterprise, the appropriate price for a product is one that yields the maximum income in relation to a given level of production. A monopolistic enterprise could perhaps sell its product at the maximum prices obtainable, subject to any regulatory action that the concerned governmental authorities might take, but for an enterprise facing stiff competition constant adjustment is necessary between the maximum price obtainable and the production costs. For enterprises planning an expansion, the production cost and product price relation 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, should not be a problem but the projection of overhead costs is more difficult since this can vary considerably with different levels of capacity utilization.

Direct or partial costing

The feasibility study should analyse product pricing in terms of projected sales so that income from sales can be determined. This is difficult as various alternatives can be taken.

When it is estimated that production costs will be unduly high during the initial production years, or even over a prolonged period, and that full absorption of such costs in product pricing may seriously affect the volume of sales, the implications should be carefully assessed. It may not be possible, in such cases, for products to be initially priced at levels where all production costs are covered and an adequate profit margin is also maintained. In many cases, particularly where long gestation is involved, product pricing has to be so adjusted to market responses that only the variable (direct) costs, or the variable costs plus a part of the fixed costs, can be covered for some time. In the manufacture of high-voltage electrical equipment or heavy and sophisticated mechanical equipment, for many years domestic production costs in developing countries may be much higher than production costs in other countries where much older manufacturing plants are operating with little or no depreciation liabilities and at 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 similar products and within a differential of 20-25 per cent. However, this would inevitably mean that production costs could not be absorbed in such cases for a number of years. Consequently, if such plants are established, they may face financial losses for relatively long periods unless wholly protected markets enable them to charge the 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 similar products as the costs of some other essential product or service, such as the cost of electric power, may have to be raised. In many such cases, part of the 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. Such factors should be brought out fully in the feasibility study.[8] A detailed description of product costing is given in chapter X.

Products may have to be priced below total production costs for certain periods, not only because initial production costs are unduly high but also because only such lower prices would enable entry into a particular domestic market. In the case of new

[8] The example may be quoted in this connection of an electric equipment plant in a developing country for which the feasibility study predicted a continuing 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 that was more or less competitive were even higher than had been estimated but, in recent years, the project has made sizable profits and over a long period, can be considered viable.

products, a particular market or markets may have to be developed through initially low prices 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 either to provide a profit element or to cover even total production cost. Such product pricing must, however, be limited to a specific period. It would not be commercially feasible to undertake the manufacture of a project where product pricing would remain below total production costs plus profits over an indefinite period.

Product pricing may also be considered in the context of a monopoly or semi-monopoly. 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 are inevitably attracted to production sectors where high profits are being made except in fields where technology cannot be obtained. Where there are such controls a monopoly or semi-monopoly may not be allowed to develop and, if it occurred, would be short-lived. It may, in any case, be more prudent to price a new product at a level that allows a reasonable profit to the initial enterprise and that discourages other entrants in that production than to fix a price that is high, consequently yielding greater profits but inviting more competition.

The reaction from competitors producing the same product, or a similar or substitute product is pertinent. 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 must take into account the nature of the competition and its likely responses. The likely consumer response should also be assessed. A substitute product for an imported item would probably command a lower price because of consumer preference for imported items or particular brand names. In such cases, if imports are not curtailed, a lower product price may have to be assessed even though production costs may well be higher than those of the imported product.

Promotional measures

The sales promotion efforts required and the target for market penetration should be broadly defined. Sales promotion through various forms of advertising, consumer advisory services and the like is an expensive process and the extent of such promotional activities should be identified and expressed in cost terms.

Distribution system

The sales and distribution organization for marketing a particular product should be broadly defined and its costs of operation estimated. Most enterprises require a marketing organization within the enterprise that is responsible for sales and that organizes, 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, in the case of products having an international market, can be spread over a number of countries. In most cases, however, actual sales and distribution are handled through agents who either live in a country or work in a number of countries and they 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, distribution outlets provided by a foreign partner or a foreign technology licensor may be utilized, particularly in potential external markets. In other cases, distribution agencies may be set up directly or jointly with the manufacturers of complementary products. A feasibility study can only provide the broad pattern and estimate the costs involved. Details regarding marketing and distribution have to be worked out during the post-implementation stage.

An important part of product marketing is the after-sales facilities and services that many products require. After-sales services and facilities are required for a wide range of industrial products and can extend from the supply of simple wear and tear parts to the provision of extensive servicing, maintenance and repair facilities and to the stocking of a large volume of spares in different locations. The nature of after-sales facilities and services for a particular product should always be defined in a feasibility study.

Sales promotion, the design and creation of a distribution system and the related costs are important in product marketing. However, they concern more the organization of marketing within 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 close estimation of freight costs is important since excessive shipping costs may reduce the profitability of the project. Schedule 3-2 summarizes all pertinent sales and distribution cost items to be covered by a feasibility study. Sales costs connected with promotional efforts might occur during the pre-production stage. If so, separate accounts should be kept since such costs will have to be capitalized as pre-production expenses (schedule 10-2/1 and chapter X). Otherwise, sales and distribution costs will become part of the total production costs (schedule 10-3/1 and chapter X).

Sales revenue

Projections of sales can only be made according to the market structure, market requirements and marketing strategies that are followed. Such strategies have 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. Only then can a reasonable projection be made of the likely annual sales (in units) and the revenue from such sales. The period such projections cover depends on the nature and type of the product; it should be 15-20 years for a machinery product and a reasonable estimate of demand and sales growth and production costs has to be assumed. For products having a short life-span, such as certain pharmaceuticals, the period can be limited to 5-10 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 which can become a rather important cost item. This information is needed for the funds-flow analysis. If the sales tax is included in the sales revenue (as it is in the *Manual*), it has also to be incorporated in the production costs (schedules 10-3/1 and 10-11 in chapter X). This ensures 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 thus it cancels out.

The production programme

After projecting of sales during different stages of production, a feasibility study should define the detailed production programme. A production programme should define the levels of output to be achieved during specified periods and, from this viewpoint, should be directly related to the specific sales forecasts. To plan such a programme the various production stages should be considered in detail, both in terms of production activities and timing. Within the overall plant capacity, there can be various levels of production activities during different 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 the initial production operations. Owing to various technological, production and commercial difficulties, most projects experience initial problems that can take the form of only a 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. Even if full production were to be achieved in the first year, marketing and sales might prove a bottle-neck. Depending on the nature of the industry and local factor situations, a production and sales target of 40-50 per cent of overall capacity for the first year should not be considered as being unreasonably low. It is usually only towards the third or fourth year that full production levels can be achieved and operating ratios effectively determined and adequately planned for. Even in certain process industries where rated plant capacity is capable of being achieved shortly after the commencement of production, during the initial years production may be programmed at well below such capacity 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, production programming should determine the extent of production integration which may initially be relatively low and increase only gradually. Production programming can take various forms and it should be determined what production pattern is the most suitable in relation to projected sales and growth of production, particularly for the initial years of the project in question.

The determinants of a production programme during the initial production years vary considerably from project to project. This can be illustrated by the different approach that would have to be adopted by the following types of industries: *(a)* single-product, continuous process manufacture as a cement production; *(b)* multiple-product, continuous process production as in an oil refinery; *(c)* batch/job order production such as in an engineering workshop; and *(d)* assembly/mass manufacture as for the production of motor cars. In the first case, the growth of sales may not be a great 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. In the fourth case, the sales aspects in relation to price would be dominant.

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 should be quantified for each stage. For this purpose, a material-flow diagram should be prepared, showing the materials and utilities balances at various stages of production. The nature and general requirements of materials and labour would have been identified prior to the determination of plant capacity but, at this stage, the specific quantities needed for each stage of the production programme and the costs that these entail should be determined. The input requirements and costs have to be assessed for *(a)* basic materials such as raw materials, semi-processed, bought-out items etc.; *(b)* auxiliary materials and factory supplies; *(c)* major utilities; and *(d)* direct labour requirements. Detailed estimates in this regard should 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 is also 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 IV and VIII which deal with material and manpower 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, as material and labour costs are variable 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" and schedule 10-12 "Production cost schedule" in chapter X.

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 the first line e.g. into the cash-flow table for financial planning (schedule 10-8/3) of chapter X. This way it will be easily possible to programme the development of variable production costs as production/sales increase.

Determination of plant capacity

Capacity definitions

The term "production capacity" can be generally defined as the volume or number of units that can be produced during a given period. This definition implies the output expectations from the production 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 since production and product-mix change during the life of a plant.

Two capacity terms, as used in this *Manual*, are defined below:

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 number of units produced during one year under the above conditions. This capacity figure should correspond to the demand figure derived from the market study.

Nominal maximum capacity. This 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 wear and tear parts, will inflate the normal level of production costs.

Determination of the feasible normal plant capacity

In a feasibility study the determination of the appropriate plant capacity is critical. While forecasts of demand and market penetration in respect of a particular product are the starting point, and the limited availability of basic materials and inputs or resources may be a constraint for certain projects, these parameters are still wide enough, in most cases, to require evaluation of various alternative possibilities 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 overall constraints on demand and market forecasts are defined, other components of the feasibility study have to be assessed to determine 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 components of the feasibility study, such as technology and equipment, availability of resources, investment and production costs, and sales and market coverage. Though one of these components will be critical for determining the feasible normal plant capacity in respect of a particular project, all the implications of all these aspects should be taken into consideration.

While detailed technology and equipment considerations should be taken into account after the feasible normal plant capacity is determined, two issues that need to be considered prior to the capacity determination are the 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 is of varying significance for different types of industries. In 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, the economic size of which is increasing rapidly for most products.

Production capacities have tended to increase rapidly in a number of sectors in industrialized countries to take greater advantage of economies of scale. Increased capacities involve investment outlays which are proportionately much lower because of the increased output, resulting in lower unit production costs. When determining the minimum economic size of a project experience gained elsewhere should be used as there is a relationship between the production costs of the project under study and such costs in the same field of production in other projects. If this is not applicable because of limited resources or size of foreseeable demand, the resulting higher production costs and prices, inability to compete in external markets and degree of protection required should be fully brought out.

Another important factor 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 should conform to a minimum economic size and if this is not possible it should be so stated. This applies also in assembly-type industries, 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 possible as production capacity can be distributed between a number of products during different periods. Nevertheless, an appropriate economic size can generally be defined in terms of equipment needs and technological application, though various combinations are possible.

Resource and input constraints

The lack of availability of domestic and/or external resources, and of basic production inputs, either raw materials or intermediate products, may hinder projects in developing countries. This is because of a shortage of foreign exchange for importing equipment, components or intermediate products, or a shortage of domestic resources, either private or public, for major projects involving large investment outlays. Where effective demand and the possible extent of market penetration are high, 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 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 below the minimum economic size, the implications in terms of production costs, product prices and such policy aspects as the degree of protection required should be brought out fully in the feasibility study.

Investment and production costs

The level of investment and production costs would be an increasingly significant determinant if there were no serious resource or material and input constraints. As mentioned above, the volume of investment costs tends to decrease with increased plant capacity per unit of production. Costs do not usually rise in strict proportion to size. This relationship can be expressed in the form:[9]

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

where C_1 is the derived cost of capacity Q_1, C_2 is known cost of capacity Q_2, and x is the cost-capacity factor. On the average $x = 0.6$. Q can be in any consistent units as it enters only as a ratio. In the chemical industry, this capacity-cost relationship is sometimes referred to as the 6/10th factor rule.

The cost-capacity ratio differs from industry to industry and can range from 0.2 to 0.9. In general, however, and particularly for process industries, scale economies may prove to be significant in respect of investment costs for higher plant capacities. Production costs at higher capacities should be evaluated together with investment outlay. 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. The cost-capacity relationship should be assessed, insofar as the proposed project is concerned, both in terms of investment outlay and production costs, and the parameters defined in relation to the other study components of the project in question.

Projected sales and plant capacity

The relationship of projected sales to feasible normal plant capacity should be carefully assessed for alternative plant capacities. For certain products, which are either new or for which 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 revenue equals production costs (break-even point). As demand and sales grow, plant capacity may be outstripped and there would be an increasing gap between demand and production, which may eventually justify plant expansion. 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 only for a defined period and to relate future sales growth to subsequent plant expansions. The relationship adopted between sales projections and plant capacity depends on such factors as the dependability of market forecast, of price elasticity demand or the cost-capacity ratio.

In 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 has to be quantified and alternative cash flows may need to be prepared so that an evaluation can be made of the implications of different production capacities against the feasible normal plant capacity determined as being most appropriate. Investment and

[9] Bertil Hedberg, "Factors influencing process selection, plants size and licence fees in the petrochemical and fertilizer industry", Paper prepared for the Regional Consultation for the Arab Countries of the Middle East and North Africa on Licensing of Technology with Reference to the Petrochemical and Fertilizer Industry, Benghazi, Libyan Arab Jamahiriya, 1-6 December 1975 (ID/WG.219/7).

production costs should be assessed at two or three alternative production levels with consequent impact on product pricing and sales projections should be for the corresponding levels of production at anticipated product prices at each level. The feasible normal plant capacity selected as the most appropriate should constitute the optimum relationship between the various study components in terms of commercial profitability.

In some projects it may be economic to provide for higher surplus capacity at certain production stages where the cost-capacity ratio is more favourable to such higher capacity and to increase capacities at other stages more or less proportionately to growth of demand. Various combinations are possible and the most appropriate has to be selected.

The concept of plant capacity changes with a number of engineering goods when it relates to the degree of manufacturing integration proposed for a particular project. Investment costs would be directly related to such integration and the less the integration the less 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 parts and such intermediate products and components may be initially inferior in quality and higher in price. The import of components depends on national policy, foreign exchange availability and so. 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, that this may involve.

No specific formula can be given for determining plant capacity. Over a wide range of industries, different components of a feasibility study exercise varying degrees of influence. However, a feasibility study should take adequate account of the 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 weighting of such components.

Depending on the feasible normal capacity decided upon, it may be necessary to quantify the various input requirements in greater detail and to determine the total costs of such inputs. Manpower requirements for a project should be estimated though these may need to be defined in greater detail after selection of technology and equipment. However, as production techniques may be related to availability of skilled personnel, an estimate of manpower requirements could be useful for most projects when feasible normal plant capacity is determined.

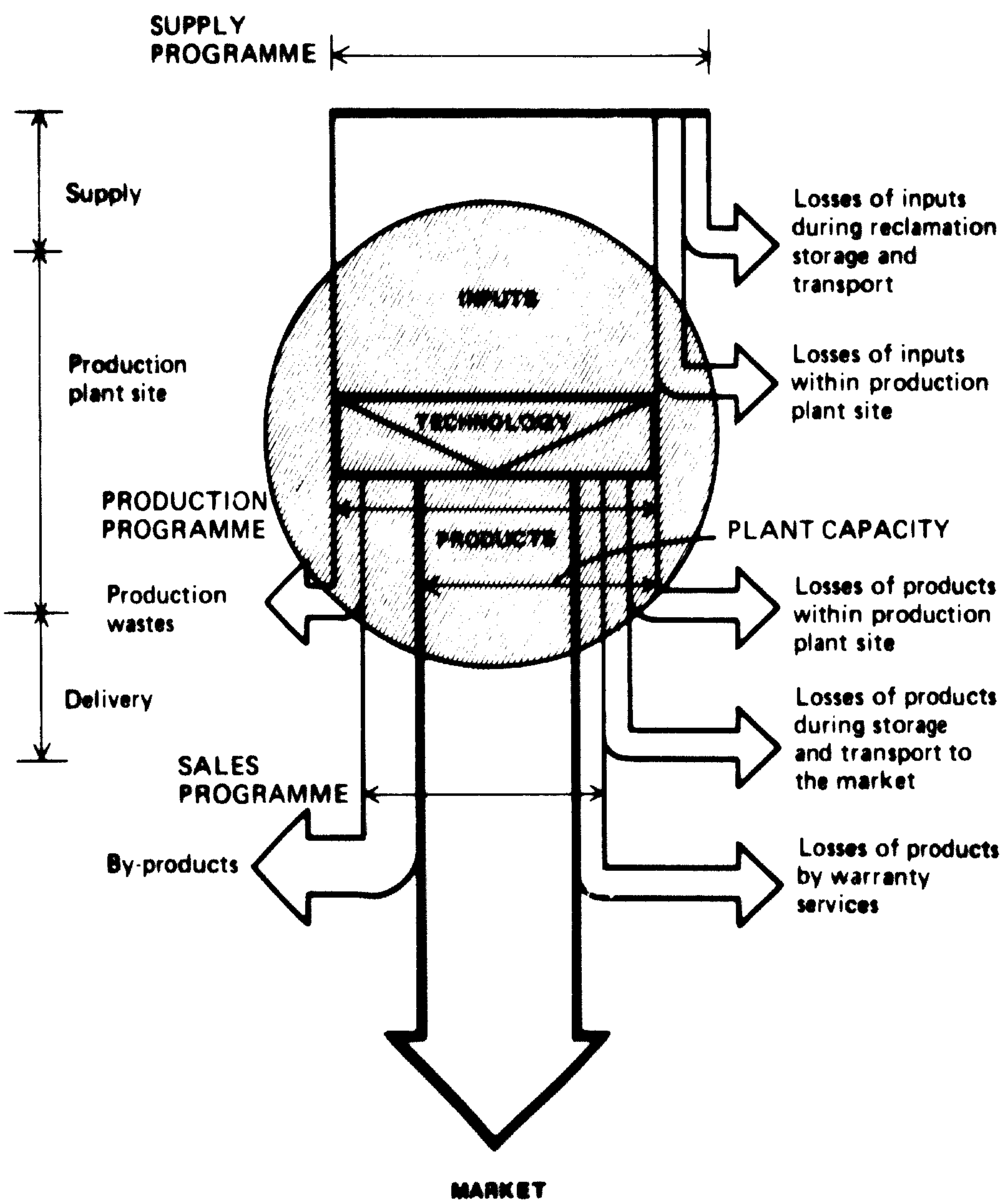
Quantitative relationship between sales, plant capacity and material inputs

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

$$Q_{\text{inputs}} = Q_{\text{outputs}}$$

Figure III 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 may be 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.

Figure III. Flow scheme of plant inputs and outputs



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 annual quantities of products, by-products and production wastes (feasible normal capacity).

The quantitative relationship between these two programmes is as follows:

$$Q_{\text{production programme}} = Q_{\text{sales}} + Q_{\text{losses}} + Q_{\text{warranty services}} + Q_{\text{by-products}} + Q_{\text{production wastes}}$$

and

$$Q_{\text{plant capacity}} = Q_{\text{sales}} + Q_{\text{losses}} + Q_{\text{warranty services}}$$

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:

$$Q_{\text{supply programme}} = Q_{\text{factory inputs}} + Q_{\text{losses}}$$

To estimate 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 losses outside the plant site are to be borne by the supplier and the buyer respectively. For perishable goods such risks may be essential and should, therefore, be taken into consideration.

To summarize, 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.

Bibliography

Behrens, K. Chr. Handbuch der Marktforschung. Wiesbaden, Betriebswirtschaftlicher Verlag Gabler, 1977. 2 v.

Ferber, Robert, ed. Handbook of marketing research. New York, McGraw-Hill, 1974.

Green, Paul *and* Donald Tull. Research for marketing decisions. 3. ed. Englewood Cliffs, New Jersey, Prentice-Hall, 1975.

Heinen, Edmund. Industriebetriebslehre. 5. ed. Wiesbaden, Betriebswirtschaftlicher Verlag Gabler, 1976.

Kanopa, Leonard Jesse. New products, assessing commercial potential. New York, American Management Association, 1966.

Kotler, Philip. Marketing management: analysis, planning and control. 3. ed. Englewood Cliffs, New Jersey, Prentice-Hall, 1976.

Krecmar, John Z. Marketing research in the developing countries. New York, Praeger, 1971.

McCarthy, E. Jerome. Basic marketing; a managerial approach. 5. ed. Homewood, Illinois, Irwin, 1975.

McGuire, E. Patrick. Generating new product ideas. New York, Conference Board, 1972.

Mills, Frederick C. Statistical methods. 3. ed. New York, Holt, 1955.

Parsons, Robert. Statistical analysis: a decision-making approach. New York, Harper and Row, 1974.

Slocum, Donald H. New venture methodology. New York, American Management Association, 1972.

Solomon, M. J. Analysis of projects for economic growth. New York, Praeger, 1970.

Wentz, Walter B. Marketing research: management and methods. New York, Harper and Row, 1972.

IV. MATERIALS AND INPUTS

The selection and description of materials and inputs that are required for the manufacture of the specified products as well as the definition of the supply programme and the computation of material costs are dealt with in this chapter.

There is a close relationship between the definition 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 with one another. The main basis for the selection of materials and inputs is the demand analysis and the production programme and plant capacity derived therefrom.

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

Characteristics of materials and inputs

Materials and inputs should be classified into:

- Raw materials (unprocessed and semi-processed)
- Processed industrial materials (intermediates)
- Manufactures (sub-assemblies)
- Auxiliary materials
- Factory supplies
- Utilities

Data and alternative

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

Selection and description 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
  - Availability (schedule)
  - Unit costs

Supply programme

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
- Replacements due to warranty services
- Local conditions

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)

Cost estimate

Estimate annual costs of materials and inputs:

- Raw materials
- Processed industrial materials
- Manufactures
- Auxiliary materials
- Factory supplies
- 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

(Carry over total of project component to summary sheet (schedule 4-2))

ESTIMATE OF PRODUCTION COST

Materials and inputs

Project component No. ... Description ______

No.	Quantity	Unit	Item description	Local	Foreign	Unit cost	Cost		
							Foreign	Local	Total
1.			**Unprocessed and semi-processed raw materials**						
2.			**Processed industrial materials**						
3.			**Components**						
4.			**Auxiliary materials**						
5.			**Factory supplies**						
6.			**Utilities**						
Total									

Schedule 4-2. Summary sheet–production cost: materials and inputs

(Insert total in schedule 10-11)

SUMMARY SHEET – PRODUCTION COST				
Materials and inputs				
Project component		Production cost carried over		
No.	Description	Foreign	Local	Total
	Total			

Note: This schedule can be expanded to suit particular requirements.

NOTES ON MATERIALS AND INPUTS

Classification of materials and inputs

Raw materials (unprocessed and/or semi-processed)

Agricultural products. If the basic material is an agricultural product, first the quality of the product must be identified. The assessment of the quantities, presently and potentially available, may become a cardinal feature in most pre-investment studies involving the use of agricultural products. In food-processing industries, only the marketable surpluses of agricultural produce should be viewed as basic raw materials, i.e. to the residue remaining after the quantities required for consumption and sowing by producers have been subtracted from the total crop. In the case of commercial crops, the marketable surplus is the total production minus sowing requirements.

If the project involves 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 the introduction of another crop. In the case of sugar-cane, for example, it would be necessary to increase the area under cane cultivation within the same region since cane cannot be transported over long distances without involving prohibitive transportation costs, 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 segment, by geographical or end-use. Storage and transportation costs often assume major significance and should be assessed. In some cases, machinery and methods of collection have also to be studied. For paper plants, the felling and collection of the raw 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 varied 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 from 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 obtained only by specific surveys, even though these tend to be expensive.

Marine products. With 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 in the industrial project.

Mineral products (metallic and non-metallic including clays). For minerals, detailed information on the proposed exploitable deposits is indispensable to feasibility studies. An industrial feasibility study of a project can only be legitimately based on proven reserves. The study should give details, unless the reserves are known to be very extensive, of the viability of opencast or underground mining, the location, size, depth and quality of deposits, and the composition of the ore with other elements, that is, the impurities and the need for beneficiation. Mineral products differ widely in their physical and chemical compositions. Products from 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, frequently, pilot plant tests may be required, in which case no risks should be taken by using short-cuts and samples should be sent to laboratories or research facilities in countries where these exist.

Processed industrial materials and components

Processed industrial materials and goods constitute an expanding category of basic inputs for various industries in developing countries. Such inputs can be generally classified under base metals, semi-processed materials relating to a wide variety of industries in different sectors, and manufactured parts, components and sub-assemblies 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 costs in some detail to ensure that the specifications in the case of the two latter categories suit the production programme envisaged for the project.

In the case of base metals, availability and prices during any particular period tend to operate at an international level. The feasible extent of the substitutability of such metals should be examined such as the replacement of copper elements by aluminium ones in electrical power distribution if these are available at lesser cost. 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 their availability from external sources and the cost, and of the implications of domestic manufacture of such inputs. Since backward linkages for the production of such basic inputs involve large capital outlays, these have to be considered independently and are not usually related to the manufacture of the final product. Thus, polyester fibre production has to be based on caprolactum, which would either have 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 has also to be taken into consideration in assessing the date at which they would be domestically available and the likely pricing.

In assembly-type industries, ranging from durable consumer goods to heavy plant and machinery, thybasic input, apart from steel, is a large conglomeration of parts, components and sub-assemblies.

While similar considerations prevail in respect of domestic and imported inputs, a different emphasis is given by the fact that the nature of the input may be changed by a project through higher backward linkages. Thus, a plant that produces diesel engines can start either with a foundry and go on to the final product, with outside supplies being limited to electrical parts, or have a high degree of bought-out parts and components, limiting itself primarily to the final assembly operation. The feasibility study should determine which alternative is chosen. This aspect is essential in plant-capacity determination and is dealt with in the chapter on project engineering.

Auxiliary materials and factory supplies

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

Utilities

A detailed assessment of the utilities required (electricity, water, steam, compressed air, fuel, effluent disposal) can only be made after analysis and selection of location, technology and plant capacity, but a general assessment of these is a necessary part of the input study. Frequently input studies do not allow for, and even the overall feasibility study tends to underestimate, the utilities required, often resulting in miscalculation of investment and production costs. An estimate of the consumption of utilities is essential for identifying the existing sources of supply and any bottle-necks and shortages that 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 energy situation must specify the requirements and the sources, availability and costs of supply of electric power. It is, therefore, necessary that a feasibility study estimate the maximum power demand, the connected load, peak-load and possible stand-by requirements, and the daily and annual consumption both by shift and in total.

Water. A general estimate should be made of water requirements (taking into account recycling arrangements) for the production process, auxiliary purposes (cooling, steam generation) and general purposes so that these can be considered in locational decisions, at which stage the cost can be specifically defined. The quality of intake water should be tested.

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

Input alternatives

In many projects different raw materials can be used for the same production. When this is the case, the raw materials must be investigated to determine which is most suitable, taking all relevant factors into consideration. If alternative materials are easily available, the problem is one of economics of the process and technology rather than of feedstock selection, although the feed material is still a basic issue.

Planning of overhead costs of materials and inputs

When estimating material and input requirements by project components, the project planner has not only to plan at the level of production cost centres but also 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 VII. Once the material overhead costs are computed the user of the *Manual* can decide which of the following alternatives to adopt:

(a) To transfer the sums directly to the "total production cost schedule" (10-11) in chapter X;

(b) To transfer the material overhead costs to the "overhead cost schedule" (7) and then shift the total overhead costs to schedule 10-11.

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

Characteristics of materials and inputs

Qualitative properties

The type of analysis required to identify the characteristics of materials and inputs depends on the nature of the inputs and their usage in the particular project. An analysis may have to cover various features and characteristics such as:

Physical properties
- Size, dimension, form (plate, rod etc.)
- Density, viscosity, porosity
- State (gaseous, liquid, solid)
- Melting and boiling points

Mechanical properties
- Formability, machinability
- Tensile, compressive and shearing strength
- Elasticity, stiffness, fatigue resistance
- Hardness and anneal

Chemical properties
- Form (emulsion, suspension)
- Composition
- Purity (hardness of water etc.)
- Oxidizing and reducing potentials
- Flammability and self-extinguishing properties

Electrical and magnetic properties
- Magnetization
- Resistance, conductance
- Dielectric constants

There may be inadequate or no experience in the use of a particular material input. In such a case, where use-history has to be developed, pilot plant and other tests may be necessary. Related to input characteristics is the establishment of organic consistency among the materials used. For example, for paper production the mixture of bamboos with bagasse and other raw materials should be defined.

Sources and quantities available

The sources and the constant availability of basic production materials are crucial to 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 depend largely 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 of the commercial and financial viability of most industrial projects. In fact, a number of projects are conceived either to exploit available raw materials or to utilize basic materials that become available from other production processes.

At the initial stage of the study the quantities of basic material inputs that may be required should be assessed principally for the purpose of determining availability and sources for immediate and long-term needs. A final 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 its location and the area of supplies, whether concentrated or dispersed, should be determined. The alternative uses likely to be made of such materials, and the consequent impact on availability, should be assessed for the project in question. For example, natural gas may be available in a remote area where it is economic to use it for the generation of electricity 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 fertilizers and petrochemicals, and it may not be economic to use it for power generation.

The question of transportability and transport costs should be carefully analysed. The distances over which basic material inputs have to be transported and the available and potential means of transportation should be defined together with possible bottle-necks.

When the basic material has to be imported, either in whole or in part, the implications of such imports should be fully brought out. First, the sources of imported inputs have to be determined. Certain materials such as intermediates and commonly-used products (springs, bearings etc.) are available from external sources whose access, however, may be greatly restricted in certain cases. Foreign-exchange restrictions may allow for imports only from particular currency areas or 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 be a lack of knowledge of alternative external sources for basic inputs, especially of intermediate and manufactured inputs.

Secondly, the uncertainty that may relate to imported inputs should be stated. There have been cases where projects have been set up in developing countries based on imported raw materials from particular sources which have then ceased to produce the material in question. Such cases primarily relate to processed materials and manufactured parts and components.

Thirdly, the implications of domestic production of a basic material that was being imported should be analysed. In most developing countries, such production is accompanied by import control and user industries have to adjust to domestic supplies of basic materials. This may involve adjustments to the quality, specifications and price of such materials. While these changes cannot be anticipated in any great detail, it should be recognized that when a project is based on imported basic materials, external and internal forces can affect availability and they should at least be identified and the general implications highlighted.

Unit costs

As well as availability, the unit cost of basic materials and inputs has to be analysed in detail as this is 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 lower the elasticity, the higher the price as related to growing demand for a particular material. For domestic inputs, the costs of alternative means of transport should be included. In the case of imported materials, the c.i.f. 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 of imported inputs would be less subject to fluctuations except when: *(a)* international prices are subject to considerable fluctuations; *(b)* monopolistic or oligopolistic conditions prevail; *(c)* supplies are linked contractually to a particular source such as between a foreign subsidiary and parent or licensee and licensor; or *(d)* there is governmental action by way of tariff or duties or major changes therein.

The impact of the domestic manufacture of a material that is a basic input for an industrial project may be significant. In most cases, domestic production costs and consequently prices of such inputs are 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 should be assessed.

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 a basis to calculate the magnitudes and types of inputs as well as the delivery requirements. 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 a continuous supply cannot be guaranteed e.g. owing to the locational separation of plant and the origin of inputs or transportation difficulties. The costs for additional warehousing and stockpiling have to be incorporated into the investment and production cost computations.

The major objective of the supply programme is to determine the annual costs of material and other inputs that constitute a major portion of the annual production costs. The results thus obtained have to be carried forward to chapter X in order to be entered later into the cash-flow table.

The relationship between sales programme, plant capacity and supply programme is explained in chapter III.

Bibliography

Henzel, Friedrich. Die industrieinternen Marktprobleme: Beschaffung, Lagerhaltung, Absatz. Berlin, Duncker und Humblot, 1973 (Führungsprobleme der industriellen Unternehmung, v. 2)

Lee, L. *and* D. Dobler, Purchasing and material management. McGraw-Hill, New York, 1971.

Patton. Materials in industry. Englewood Cliffs, New Jersey Prentice-Hall, 1968.

United Nations. A guide to industrial purchasing. (ID/82)
Sales no.: 72.II.B.19.

——— UNIDO guides to information sources.

The following topics have been covered so far:

No. 1/Rev.1	Meat-processing industry
No. 2/Rev.1	Cement and concrete industry
No. 3	Leather and leather goods industry
No. 4/Rev.1	Furniture and joinery industry
No. 5/Rev.1	Foundry industry
No. 6	Industrial quality control
No. 7/Rev.1	Vegetable oil processing industry
No. 8	Agricultural implements and machinery industry
No. 9	Building boards from wood and other fibrous materials

No. 10	Pesticides industry
No. 11	Pulp and paper industry
No. 12	Clothing industry
No. 13	Animal feed industry
No. 14	Printing and graphics industry
No. 15	Non-alcoholic beverage industry
No. 16	Glass industry
No. 17	Ceramics industry
No. 18	Paint and varnish industry
No. 19	Canning industry
No. 20	Pharmaceutical industry
No. 21	Fertilizer industry
No. 22	Machine tool industry
No. 23	Dairy product manufacturing industry
No. 24	Soap and detergent industry
No. 25	Beer and wine industry
No. 26	Iron and steel industry
No. 27	Packaging industry
No. 28	Coffee, cocoa, tea and spices

V. 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 made from a fairly wide geographical area within which several alternative sites may have to be considered. Once the site has been selected, the impact on the environment of erecting and operating the industrial plant has to be studied.

Location

Data and alternatives

Describe the fundamental data and requirements on the locations for plant operation

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

Choice of location

Select and describe in detail the chosen optimum location

State reasons for selection

Describe location, state:

- Country
- Geographical location
- District
- Town

For the choice of location, the following aspects, among others, should be taken into consideration:

- Public policies
- Material versus market orientation
- Local conditions: infrastructure and socio-economic environment

Site

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

Site selection

Select and describe in detail the chosen 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 connections
    Utility connections, next points of tie-in
    Existing obstacles and structures
    Underground conditions

- Existing rights of way, easements etc.

For the selection of the plant site, the following aspects, among others, 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

Cost estimate

Investment cost, such as:

- Land
- Taxes
- Legal expenses
- Payments to neighbours
- Rights of way (one time payments)

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

Production cost, such as annual payments for:

- Rights of way
- Easements
- Rents

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

Local conditions

List and describe local conditions
Climate
Site and terrain
Transport facilities
Water supply
Power supply
Waste disposal
Manpower

Fiscal and legal regulations
Construction, erection and maintenance facilities
Living conditions
A general check-list of local conditions is annexed to the notes on this chapter

Environmental impacts

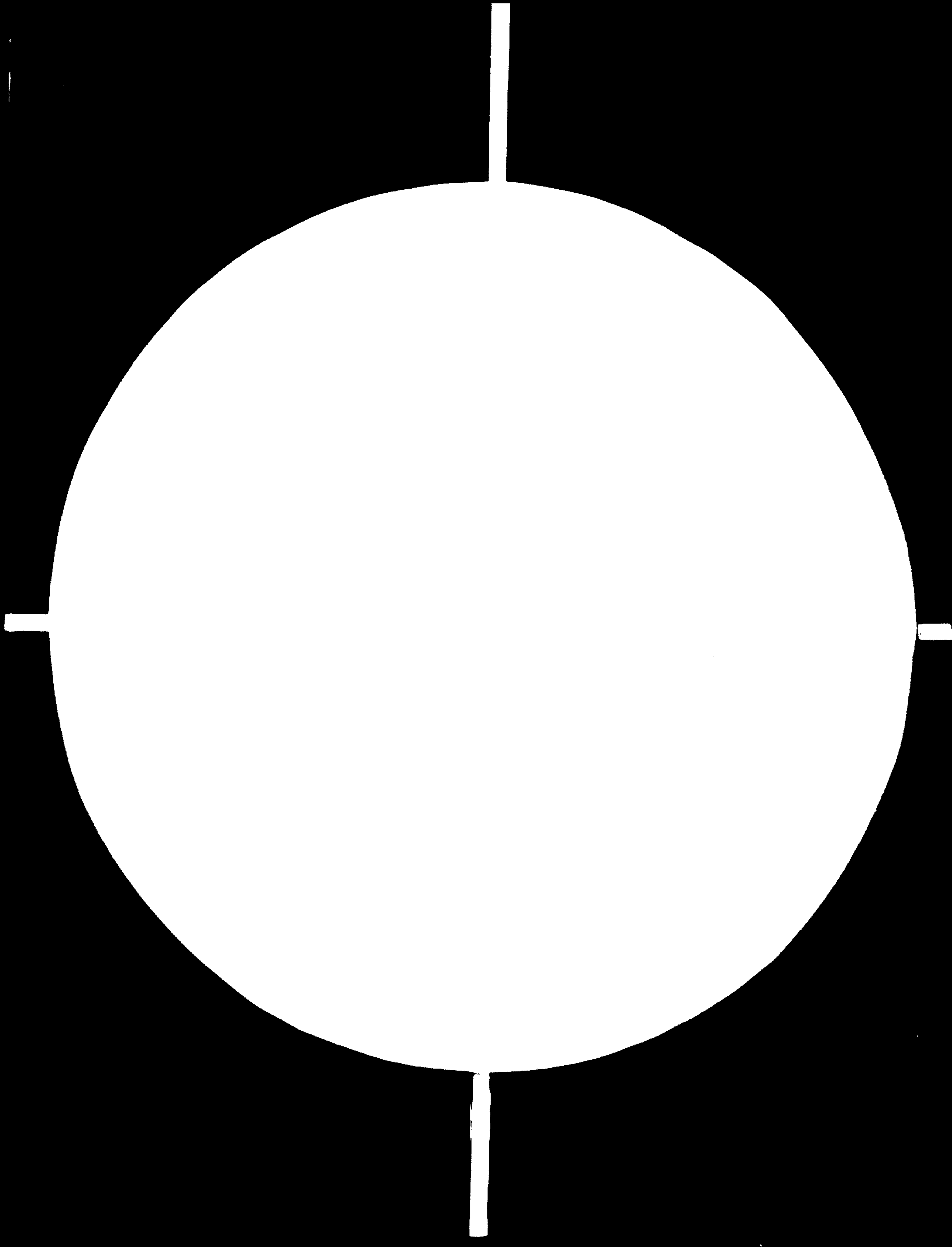
Describe environmental impacts to be expected because of erection and operation of plant on

Population (increase of employment etc.)
Infrastructure (development of traffic network, public utilities etc.)
Ecology (water, air, soil, plants, animals etc.)
Landscape

Schedule 5-1 follows

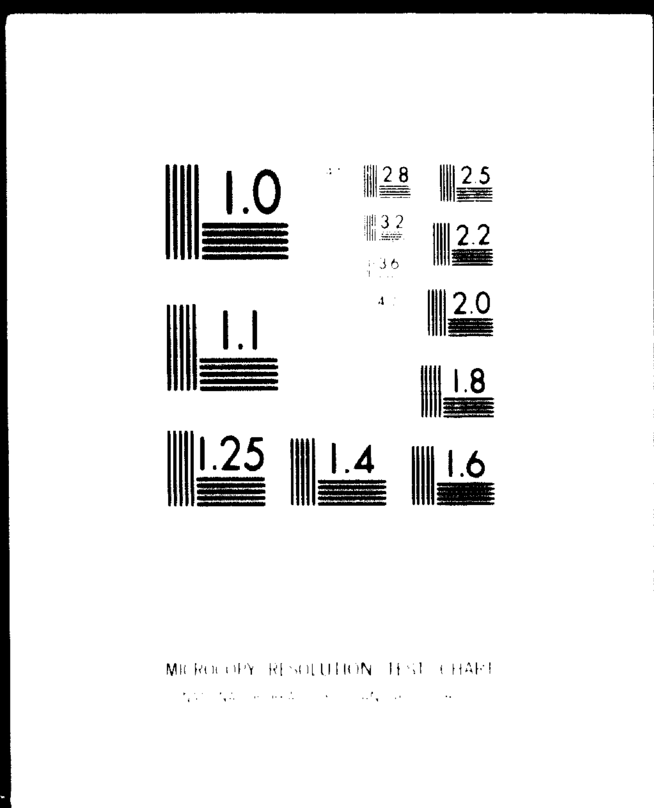
C-15

79.11.16



2 OF 3

08219



24x
C

Schedule 5-1. Estimate of investment cost: land

(Insert total in schedule 10-1/1)

ESTIMATE OF INVESTMENT COST

Land

No.	Quantity	Unit	Item description	Local	Foreign	Unit cost	Cost		
							Foreign	Local	Total
			Land Taxes Legal expenses Payments to neighbours Rights of way						
			Total						

Schedule 5-2. Estimate of production cost: land

(Insert total in schedule 7)

ESTIMATE OF PRODUCTION COST

Land

No.	Quantity	Unit	Item description	Local	Foreign	Unit cost	Cost: Foreign	Cost: Local	Cost: Total
			Annual payments for: Rights of way Easements Rents						
Total									

NOTES ON LOCATION AND SITE

Choice of location

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

The determination of industrial location should take into consideration three principal considerations: public policies, the relative weight of, and the 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 proximity of raw materials and of markets because transport costs are of major significance, other factors have assumed increased importance in recent years.

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 should be clearly defined. In a number of developed and developing countries there is considerable pressure for the decentralization of industries. In industrialized countries, such dispersal is sought principally on environmental grounds to reduce industrial pollution in areas of heavy industrial concentration. While the emphasis on environmental considerations is increasing in many developing countries also, the main objective of decentralization is to reduce the external diseconomies of urban industrial concentration.

Even when public policies do not take the form of restrictions on industrial growth in particular areas or regions, knowledge of locational policies is necessary so that adequate consideration can be given to various concessions and incentives that may be a part of such policies. In some countries, specific geographical zones have been set up and varying patterns of financial incentives have been prescribed for them. In some 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 in which financial and other incentives are being given to industrial projects located in underdeveloped regions. The impact of such incentives on the economics of a proposed project should be analysed. For large and medium projects, such incentives may not affect project economics to any critical extent; however, they may assume much greater significance for individual projects that are not influenced by locational factors.

Apart from the element of persuasion, public policies may directly determine industrial locations when there is a substantial involvement of public or institutional finance. The growth of public sector enterprises has been significant in the industrial growth of a number of developing countries. In these cases, wider policies, such as regional industrial dispersal, tend to play a vital part in locational decisions. If feasibility studies are sponsored for such projects, however, it is 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.

Material versus market orientation

Critical to location selection is the impact on a particular project 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 is to calculate the transport, production and distribution costs at alternative locations determined principally by the availability of raw materials and principal markets. A resource-based unit should be located near the source of the basic material as transport costs, for example for limestone for a cement factory, may be very high and copper or nitrate deposits can be most economically processed near the location of the ores. Projects based largely on imported materials may need to be located at ports or near terminals. On the other hand, perishable products or agro-processing industries are market-oriented and it is advantageous to locate such production near the principal consumption centres. For products that can be determined as resource-oriented or substantially market-oriented, project locations largely follow the location of resources or consumption centres as the case may be.

A great many industrial products, however, are not affected by any one particular factor. Petroleum products and petrochemicals, for example, can be located at source, near consumption centres or even at some intermediate point. A wide range of consumer goods and other industries can be located at various distances from materials and markets without unduly distorting project economics. Even in the case of engineering goods, including machine-building, assembly and sub-assembly plants, other locational factors exert considerable influence though the products, in terms of bulk and transport costs, can be said to be primarily market-oriented.

Because of the widening scope of industrial activities, transport costs of materials as compared to products, though still vital for certain projects, have to be viewed in conjunction with such other aspects as production factor substitution, demand elasticity and the possibilities of alternative pricing formulae, all of which could materially affect the weighting of raw material or market factors.

Local conditions: infrastructure and socio-economic environment

Infrastructure

The availability of infrastructural investment is vital to the operation of any project and therefore the energy, transport, water, communications and housing for the project proposal should be assessed. For this purpose it is necessary to have an understanding of the capacity to be installed and the technology to be applied.

The inadequat supply of electricity or its high unit cost in a particular area can constitute a major constraint for a project or for a particular technological process such as electrical smelting. Where the location of a resource-based project cannot be changed, the project has to provide its own power source. The power requirements can be defined in relation to plant capacity and the supply and cost at various locations should be studied. To determine the impact of energy factors, however, it may be necessary to collect and compare considerable detailed data for alternative locations. In the case of electrical energy, such data would need to cov[illegible]: *(a)* the amount available; *(b)* whether high- or low-tension current; *(c)* stability of supply; *(d)* point of tie-in for a particular area; and *(e)* price at different consumption levels. For coal, coke, fuel oil or gas, such data should cover, for each item, the quantities normally available, quality, calorific value and chemical composition (to determine pollutants), source, distance to different locations, transport facilities and cost at alternative locations.

Transport (by rail, road, air or water) should be available for the inflow of various inputs and the marketing of products. Availability and cost will have to be detailed for the total volume of inputs into the proposed plant and the total outputs leaving the plant with comparisons for various alternative [illegible]. The amount of detail needed depends on the nature and the extent of [illegible]lved.

For sea transport, details of port facilities are [illegible]e depth of the relevant harbour basin, crane capacity, the siz[illegible] the port, and port warehousing facilities and charges. For [illegible]t may be necessary to define the width of roads and b[illegible]d bearing capacities of bridges, the category of road and the [illegible]s that may devolve onto the project, apart from the cost of su[illegible]ad has to be constructed to a particular location, estimates will have [illegible] and details of the construction taken into account. For extensive rail transport, an assessment would be necessary of the capacity of rolling stock, loading and unloading facilities, warehousing and storage facilities and any seasonal or other bottle-necks that may develop, apart from the cost of rail transport to the principal movement points to and from possible plant locations. Water transport may also be feasible in which case the width and depth of rivers and canals, the capacity of barges or other vessels that can be used and other related aspects should be considered. In each case, the likely cost of transport should be estimated, apart from other considerations.

The water supply, apart from such projects as a brewery for which it is also a raw material, should be identified. The water required for a project can be ascertained from the plant capacity and technology. First, the availability of water and the costs entailed should be determined, including: *(a)* the requisite quantities that could be obtained, if any, from public utilities, together with the conditions of supply and price; or *(b)* the separate facilities, and their estimated cost, that would have to be provided by the project from surface (e.g. a river) or subsurface sources. Secondly, the quality of the water at different locations should be assessed for different purposes, such as for drinking, for use as a coolant and for steam generation.

[illegible]nd communication facilities, including telex and telephone, s[illegible] be [illegible]or alterna[illegible]e locations.

Socio-economic environment

The location study should also assess *(a)* waste disposal; *(b)* availability of labour; *(c)* construction and maintenance facilities; *(d)* fiscal and legal regulations; and *(e)* climatic conditions.

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

Certain effluents that are noxious, unpleasant or even dangerous require special treatment. The location study should determine the extent of effluents and the possible manner of disposal at alternative locations. For this purpose, it may be necessary to take into account any ordinances on emission treatment that may prescribe the specific steps and levels of treatment and the disposal. In such cases, the cost of the treatment, of pumping and piping facilities or of establishing and maintaining effluent dumps have to be considered. Climatic and environmental data may need to be collected to determine the likely impact on a community of waste disposal from a project. This would be particularly applicable in the case of waste material discharged into the atmosphere or liquids discharged into rivers and seas.

When considering alternative locations, the availability of skilled and semi-skilled workers, and the type of skills, should be taken into account. Labour requirements should be estimated together with allowances for various categories and general living conditions, including housing, social welfare and recreational facilities. Labour history should be identified together with any special labour legislation, conditions and attitudes.

Most major projects incorporate training programmes, either during plant construction or as in-plant training.

For certain projects it may be desirable to consider the facilities available at different locations for civil construction, machinery erection or installation and maintenance of plant facilities. This would largely depend on the availability and quality of contractors and building materials. While such facilities would not be a locational determinant, they may affect project costs and should be considered in this regard.

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

Climate can be an important locational factor. Apart from the direct impact on project costs of such factors as dehumidification, air-conditioning, refrigeration or special drainage, the environmental effects may be significant. Information should be collected on temperature, rainfall, flooding, dust, fumes, earthquake frequency and other factors for different locations. A check-list on local conditions is annexed to the notes on this chapter.

Final choice of location

A good starting point for the locational analysis in a feasibility study is the location of raw materials and inputs or the principal consumption centres in relation to the plant. Transport costs of materials from the sources to alternative locations should be taken into account. The substitution of materials and inputs should also be considered. Demand elasticities, as assessed in the demand analysis, and alternative pricing formulae for different market segments should also be taken into consideration. Infrastructure should then be considered in terms of availability and cost. A combination of these aspects enables a determination of production (including distribution) costs at alternative locations. Added to these costs should be an allowance for socio-economic environmental factors. The best location would be one where production costs are lowest and where there is no great difference in such costs between locations. However, other socio-economic and environmental factors, including the climate and social welfare facilities, such as education, medical services and recreational facilities, can be assessed in qualitative terms. In projects where production costs do not vary much for alternative locations, the qualitative socio-economic environmental considerations could have an overriding effect in locational recommendations.[7]

For projects that are not unduly resource- or market-oriented, an optimum location could well combine reasonable proximity to raw materials and markets; favourable environmental conditions; a good pool of labour; adequate power and fuel, at reasonable cost; equitable taxes; good transport; an adequate water supply; and facilities for waste disposal. A feasibility study has to take all these factors into consideration.

Site selection

Once the geographical area is decided upon, the specific site for the project or at least the costs of two or three alternative sites should be defined in the feasibility study. This will need an evaluation of the characteristics of each site, as follows: *(a)* cost of land; *(b)* local conditions: infrastructure and socio-economic environment; and *(c)* site preparation and development. The importance of these characteristics varies depending on the nature of the project, the type of civil construction contemplated, the weight of the heavier equipment items, the type of effluent, the number of workers etc. The site selection study should therefore review all these aspects in the context of the proposed project. Full information may not be readily available and it may be necessary to investigate further.

Cost of land

The cost of land is an obvious element of site determination and information on this is usually available. Industrial areas are possible site alternatives and in any event, provide indications of land costs in the area.

Local conditions: infrastructure and socio-economic environment

The availability and cost of electricity is common for most sites within a given location. If an independent power facility has to be set up as part of the project, the cost tends to be similar at various sites within an overall location. Similarly, cost of electrical substations and electrical equipment, such as transformers, tend to be the same at different sites. However, the cost of extending power transmission lines to the factory site varies substantially from site to site and has to be estimated.

Transport is very important when comparing the suitability of different sites. Since the volume of inputs and outputs will be known after the plant capacity is determined, transport alternatives and costs could then be calculated and compared for different sites. Preliminary estimates should be made for: *(a)* terminals for oil, gas or other materials; *(b)* railway sidings from the nearest railhead; *(c)* feeder roads connecting with main highways; and *(d)* water transport.

For a determined plant capacity, it would be easy to define the water required for various purposes, such as cooling, steam generation and drinking. Where water is a requirement for the manufacturing process, as for pulp, such assessment is more important and the source and cost of the water supply has to be estimated at alternative sites. Such costs can vary considerably and may be a significant element of site selection, particularly if large quantities of water are required.

The disposal of effluent may be a problem for many industries, as discussed earlier in this chapter. The possibilities for effluent disposal at different sites should be carefully studied bearing in mind the type of effluent. The site for a cement plant should not be selected to windward of a dense urban community or refinery effluent discharged upstream of a drinking water supply.

Labour availability at plant sites is important when considering the construction of housing and supporting facilities. Such construction may be necessary for major projects, such as steel plants and heavy engineering industries, involving a large labour complement but would prove an unduly heavy financial burden in most other cases, at least during the initial stages.

To determine building and plant designs a survey should be made of soil conditions, including bearing qualities and groundwater level, at alternative sites. Special attention should be paid to construction in the seismic zones.

Site preparation and development

The cost of site preparation and development, as classified in schedule 6-4, should be considered for alternative sites and detailed for the selected site.

Final site selection

The selection of plant location and site does not have to be undertaken in two stages. Generally, alternative sites are considered in conjunction with wider locational considerations so that much of the information required is collected simultaneously. It is useful if the conclusions on the location of the site study are tabulated so that the relevant information can be incorporated into the next stage of project formulation.

It is often necessary to limit the choice of plant site and location according to guidelines made by the project sponsors, whether public, institutional or private, which reduces the task of the feasibility study. If, however, the study has to indicate the various alternatives without any such guidelines or constraints, the foregoing factors should be considered.

Check-list on local conditions

Climate

Air temperature

Maximum–minimum–average temperatures over one day–one year–ten years

Humidity

Maximum–minimum–average humidity over one day–one year–ten years

Sunshine

Daily duration of sunshine over one year–ten years

Wind

Direction and number of days (wind rose)
Direction and maximum velocity
Destructive winds (hurricanes etc.)

Precipitation (rain, snow)

Duration and height of precipitation (maximum–minimum–average) over one hour–one-day–one month–one year–ten years
Extremes (hailstorms etc.)

Dust and fumes

Dust winds (duration, direction, velocity, contents of matter per m^3 of air)
Drifting sand
Fumes from neighbouring plants

Flooding from surface sources

Height, duration and season of flooding

Earthquakes

Magnitude according to international scales (e.g. Richter scale)
Frequency

Site and terrain

Location of site

Address (country, district, town, street, number)
Neighbours (name, addresses, types of industries)

Site description

Dimensions (length, width)
Height above sea level
Geographical orientation
Topography
Existing rights of way (water, powerline, roads etc.)
Price of real estate

Transport facilities

Roads

- Width of roads and bridges
- Bearing capacity
- Clearances under bridges
- Types of road (all weather, macadam, dirt road)
- Close-downs due to seasonal conditions
- Road network (show on maps)

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

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

Air transport

- Type of landing place (airport, air strip)
- Length of runways
- Warehouses and storage
- Fares

Passenger transport systems

- Buses, trams etc.

Water supply

Characteristics (without reference to specific uses)

- Dissolved content: hardness, corrosiveness, gases
- Suspended matter
- Temperature: max-min over one day, max-min over one year
- Pressure: maximum, minimum

Sources

- From public utilities: maximum quantity, place of possible connection, diameter and material of existing network, pressure, price
- By private development of: surface supplies (river), sub-surface supplies (groundwater), reclaimed effluents
- This involves: water table studies including pumping tests, riparian rights and easement, allotments (in conservation areas), impounding (for levelling of availability), treatment of effluents for recovery
- Methods of treatment: removal of suspended matter, removal of dissolved matter, biological treatment of effluents

Power supply

Electricity from public or private utilities
    Power available (kVA)
    Voltage (V) (high, low)
    Point of tie-in (distance to site)
    Price (tariff)

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

Coal, coke, gas
    Quantity
    Quality (kJ/kg)
    Source
    Price

Steam
    Quantity
    Pressure
    Point of tie-in (connection to site)
    Price

Communication systems
    Telephone: system (hand-operated–automatic), capacity, point of tie-in, tariff
    Telex
    Wireless

Waste disposal

Dumps
    Type, location, access, dues, public transport

Sewage system
    Type (rainwater, mixed), diameter and material of pipes in the network, point of tie-in, dues

Sewage treatment plant
    Type, location, dues

Manpower

Employees
    Type and level of training available, salaries

Labour
    Type and level of skill, availability, wages

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

Labour history and jurisdiction, labour laws and industrial relations

Fiscal and legal regulations

Authorities (local-regional-national)

Fiscal regulations

Taxes, customs, depreciation rates etc.

Legal regulations

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

Insurances

Fire, accident, liability, flood and storm damage

The liability to maintain on-site medical facilities

Construction, erection and maintenance facilities

Contractors

Civil, electrical, mechanical etc.
State: firm, address, capacity, level of skill

Building materials

State: availability, quality, source, price

Living conditions

Housing

Food

Recreation

Schools

Places of worship

Shopping facilities

Medical welfare

Bibliography

Greenhut, Melvin L. Plant location in theory and in practice. Chapel Hill, University of North Carolina Press, 1956.

Hilhorst, J. G. M. Regional planning. Rotterdam, University Press, 1971.

Jacob, H. Zur Standortwahl der Unternehmungen. Wiesbaden, Betriebswirtschaftlicher Verlag Gabler, 1976.

Schärlig, Alain. Où construire l'usine? Paris, Dunod, 1973.

Soderman, S. Industrial location planning. New York, Halsted, 1975.

United Nations. Industrial location and regional development; an annotated bibliography. (ID/43)
Sales no.: 70.II.B.15.

_______ Industrial location and regional development. Proceedings of interregional seminar, Minsk, 14-26 August 1968. 2 v. (ID/50).
Sales no.: 71.II.B.18.

VI. 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 should 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.

Project layouts

Data and alternatives

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

- Production programme
- Supply programme
- Technology
- Equipment
- Civil works
- Local conditions

Prepare and describe alternative project layouts

Selection of layouts

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

Scope of project

Data and alternatives

State the data required to define the scope of the project
Prepare and describe alternatives

Selection of the scope of the project

Select and describe in detail the optimum scope of the project
State reasons for the selection
Use physical layout drawings to show the scope of project and project components
Number and list the project components required to serve as bases for further engineering and cost estimates

Technology(ies)

Data and alternatives

State the data required for the technologies to be used
Describe alternative technologies

Selection of technology

Select and describe in detail the optimum technologies
When selecting the technologies the following aspects should be considered:

- The nature of the technologies required (e.g. labour versus capital intensity, non-obsolescence)
- Sources
- Means of acquisition: licensing; purchase, joint venture
- Cost

State the reasons for the selection
Describe the selected technology, stating the type, source, specification

Cost estimate

Investment costs
Lump sum payments—use schedule 6-1 and insert total in schedule 10-1/1.

Production cost

Royalties

Fixed annual payments—use schedule 6-1 and insert total in schedule 10-11

Equipment

Equipment should be classified into production, auxiliary, service equipment, spare parts and tools. For details see the check-list attached to the notes of this chpater

Data and alternatives

State the data for equipment engineering
List the necessary equipment and alternatives

Selection of equipment

Select and describe in detail optimum equipment
State reasons for the selection
Describe selected equipment, stating number, type, specification, capacity, source

Cost estimate

Estimate the cost of equipment:
Investment
Production
Auxiliary
Service
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

Civil engineering works

Civil engineering works should be classified into site preparation and development, buildings and special civil works, and outdoor works (auxiliary and service facilities). For details see check-lists.

Data and alternatives

Describe data for civil engineering
List civil engineering works and possible alternatives
Physical plant layout
Availability and quality of construction material, plant and manpower
Technical requirements of plant operation
Local conditions
Cost

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)

Cost estimates

Estimate the cost of civil engineering works:

- Investment costs
- Site preparation and development
- Buildings and special civil works
- Outdoor works

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

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

- Site preparation and development
- Building and special civil works
- Outdoor works

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

Schedule 6-1. Estimate of technology costs

Technology(ies) selected
 Specification(s)
 Supplier(s)

Costs

Lump-sum payments (incorporated fixed assets)

Technology	Foreign	Local	Total
Total[a]			

[a] Insert in schedule 10–1/1.

Royalty payments (as ...% of annual sales for a period of ... years)

Year	Anticipated sales	Cost of estimated royalties		
		Foreign	Local	Total[b]
1				
2				
3				
4				
.				
.				

[b] Insert in schedule 7.

Royalty payments (as a fixed annual payment for a period of ... years)

Technology	Cost of estimated royalties		
	Foreign	Local	Total
.			
.			
.			
.			
Total[b]			

[b] Insert in schedule 7.

Schedule 6-2. Estimate of investment cost: equipment

(Carry over total of project component to summary sheet (schedule 6-3))

ESTIMATE OF INVESTMENT COST

Equipment

Project component No.___ Description ___________________

No.	Quantity	Unit	Item description	Local	Foreign	Unit cost	Cost: Foreign	Cost: Local	Cost: Total
1.			Production equipment						
2.			Auxiliary equipment						
3.			Service equipment						
4.			Primary stock of spare parts, wear and tear parts, tools						
Total									

Schedule 6-3. Summary sheet–investment cost: equipment

(Insert total in schedule 10-1/1)

SUMMARY SHEET – INVESTMENT COST				
Equipment				
Project component		Investment cost carried over		
No.	Description	Foreign	Local	Total
	Total			

Note: This schedule can be expanded to suit particular requirements.

Schedule 6-4. Estimate of investment cost: civil engineering works

(Carry over total of project component to summary sheet (schedule 6-5))

ESTIMATE OF INVESTMENT COST

Civil engineering works

Project component No. __ Description ____________________

No.	Quantity	Unit	Item description	Local	Foreign	Unit cost	Cost		
							Foreign	Local	Total
1.			Site preparation and development						
2.			Buildings and special civil works						
3.			Outdoor works						
			Total						

Schedule 6-5. Summary sheet—investment cost: civil engineering works

(Insert total in schedule 10-1/1)

SUMMARY SHEET – INVESTMENT COST				
Civil engineering works				
Project component		Investment cost carried over		
No.	Description	Foreign	Local	Total
	Total			

Note: This schedule can be expanded to suit particular requirements.

Schedule 6-6. Estimate of production cost: civil engineering works

(Carry over total of project component to summary sheet (schedule 6-7))

ESTIMATE OF PRODUCTION COST

Civil engineering works

Project component No. __ Description ______________

No.	Quantity	Unit	Item description	Local	Foreign	Unit cost	Cost		
							Foreign	Local	Total
			Maintenance and repair of works of:						
1.			Site preparation and development						
2.			Buildings and special civil works						
3.			Outdoor works						
			Total						

Schedule 6-7. Summary sheet–production cost: civil engineering works

(Insert total in schedule 7)

SUMMARY SHEET – PRODUCTION COST				
Civil engineering works				
Project component		Production cost carried over		
No.	Description	Foreign	Local	Total
	Total			

Note: This schedule can be expanded to suit particular requirements.

NOTES ON PROJECT ENGINEERING

Project charts and layouts

Project charts and layouts define the scope of the entire project and serve as a basis for detailed engineering work to estimate the investment and production costs. They are not usually to scale. The types of charts and layouts, and the degree of detail depend on the size and technical sophistication of the project.

When preparing layouts, data should be available on the size of the market, the estimated plant capacity, the supply base of the project, the conditions prevailing at the plant site, and the required technology, equipment and civil works.

The following are some typical functional charts and layout drawings:

(a) General functional layouts which show the interrelationship between equipment, buildings and civil works. It is essential in these layouts to provide for possible extensions of production, storage, transport, buildings etc.;

(b) Materials-flow diagrams which 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. The main equipment and/or structures and buildings are frequently illustrated;

(c) Quantity flow diagrams which indicate the quantities entering or leaving the process; the magnitudes involved are frequently indicated by varying widths of the flow line;

(d) Production line diagrams which show in detail for each section the progress of production, stating location, space requirements, description and dimensions of main equipment and its distance from the next section, requirements for power and other utilities, and the dimensions of foundations and mounting devices;

(e) Transport layouts which show distances and means of transport outside the production line. They are used if greater distances are to be bridged for inputs and outputs;

(f) Utility consumption layouts which show the major consumption points of power, water, gas, compressed air etc., the qualities and quantities of utilities required and the daily consumption. These layouts serve as bases for the dimensioning of the utility supply installations, for contractual arrangements with the suppliers and for the calculation of investment and production cost;

(g) Intercom layouts which indicate the necessary connections of all parts of the project with telephones, the telex, intercoms etc.;

(h) Manpower requirement layouts which indicate the number and the skills of the manpower required;

(i) Organizational layouts (organigrams) which show the organizational set-up of the entire project. This layout is often supported by an organization requirements chart, showing location and personnel requirements of specific departments and their functional relationship;

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

(i) Major equipment;
(ii) Structures and buildings, civil works;
(iii) Roads, railroads and other transport facilities up to their point of connection with the public network;
(iv) Various utility lines (electricity, water, gas, telephone, sewage) within the plant site and outside up to their connecting points with public or private networks;
(v) Areas for further extension.

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

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

For scope of project see part one.

Technology

The feasibility study should define the technology required for a particular project, evaluate technological alternatives and select the most appropriate technology in terms of optimum combination of project components. The various implications of the acquisition of such technology should be assessed, including contractual aspects of technology licensing when applicable. In the case of technology licensing, the specific engineering and technical services associated with the selected technology should also be defined and disaggregated from the technology package and the agencies to perform such services identified. The selection and acquisition of technology has then to de dove-tailed with the selection of machinery and equipment as this often bears a close relation to the production techniques chosen.

Considerable literature has appeared in recent years on the concepts of technological choice. Most such studies centre on the degree of capital intensity as opposed to the extent of labour orientation for a particular project. With relatively cheap labour available in most developing countries, the labour-intensity aspect is important, both in terms of overall employment objectives and the direct cost implications of capital substitution at the enterprise level. The interrelationship between factor prices of labour and capital and the implications of substantial changes in one or the other should be reflected 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 selection should be based on the combination of various factor resources in the project.

Market

In most industrial subsectors, the market for technology tends to be imperfect with oligopolistic tendencies increasing as products become more sophisticated. Thus, while various alternative production techniques may be available for the manufacture of relatively simple consumer goods, technological choices decrease with the production of more sophisticated products. In dynamic technological branches of sectors, such as petrochemicals and electronics, the technology market becomes very restricted even at the global level. Nevertheless, for most industrial projects and products of interest to developing countries, a considerable degree of technological choice does exist and should be identified.

Nature of the required technology

The technology required for a particular project must first be identified. 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 acquired. Unpatented know-how can range from relatively simple production techniques to complex process know-how possessed only by a few enterprises. The source of technology acquisition would, to a large extent, depend on the nature and complexity of the techniques involved. When 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 personnel in the operation, use and maintenance of plant equipment. It is in respect of products for which the manufacturing technology is independent of machinery and equipment that the 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 must be obtained from those possessing such know-how.

Selection

Alternative techniques should be evaluated in the feasibility study to determine the best technology for the plant. This evaluation should be related to plant capacity and should commence with a quantitative assessment of output, production build-up and gestation period and a qualitative assessment of product quality and marketability. Then the influence of the alternatives on capital investment and production costs should be assessed over a period. Apart, however, from the above basic criteria, the technology must have been fully proven and be utilized in the manufacturing process, preferably in the company from which it came. While new and unproven or experimental techniques should not be considered appropriate, obsolescent technology should be avoided, which means that technological trends and the possibilities of using more developed techniques should be studied. For example, high voltage circuit breakers apply different technologies to extinguish break parts (bulk-oil, air-blast and SF_6). It would not 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 processes that, though proven, are soon likely to be obsolescent.

The selection of technology has to be related to the principal inputs that may be available for a project and to an appropriate combination of factor resources for both short- and long-term periods. In certain cases, the raw materials could determine the technology to be used. The quality of limestone, for example, is a determinant factor whether the wet or dry process is used for a cement plant. The availability of surplus bagasse would determine the type of technology for the production of paper or newsprint. Furthermore, the non-availability or restricted availability of certain raw materials could be a technological constraint. A technological process based on indigenous raw materials and inputs may be preferable to one for which the principal inputs have to be imported indefinitely, particularly if serious foreign exchange regulations affect the inflow of such materials. Apart from the wider policy implications, supplies of materials and inputs are much better assured if indigenous and may be less subject to external influences. In fact, progressive integration may be the only practicable means of undertaking production in a developing country for a large number 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, should be taken into account.

The degree of capital intensity considered appropriate could define the parameters of technology. In countries with a shortage of labour, or where labour is very expensive as in Western Europe, capital-intensive techniques may be appropriate and economic. In countries with excess labour, labour-saving techniques may prove unnecessarily expensive. This situation may apply to the overall technology as well as the degree of mechanization of projects or particular production operations such as material-handling. The choices from the viewpoint of both labour and capital should be given in the feasibility study so that the most appropriate technique can be selected.

The extent to which a particular technology or production technique can be effectively absorbed by a country could influence the choice of technology. It is often suggested that a technology is too sophisticated for a particular developing country as it is above the level of technological absorptive capacity. Such an approach may tend to be exaggerated and has been used to impose obsolescent techniques for projects in these countries. There would, however, be cases for which a particular technology, for example involving complex data processing, cannot be effectively absorbed in a country because of the difficulty in training the technical personnel required for the "software" work within a reasonable period.

Full account should be taken of the cost of capital when judging the appropriateness of more capital-intensive techniques. In developing countries the tendency is often to prefer a capital-intensive technique because it is used in industrialized countries. The additional capital cost involved in such technologies should be viewed against the labour costs of less capital-intensive techniques. Both the preference of labour-capital intensive technologies and the choice of technology can only be judged on techno-economic grounds and should be subject to a careful cost-benefit analysis in the feasibility study.

Technology sources

Together with the selection of technology, alternative sources should be located from which such techniques can be acquired. The sources of unpatented technological know-how can vary with the nature and complexity of the production process and can range from individual experts to entire enterprises, domestic or foreign, already engaged in the manufacture of the product in question. Consultancy organizations are usually a valuable source, particularly for specialized products and techniques. An experienced spinning master or a good foundry man may be quite adequate for the transfer of know-how in a spinning mill or a foundry. However, 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, another enterprise in the same sector may be required, though, for simple products and components, experienced individual experts may also prove adequate. For such sectors as petrochemical production, process technology would have to be obtained either from other manufacturing enterprises or specialized consultancy agencies.

Industrial property rights

Where a desired technology is patented or covered by registered trade marks, it is necessary to secure industrial rights from their holders. The coverage and life of particular patents for a required technology should be investigated. For a large number of products, the use of a particular trade mark or trade name may be of special significance for product marketing and this should 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 domestically and for exports. The use of brand names may also affect the marketing of a wide range of consumer products ranging from perishable items to consumer durables and this should be assessed for each such product.

Means of technology acquisition

When technology has to be obtained from some other enterprise, the means of acquisition have to be determined. These can take the form of *(a)* technology licensing; *(b)* outright purchase of technology; or *(c)* a joint venture involving participation in ownership by the technology supplier. The implications of these methods of acquisition should be analysed.

Licensing

Technology licensing has developed into a popular and effective mechanism for trade in technology and a license gives the right to use patented technology and the transfer of related know-how on mutually-agreed terms. Most licenses for 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 they can also be obtained from domestic enterprises, particularly where no patents are involved. In cases where technology licensing is considered necessary, it is desirable to consider: *(a)* the disaggregation of the technology package; and *(b)* some of the critical contractual elements. Though both these aspects relate to the post-feasibility implementation stage, if they are considered in the study it would greatly assist in the subsequent negotiations of the technology license contract.

Disaggregation

The technology package should be disaggregated into various component parts, such as the technology proper, related engineering services, phasing of domestic integration, supply of intermediate products and even the supply of equipment by the licensers, because prospective licensees from developing countries are often in a weak bargaining position and technology suppliers tend to load the technology package with features that are not essential to the technology. A distinction should be made between essential technological features and others that should be evaluated separately.

Contractual aspects

The contractual aspects of technology licensing should be confined to essential issues to be considered prior to the acquisition of technology. These can relate to the *(a)* definition of the technology to be acquired and guarantees by the licenser; *(b)* costs of technology; *(c)* duration of the agreement; and *(d)* purchase of intermediate products, components and inputs by prospective licensees. It is important to clearly define the technology to be acquired. Where process technology is involved, the process and the expected production results should be described. Where manufacturing techniques are being acquired, the documentation and other elements of production know-how should be elaborated, as should the guarantees which should be given by the technology licensor on the quality of the know-how and the fact that it will be transferred fully following the license agreement. The appropriate payment for technology should be specialized together with the form of such payment and the range, which is usually 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 further extension should be avoided. Since the sources from which critical intermediate products and inputs can be obtained are defined in a feasibility study, this aspect should also be covered in the technology contract so that such products may be secured from the licenser for varying periods. Where such products and inputs can also be obtained from sources other than the technology supplier, it would not be desirable to have a contractual commitment to purchase them from the licenser.

Purchase of technology

For certain industrial branches it is desirable to acquire the technology by outright purchase and if this is so it should be emphasized in the feasibility study. Outright purchase is appropriate when "one-time" technological rights or know-how are to be secured and when there is little likelihood of subsequent technological improvements or need for continued technological support to the prospective licensee.

Participation of the licence-holder in the venture

Equity participation by a technology supplier is a policy matter for the project sponsors and is beyond the scope of the feasibility study. However, the study should consider such participation in terms of *(a)* continuing technological support on a long-term basis; *(b)* possible access to existing markets of the technology supplier either in the domestic market or in external markets that can be served by the proposed project; *(c)* participation in the risk of new products not tested in a particular market; or *(d)* effects of participation from the viewpoint of covering resource gaps in projects involving a large outlay. Such evaluation should, at the same time, highlight the financial benefits that would accrue to the technology supplier both as a supplier and as an equity participant.

The detailed technological services that would be required in conjunction with the use of a particular technology should be stated in the study, and the type of agencies listed that perform such services. These services include detailed engineering, plant design and equipment layout; auxiliary facilities at the pre-implementation stage; supervision during implementation; and testing, commissioning and start-up in the post-implementation period. The nature and scope of such technical services should be defined. In certain instances, the technology and the engineering services are combined as in a consultancy organization, but even then, the costs should be separately considered and judged.

Cost of technology

The cost of technology and technical services should be estimated in the feasibility study apart from the selection of technology and the engineering and technical services that may be required in conjunction with it. This may present difficulties as negotiations on technology acquisition and technical services between the prospective licensee and licenser are subsequent to the preparation of the study and, in a number of developing countries, may depend on the degree of regulatory control of licensing arrangements by governmental bodies. The assessment of this in the feasibility study could, however, serve as a guideline to the project sponsors on technology negotiations and could give the framework within which such negotiations could be conducted.

An assessment has to be made of the proper remuneration for technology and services and to do this, reference may be made to technology payments made in other cases for the same industry, if the information can be obtained. An assessment could also be made of various alternatives of payment such as a lump sum, a running royalty rate or a combination of the two. A royalty payment may be more appropriate when the technology necessitates a relationship with the technology licenser over a period. This rate tends to range from fractional precentages up to 3-5 per cent of actual sales, depending on the nature of the industry and plant capacity. For most technical services, assessment of appropriate costs would be easier as the cost of comparable services can generally be obtained except when they are highly complex or proprietory in nature.

The estimates of technology payment can be quantified and the pro forma at schedule 6-1 may be utilized for this purpose. Lump sum payments for patents and trade marks for special rights and concessions and for unpatented know-how can be capitalized and amortized according to the regulations obtaining in a country and incorporated into fixed capital assets. Royalty payments, however, are generally not capitalized and are included in production costs.

Selection of equipment

The selection of equipment and technology are interdependent. In certain projects, such as a cement plant, production and operational technology is part and parcel of the supply of equipment and no separate arrangements for technology acquisition are necessary. However, in cases when technology has to be independently acquired, the selection of equipment should follow the determination of technology as the two are closely linked. The requirements of machinery and equipment should be identified in the feasibility study on the basis of plant capacity and the selected production technology.

Equipment selection at the feasibility study stage should broadly define the optimum group of machinery and equipment necessary for a specific production capacity by using a specific production technique. This selection differs in emphasis with the type of project. For most process-oriented industries, machinery, or groups of machines, have to be defined for various processing stages so that the various stages merge 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. Thus, the requirements of machinery and equipment must be directly related to capacity needs at different stages of processing. The equipment choice for manufacturing industries is much wider as different machines can perform similar functions with varying 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 be kept to a minimum, consistent with the needs of various machinery functions and processes. Thus, to determine the equipment required for a machine-building enterprise, for example, it is necessary to define various machining and other operations required for projected production volumes over a certain period, the break-down of the machine-hours required for each operation, the selection of specific machine tools to perform each function and the number of machines required for different production levels to be achieved over that period.

Relation to other study components

The determination of equipment requirements should be related to other study components. While most of these components should be covered in the determination of plant capacity and technological processes, others may prove pertinent 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 restrictions such as the availability of power for a large electric furnace or the transport of heavy equipment to a remote 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. The use of more sophisticated equipment may also be ruled out or postponed, when such equipment has to be imported, on account of overall investment constraints or foreign exchange availability. The maintenance requirements and the availability of maintenance facilities could also be an important factor. Government policies, such as import controls, may restrict the import of certain types of equipment and equipment selection has then to be tailored to available domestic products.

Production equipment

The list of plant machinery and equipment should include all movable and immovable machines and equipment for production, processing and control and related facilities that form an integral unit with the machines not serving any other purpose. Such equipment can be variously classified for different types of projects, one classification being to divide the items into the subgroups of *(a)* plant (process) machinery; *(b)* mechanical equipment; *(c)* electrical equipment; *(d)* instrumentation and controls; *(e)* process conveying and transport equipment; and *(f)* other plant and machinery. The erection and installation of machinery has to be provided for which may necessitate special foundations, 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 the machinery list should be complete so as to cover the requirements for each stage of production from the receipt of raw material to the dispatch of the final product. The rated performance required for various pieces of process equipment should be defined and for each project component a list of equipment should be tabulated in accordance to the schedule annexed to these notes.

However complete the list and evaluation of machinery and equipment may be at the stage of a feasibility study, it may have to undergo substantial modification if the parameters of a project are modified in the course of investment decision, including changes in the technological process adopted. Such modifications would, however, have to be elaborated in the post-feasibility study stages.

Spare parts and tools

A list should be prepared of required spare parts and tools with their estimated prices, including the parts to be obtained with original equipment and parts and tools required for operational wear and tear. Spare part needs would depend on the nature of the industry, availability of spare parts and the manufacturing capacity for such items within a country and facilities for imports. Generally, a supply for 3-6 months is stocked. This could be higher but has to be carefully evaluated as it has an impact on plant inventories and working capital.

Imported and domestic equipment

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

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

Structures and civil works

Cost estimates

Estimates should be prepared for the costs of civil works and building structures bearing in mind the selected site, site conditions, selected technology and equipment. To cover all parts of the construction programme, they should be divided into three categories:

(a) Site preparation and development (for details see check-list at the end of this chapter);

(b) Buildings:

Factory or process buildings
Ancillary buildings, such as maintenance buildings, garages, cafeteria, research and control laboratories, medical service buildings and others
Stores an^d 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);

(c) Outdoor works.

All construction and civil works should be dealt with under one of the categories shown in the check-list at the end of the chapter in order to ensure the completeness of the cost estimates. When undertaking such estimates, detailed drawings should be prepared to supplement the layout drawings in order to accurately compute all quantities. Different scales should be selected depending on the technical difficulties and on the sophistication of the project. In most cases, scales of 1:200 and 1:100 will be sufficient, but detail drawings may be done to scales of 1:50, 1:20 or even 1:10.

The quality of the construction materials to be used and the levels of workmanship should be specified. These two factors are essential to investment cost outlay. Materials that are not available in a developing country have often to be transported over long distances to the construction site. Aside from the increased risk of losses and/or damages during transport, excessive transport costs may endanger the profitability of the project. Furthermore, the inexperience of local labour working with certain construction materials may lower the quality of the construction work. This should be kept in mind particularly with regard to the post-construction period when most maintenance has to be done by local labour.

Next, quantity surveys should be made 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 the square metres of a built-up area or the cubic metres of the enclosed space of a building. These may be obtained from existing comparable values for equal or similar works or by obtaining suitable quotations from contractors.

The calculation of the costs of certain fixed installed equipment, such as plumbing, central heating, electrical wiring and piping of all kind, should, in many countries, be given 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.

Non-factory buildings

The required non-factory constructions and their timing should also be determined in the feasibility study. Thus, administration buildings sometimes have to be built even before factory constructions are started. Since elaborate administration structures should be constructed only when substantial profits have accrued, the initial facilities should be planned on the basis of minimum essential needs. On the other hand, social welfare facilities for plant labour should be adequately provided for; a good cafeteria and good recreational facilities can contribute greatly to productivity and sound management-labour relations. Although final decisions on such facilities would rest with the project authorities, it is desirable to define an appropriate pattern.

It should be considered whether or not housing facilities should be provided. Generally speaking, they should not be provided except on a limited basis, such as for shift engineers and supervisors; site conditions would be a determinant in this regard. There may be problems in obtaining suitable labour for a plant located some distance from an urban centre so transport facilities for plant personnel may have 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. Although this is an expensive burden on a project, it may be unavoidable in developing countries.

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

(a) A housing colony;

(b) Extensive transport facilities;

(c) Payment of transport allowances.

The special financing facilities that may be available from governmental and institutional sources for undertaking such housing construction should be ascertained and presented in the study.

Check-list of classification of equipment

Production equipment

Plant (process) equipment
Mechanical equipment
Electrical equipment
Instrumentation and controls
Process conveying and transport
Other plant and machinery

Auxiliary equipment

Transport: cars, buses, trucks, tank-trucks, fork-lifts, railway equipment, water transport, ropeways etc.
Utility supply: electric power equipment, water supply (pumping stations etc.), gas (booster stations etc.)
Generating plants for: electricity, steam, hot and cold water, compressed air etc. (if not included in production equipment)
Emergency power: stand-by diesels, batteries etc.
Workshop equipment: mechanical, electrical, measuring instruments etc.
Laboratory
Storage and warehouse equipment
Intercommunications: central units for telephone, wireless, telex etc.
Heating, ventilation, air conditioning
Packaging equipment and durable packaging, mechanical saws, nailing machines, planners, drums, containers etc.
Sewage disposal and treatment: pumps with drives, dcrew conveyers, treatment plant
Waste disposal and treatment
Other auxiliary equipment

Service equipment

Office equipment: machines, reproduction equipment, furniture, lockers etc.
Canteen
Medical service
Plant security: fire protection, supervision etc.
Plant yard cleaning and service: mechanical brooms, sprinkler cars etc.
Staff welfare and residential buildings
Other

Note: Costs of auxiliary and service equipment should only be listed if they are not included in civil works installations.

Check-list of classification of cost of site preparation and development

Relocation of existing structure, pipes, cables, powerlines, roads etc.

Demolition and removal of structures and foundations

Wrecking

Grubbing

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

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

Diversion of streams etc.

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

- Electric power (high tension/low tension)
- Water (use water and/or drinking water)
- Communications (telephone, telex etc.)
- Roads
- Railway sidings
- Other

Other site preparation and development work

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

Note: The costs of site preparation and development not covered by "outdoor works" should be calculated.

Check-list of classification of buildings and civil works[10]

Buildings and structures. (Normal construction and installation work: use unit prices or cost parameters for cost estimates such as square metres of built-up area or cubic metres of space enclosed.)

- Buildings including excavation, bricklaying, concrete and reinforced concrete works, waterproofing, masonry, structural steel roofing and cladding, steel-sheet works, carpentry etc.
- Structural finishing including masonry, carpentry, steel works, plaster, joinery, glazing, waterproofing, caulking, ceramic tiling, flooring, asphalting, parquetry, paving, wallpapering, painting etc.
- Technical installations and equipment including heating and ventilation, air conditioning, plumbing, gas, power current, low-tension current installations

Special civil engineering works including: pile foundations, slurry trench walls, walls, soil consolidation, drainage, lowering of groundwater table, steel sheet-piling, ramps, chimney and stacks. Foundations for all kinds of heavy equipment

Buildings and structures (special construction and installation works): estimate the cost of equipment if it has not been listed under auxiliary production or service equipment

[10] Use unit prices for cost estimates.

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

Check-list of classification of outdoor works[11]

Utility supplies and distribution including water (use water and drinking water); electric power (high and low tension current); communications (telephone, telex); steam; gas

Emissions handling and treatment including sewage system (main-water, water for sanitary and process purposes); oil and grease separators; pumping stations and screw conveyors; treatment plants; waste storage boxes, refuse burning plants; others

Traffic installations including yards, roads, paths, parking areas; railway tracks; sheds for bicycles, motor-bicycles and cars; traffic lights; outdoor lights; outdoor lighting

Landscaping including plants, grass, sods; water basins; others

Fencing and supervision including fences, walls; doors, gates, barriers; supervision and plant security installations; others

Bibliography

Baranson, Jack. Industrial technologies for developing countries. New York, Praeger, 1969.

Bhalla, A. S., ed. Technology and employment in industry. Geneva, International Labour Office, 1975.

Cooper, Charles. The transfer of industrial technology to the underdeveloped countries. *Institute of development studies bulletin* (Brighton, University of Sussex) 3 October 1970.

Economic Development Foundation. Manual on plant layout and material handling. Tokyo, A.P.O., 1971.

Frey, Siegmar. Plant layout. Munich, Hanser, 1975.

Henn, Walter. Industriebau. Munich, Callwey, 1975. 4 v.

International Association for Bridge and Construction Engineering. Problems associated with design and construction in developing countries. Zurich, 1977.

Lester, J. M. Technology transfer and developing countries: A selected bibliography. Washington, D.C., George Washington University, 1974.

Moore, J. M. Plant layout and design. New York, Macmillan, 1962.

[11] Use unit prices for cost if the cost of the listed items is not covered under site development, buildings or equipment.

National Aeronautics and Space Administration. Technology transfer: A selected bibliography. Rev. ed. Washington, D.C., 1971.

Pratten, C. F. Economies of scale in manufacturing industry. London, Cambridge University Press, 1971.

Stumpf, Herbert. Der Know-how Vertrag. 3. ed. Heidelberg, Verlag für Recht und Wirtschaft, 1977.

United Nations. Guidelines for the acquisition of foreign technology in developing countries; with special reference to technology licence agreements. (ID/98)
Sales no.: 73.II.B.1.

_______ Economic Commission for Europe. Guide for use in drawing up contracts relating to the international transfer of know-how in the engineering industry.
Sales no.: 70.II.E.15.

_______ Economic and Social Commission for Asia and the Pacific. Guidelines for development of industrial technology in Asia and the Pacific. 1976. (E/CN.11/1273)

United Nations Industrial Development Organization. National approaches to the acquisition of technology. May 1977. (Development and transfer of technology series, No. 1. ID/187)

_______ UNIDO abstracts on technology transfer: studies and reports on the development and transfer of technology (1970-1976). May 1977. (Development and transfer of technology series, No. 2. ID/189)

United Nations Institute for Training and Research. The acquisition of proprietary technology by developing countries from multinational enterprises: A review of issues and policies. Prepared by Walter A. Chudson and Louis T. Wells, Jr. 1971.

_______ The international transfer of commercial technology to developing countries. Prepared by Walter A. Chudson. 1971.

VII. 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 be decisive to their profitability. A feasible division of the plant into components (production, service and administrative cost centres) is imperative for a realistic assessment of overhead costs.

Cost centres

Data and alternatives

State data to set up cost centres, such as

- Engineering layouts
- Production programme and capacity
- Types of cost centres (production, services, administrative)

Prepare alternatives

Selection of cost centres

Select and describe in detail the composition of cost centres
State reasons for selection
Show selected cost centres

Overhead costs

Data and alternatives

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

Selection of cost items and their grouping as overheads

Select and describe in detail composition of overhead cost items
State reasons for selection

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

Schedule 7. Overhead costs (alternative 1)

(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 17 into schedule 10-11, line 5.3.)

	Service cost centres												*Administration and finance cost centres*					
	Social service	*Plant management*	*Off-site transport*	*Purchasing*	*Stores*	*Repair and maintenance*	*Power, heat, light*	*Steam*	*Water supply*	*Laboratories*	*Effluent disposal*	*Subtotal 1-11*	*General administration*	*Personnel*	*Training*	*Accounting and bookkeeping*	*Subtotal 13-16*	*Total 1-16*
Cost items	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
A. Maintenance (from schedule 6-9)						X												
B. Insurance													X					
C. Communication				X									X					
D. Travel				X									X					
E. Rents													X					
F. Recurring land charges (from schedule 5-2)													X					
G. Royalties (from schedule 6-1)													X					
H. Property taxes													X					
I. Effluents											X							
J. Licenses, fees													X					
K. Subtotal																		
L. Depreciation																		
Building																X		
Machinery																X		
Office equipment																X		
M. Subtotal																		
N. Total																		

NOTES ON PLANT ORGANIZATION AND OVERHEAD COSTS

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 and 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 engineering to attain the established production programme.

When dealing with the organizational arrangements for a new project, attention should 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 obtain a good understanding of the types of operations and services needed to achieve the production objective. To facilitate this task, the production process may be divided into related functions grouped into cost centres. The service cost centres that have to render certain types of services for the production line have to be similarly established. The same applies to administration and sales.

It is not possible within the framework of the *Manual* to enter into the intricacies of cost centre accounting; a brief check-list is provided of cost centres that may occur in any plant as they should be reflected in the organization of the project.

Production cost centres are those areas of activity where all major industrial operations are performed within the context of a manufacturing establishment, e.g. within a vegetable oil processing factory. These centres are: delinting, decorticating, pressing, solvent extraction, bagging, neutralizing, bleaching, deodorizing, winterizing, filling and packing.

Service cost centres are those areas of activity that render the supplementary services necessary to the smooth running of the plant, such as:

Social services including housing, health service, cafeteria, transport, company food stores etc.

Plant management: production workshops

Off-site transport: all transport activities that are not related to connected production processes

Purchasing of raw materials, 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 (when the company has its own supply)

Laboratories: process control

Effluent disposal

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

Administration and finance cost centres comprise all activities related to managerial planning, control, and performance evaluation. Practice varies with respect to the number of centres in which these activities are grouped. Larger factories maintain specialized centres for planning, budgeting, costing, statistics, personnel training, accounting and finance. Smaller factories have fewer such centres. Hence, all expenses related to administration and finance should be accumulated in one centre under the designation of administration and finance.

Overhead costs

In most feasibility studies very little attention is paid to the planning of overhead costs. Frequently, overhead costs are computed as a percentage surcharge on total material and manpower inputs, a procedure that, 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 unsatisfactory, the project team should 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 consequently a detailed analysis should be undertaken.

The major blocks of overhead costs should be as follows:

Factory overheads that 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) of manpower and employees not directly involved in production	Chapter VIII
Auxiliary material Office supplies Utilities (water, electricity, gas, steam etc.)	Chapter IV
Repair and maintenance (contractual) Effluent disposal	this chapter

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

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

	Source
Wages and salaries (including benefits and social security contributions)	Chapter VIII
Office supplies Utilities Communications	Chapter IV
Engineering costs (contractual) Rents Insurances (property) Taxes (property)	this chapter

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

Depreciation charges which are frequently included under factory overheads. However, since these are not required for cash-flow analysis they can be dealt with separately. In this way, it is still possible to use them for the calculation of factory 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 preproduction capital expenditures.

Financial costs, such as interest on term loans, which are frequently a part of administrative overheads. The *Manual*, however, treats this item separately (chapter X).

The list of factory and administrative overhead cost items is repetitive in the sense that wages, salaries, utilities and supplies are mentioned although all material inputs and manpower requirements are already computed (chapters IV and VIII). Once all material inputs and manpower costs are compiled by production, service and administration cost centres, as outlined in chapters IV and VIII, two alternatives can be followed:

(a) Transfer the respective sums to the total production cost schedule (10-11) in chapter X and deal only with the remaining cost items in the overhead cost schedule (7) in this chapter;

(b) Transfer the material and manpower overhead costs (chapters IV and VIII) to the overhead cost schedule (7), which would have to be expanded accordingly, and estimate the remainder of the overheads and transfer afterwards the total overhead costs to the total production cost schedule in chapter X.

In order to avoid any unnecessary burden on the proposed pro forma system, the first alternative is recommended.

As a result, the residual factory overhead costs (service cost centres) can be derived from schedule 7, line K, column 12 and the residual administrative overhead costs from schedule 7, line K, column 17. Both sums should be inserted in schedule 10-11.

When forecasting overhead costs, attention should be given to the problem of inflation. In view of the numerous cost items in overhead costs it will not be possible to estimate their growth individually but only as a whole. A sound judgement has therefore to be made as to the magnitude of the overall inflation rate of overhead costs.

Bibliography

Aggteleky, Béla. Fabrikplanung. Munich, Hanser, 1970.

Barnes, M. C. Company organization—theory and practice. London, Allen and Unwin, 1970.

Depallens, G. Question financière de l'entreprise. 3. éd. Paris, Sirey, 1967.

Grant, E. L. *and* L. F. Bell. Basic accounting and cost accounting. 2. ed. New York, McGraw-Hill, 1964.

Heinen, Edmund. Industriebetriebslehre. 5. ed. Wiesbaden, Betriebswirtschaftlicher Verlag Gabler, 1976.

Horngren, Charles T. Accounting for management control. 3. ed. Englewood Cliffs, New Jersey, Prentice-Hall, 1974.

Moore, Russel F. AMA management handbook. New York, American Management Association, 1970.

Morrison, Robert S. Handbook for manufacturing entrepreneurs. 2. ed. Cleveland, Ohio, Western Reserve, 1974.

Seicht, Gerhard. Moderne Kosten- und Leistungsrechnung. Vienna, Industrieverlag Peter Linde, 1977.

VIII. MANPOWER

When the determination of plant production capacity and the technological processes to be employed has been made, it is necessary to define the personnel required for the project under consideration at various levels of management; production and other related activities should be assessed together with the requirements of training at various levels and during different stages of the project.

Labour

Data and alternatives

Describe data required for the determination of labour inputs

Prepare alternative manning tables, considering 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

Selection of labour

Select and describe in detail the manning table for labour
State reasons for selection
Describe in detail the selected alternative

- Show the structure (organization)
- Prepare detailed manning table considering the subdivision into production labour and non-production labour (e.g. administration)

Cost estimate

Estimate annual labour cost at nominal feasible capacity, subdivided into
Cost of production labour (variable)
Cost of non-production labour (fixed)

Use schedules 8-1 and 8-2 and insert totals in schedule 10-11.

Staff

Data and alternatives

Describe data required for the determination of staff inputs

Prepare alternative manning tables, considering:

- 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

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

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

(Insert total in schedule 8-2)

MANNING TABLE – LABOUR: Variable and fixed													
Department		Wage categories (No. of workers)											
										Subtotal			
Function	Shift	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Total
	I											
	II											
	III											
	I											
	II											
	III											
	I											
	II											
	III											
	I											
	II											
	III											
	I											
	II											
	III											
Total labour												

Note: This schedule can be expanded to suit particular requirements.

Schedule 8-2. Estimate of production costs: wages

(Insert totals in schedule 10-11)

ESTIMATE OF PRODUCTION COSTS – WAGES

Department (project component)		Variable costs wage categories (No. of workers)							Fixed costs wage categories (No. of workers)						
						Subtotal							Subtotal		
No.	Description	Foreign	Local	Foreign	Local	Foreign	Local	Total	Foreign	Local	Foreign	Local	Foreign	Local	Total
Total No. of workers															
Working hours per day															
Working days per year															
Hours per year															
Wages per hour															
Surcharge (%)															
Wages per year															
Total															

Note: This schedule can be expanded to suit particular requirements.

Schedule 8-3. Manning table–staff

(Insert total in schedule 8-4)

MANNING TABLE – STAFF											
Department	Salary categories (No. of staff)										
									Subtotal		
Function	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Total
Total staff											

Note: This schedule can be expanded to suit particular requirements.

Schedule 8-4. Estimate of production costs: salaries

(Insert total in schedule 10-11)

ESTIMATE OF PRODUCTION COSTS – SALARIES												
Department (project component)		Salary categories (No. of staff)										
										Subtotal		
No.	Description	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Total
Total No. of staff												
Working months per year												
Man-months per year												
Salaries per month												
Surcharge (%)												
Salaries per year												
Total												

Note: This schedule can be expanded to suit particular requirements.

NOTES ON MANPOWER

The manpower estimate fulfils two main requirements: *(a)* a detailed manning table for the calculation of the cost of manpower as part of the production costs; and *(b)* a comparison of the required personnel with the structure of the labour force available in the project region. This comparison will facilitate the assessment of training requirements.

Labour and staff costs can be estimated using schedules 8-1 and 8.3. These schedules should be prepared for all departments; when added together they should give the total manpower costs of the project. The departments will be shown on the organizational layout plan. All labour and staff personnel should be included in a department and care should be taken that no double counting takes place.

Manpower requirements

Manpower planning should start at the departmental level, defining the labour and staff requirements by functions and categories (workers: supervisory, skilled, semi-skilled and unskilled; staff: managerial, administrative and sales). The departmental manning table can be set up according to 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 the following factors: *(a)* a general assessment of the supply and demand of manpower and especially of labour in the area; *(b)* an appraisal of manpower and occupational skills available at national and regional levels in view of the skill and technological requirements of the project; *(c)* a note of the main provisions of labour legislation covering industrial relations (individual and collective), procedures of recruitment and discharge; as well as wage levels, fringe benefits and their expected annual growth rates; the number of shifts; and *(d)* the number of annual working days.

The number of working days in a year is frequently overestimated planners should be aware of losses of working days due as Sundays, national holidays and the like. Often only 200-250 working days are actually available per year.

Preproduction phase

When estimating manpower requirements, a distinction should be made between the preproduction and the operational phases. During the preproduction 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 also to attend to the construction of buildings and the installation of equipment that they will later be operating. Estimates should be made by category of staff and workers, as well as by function, applying standard pro forma man-month costs to arrive at the labour costs that need to be capitalized. The persons required at this phase should be kept to a minimum to maintain preproduction costs as low as possible.

Foreign expertise may also be required for such functions as detailed engineering or supervision of construction or equipment erection. The number of persons required together with costs and periods of service could in each case be indicated. It should be specified when foreign expertise is provided at this stage on a lump-sum basis. When such expertise is provided at the plant site or within the country of the project, the man-months and periods of service should be specified in each case. This is to ensure that suitable training programmes can be set up for domestic personnel easily enough to keep both the number of foreign personnel and the time they are required to a minimum.

Operational phase

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

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;

Payroll taxes.

In the case of both wage and salary estimates it is suggested that these extra manpower costs should be covered by surcharges; these should be computed separately for wage and salary earners. An example is provided at the end of these notes.

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

Labour norms

A common error in the assessment of labour requirements is the adoption of labour norms prevailing in industrialized countries. This is particularly true in the engineering goods sector where norms relating to machine hours and the like are usually considerably higher in industrialized countries than in most developing countries. Inadequate skills and experience in the latter inevitably reduce performance and productivity, particularly in the 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 important that realistic norms are adopted in the early years of production and that manpower needs are assessed accordingly. However, such norms may not be easy to establish and may have to be based largely on experience with similar industrial activities in the country and area of the proposed project.

Supervisory and managerial staff

A serious bottle-neck to project implementation in many developing countries is the lack of suitably experienced supervisory personnel. Manpower planning for this category should be undertaken well in advance of requirements. The feasibility study should define the requirements on a shift-by-shift basis and state the qualifications and experience necessary. Given the typical lack of such experienced personnel, the timing of recruitment, possible sources of availability and the nature of necessary training programmes should be indicated.

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 that the requirements of such personnel are defined in the feasibility study so that they can be recruited by the project authorities well in time. In many projects, key senior personnel need to be associated with the project during the preproduction stage and even during the prior stage of project formulation and the feasibility study. The timely provision of qualified staff to manage all the functions of the plant is most important.

Experience has shown that, in most cases, it is not too difficult to finance a project proposal and that even its implementation is not very difficult if the project has a good management structure, or is, for example, delivered on a turnkey basis. Many investment projects that perform poorly suffer mainly from bad management. Thus, before approving a new project or a major extension of an existing project the source and cost of managerial staff should be determined. It is costly to count on remedial action taken as late as the operating phase of the project.

Foreign experts

The lack, or inadequacy, of managerial skills at the technical, administrative and commercial levels can only be offset by 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 found; shortfalls in experience can only be made up through intensive training during the preproduction stage. In many cases, such training will have to be arranged in foreign countries and negotiated as part of the technology supply arrangement.

An attempt is often made to compensate for the lack of experience of local managerial talent through the employment of foreign personnel, either by hiring individual expatriates or by signing management contracts with foreign companies. This is an expensive course and does not further the important aim of developing indigenous managerial skills, especially if it extends over long periods, as is often the case.

The study of manpower needs should assess the availability of suitable domestic managerial skills and, when foreign assistance is necessary, the duration and conditions of obtaining such assistance should be prescribed. The duration should be for the minimum period possible and an important condition should be to select and train suitable domestic counterpart personnel to take over gradually such responsibilities. The timely arrangement for transferring industrial management skills to the developing countries is of great importance, and may be seen as being parallel to the transfer of technologies.

Training

Since the lack of technical personnel and skills can constitute a significant bottle-neck to project implementation and operation in developing countries, extensive training programmes should be programmed and undertaken as a part of various projects. Training may be organized at the plant on an in-plant or on-the-machine basis, or by setting up a training unit, or at outside training institutes or similar factories in the country or abroad. Training can be provided at the factory by high-level managerial personnel (technical and others), by specially recruited experts, or by expatriate personnel.

The timing of training programmes is of crucial importance since persons should be sufficiently trained to be able to take up their positions as and when they are required. Thus, personnel at various levels should already have undergone any training necessary before production starts, during the preproduction and construction stages. In the case of managerial and key non-technical personnel, such training would cover aspects of management and procedure; the training of supervisory and production personnel would cover production branches in sufficient detail to enable them 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 location of and arrangements for training should be defined. In many cases, training units are set up at the plant site during the preproduction stage. In other cases, foreign training may have to be provided for a number of personnel; this should constitute an important element of technical assistance in cases of technology licensing and joint ventures. Training programmes may need considerable funds. 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 production starts but from time to time thereafter, since the upgrading of skills and management development is a continual process. Training requirements should be defined separately for the preproduction and for the operational periods in order to provide adequately for preproduction and operational training costs. One way of calculating training costs involves the use of 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.

Planning of overhead costs of manpower

When estimating manpower requirements by project component, the project planner has not only to plan at the level of production cost centres but also 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 VII. Once the overhead costs of manpower are computed, the user of the *Manual* can decide which of the following alternatives to adopt:

(a) To transfer the sums directly to the "total production cost schedule" (10-11) in chapter X;

(b) To transfer the overhead costs of manpower to the "overhead cost schedule" (7), which would have to be adjusted accordingly, and then shift the total overhead costs to schedule 10-11.

In order to avoid any unnecessary burden on the proposal pro forma system, the first alternative is suggested.

Computation of surcharges on wages and salaries

The following example for the computation of surcharges on wages and salaries is typical.

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

The figures should be checked carefully before being introduced into the production cost estimates.

Effective working days per year:		*Days*
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
Deduct paid unproductive working days (typical figures)		
Official and religious holidays, not falling on Saturdays or Sundays	11	
Leave (according to labour laws)	20	
Sickness (according to statistics)	15	
Training etc.	10	
Others	5	
Total paid unproductive working days		-- 61
Number of effective working days per year:		200

Computation of surcharges due to:		*Percentage*
Unproductive working days $(\frac{61}{200} \times 100)$		30
Social security (insurance of all kinds, according to local labour jurisdiction), say		15
Social security for unproductive working days (15% of 30%)		4.5
Allowances:	*Days*	
Leave, equivalent to, say	20	
Christmas, equivalent to, say	20	
Subsistence, equivalent to, say, 1 day/month	12	
Total allowances	52	
corresponds to:	$\frac{52}{200} \times 100$	26
Payroll-tax, according to laws, say		2.5
Total surcharge		78

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

Bibliography

Craig, R. L. *and* L. R. Bittel. Training and development handbook. 2. ed. London, McGraw-Hill, 1976.

Dunette, M. D. Personnel selection and placement. Monterey, California, Brooks/Cole, 1966.

Franke, G. Stellen- und Personalbedarfsplanung. Wiesbaden, Betriebswirtschaftlicher Verlag Gabler, 1977.

Jucius, M. J. Personnel management. 6. ed. Homewood, Illinois, 1967.

Planning production, inventories and work force. *By* Charles C. Holt *and others.* Englewood Cliffs, New Jersey, Prentice-Hall, 1960.

Taylor, Barnard. Management development and training handbook. London, McGraw-Hill, 1975.

IX. IMPLEMENTATION SCHEDULING

The project implementation phase embraces the period from the decision to invest to the start of commercial production. It includes a number of stages, including negotiation and contracting, project design, construction and start-up. If not planned properly, this phase may extend over enough time to endanger the potential profitability of the project. The primary objective of implementation planning is therefore to determine the financial implications of the implementation phase with a view to securing sufficient finance to float the project until and beyond the start of production. The choice of financing (equity or loan), 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.

Data and activities

State fundamental data for project implementation
Elaborate implementation programme and time schedule and show alternatives, considering:

Establishment of project implementation management
Arrangements for technology supply
Detailed engineering 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 with public authorities for timely approval of licences, contracts etc.
Preliminary and capital issue expenses

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

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 chapters. All cost components are collected in the following chapter with the objective of determining their timing; this will be based on the implementation schedule decided upon in the present chapter. For activities that occur during the investment phase up to the moment when the project becomes operational, cost estimates have to be made for the activities mentioned under "Data and activities" above.

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

Schedule 9. Estimate of investment cost: project implementation

(Insert total in schedule 10-2/1)

ESTIMATE OF INVESTMENT COST

Project implementation

No.	Quantity	Unit	Item description	Local	Foreign	Unit cost	Cost		
							Foreign	Local	Total
1.			Management of project implementation						
2.			Detail engineering, tendering						
3.			Supervision, co-ordination test-run and take over of civil works, equipment and plant						
4.			Build-up of administration recruitment 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						
9.			Financial cost during construction						
Total									

NOTES ON IMPLEMENTATION SCHEDULING

Project implementation scheduling

A realistic schedule should be drawn up for the various stages of the investment phase of project implementation. This is an essential part of the feasibility study as the implementation of every project must be related to a time-scale. Such a schedule should initially define the various implementation stages, such as negotiation and contracting, project formulation, and actual construction and running-in, in terms of time required for each stage. The schedule should then lay down a time-programme that combines the various stages into a consistent pattern of activities that dovetail into one another. This comprehensive schedule should cover the entire investment phase, including the period between the investment decision and the end of the start-up stage (figure I) 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 between the moment when the investment decision is taken and the actual start of construction. This period comprises tendering, opening of bids, evaluation of bids, final negotiations on technology, and award of contracts, and may take up to 12 months. In some rare cases, due to unforeseen delays, this period may be so long that the cost data given in the feasibility study become outdated and need to be reviewed. If a construction period of two or three years follows, the cost data taken for the investment decision may be several years old by the time of the start-up. Thus continuous cost control, both by way of projections and of gathering actual data, is required.

We are considering project implementation planning here mainly in order to draw the project planner's attention to the financial implications of project scheduling (the relative advantages of equity and loan financing, working capital requirements etc.) and to the possibilities of the early detection of implementation delays and their financial impacts.

At this stage, with the determination and planning of the construction period completed, the first portion of the time schedule needed for the cash-flow table (line 1) can be drawn up. The operational part of the time schedule of the cash flow table is formulated with the help of the production programme as outlined in chapter III. When the schedule of the cash-flow table is finalized, all investment and production costs can be summarized and scheduled in chapter X.

Varying periods of time are required for various stages of implementation in different projects. These depend on the circumstances prevailing in a country and the specific nature and requirements of a particular project.

The stages do not always lend themselves to stage-by-stage analysis with one stage invariably leading to the other. A great deal of overlapping may take place. This will be necessary in projects in which some activities have to be undertaken either earlier or later than others, depending on the estimate of time required.

Project implementation management

When implementing a project, the investor should first set up his own project implementation management team. Authority should be delegated by the investor to such a team to act always (or only in his absence) as a counterpart to contractors and consultants. The efficient implementation of a project may depend considerably on the support services the counterpart team is able to furnish. Thus, it is likely that, for example, its intimate knowledge of local conditions could 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 that is to be put in charge of operating the plant.

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.

Detailed engineering (equipment and civil works), tendering, evaluation of bids, awards of contracts

An adequate period should be provided for various activities before the actual site work begins, including detailed planning, preparation of tender documents, calls for tenders, evaluation of tenders, contract negotiations and preparatory work for site installation.

There is normally a considerable lapse of time between the invitation for machinery quotations and the placing of final orders, but nevertheless this period can generally be projected without too much difficulty. The time elapsing before equipment is delivered may, however, be very long, ranging from three to six 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 erection time and the requirements for various processing stages need to be considered, to ensure that the equipment arrives in a sequence that is optimal 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, domestically manufactured equipment in developing countries takes considerably longer to deliver than imported equipment and orders need to be planned in advance to a greater extent owing to the limited capacities available locally.

Project financing

After the decision to invest has been taken and once the total investment costs and their scheduling are known, arrangements for project financing need to be initiated. A sound debt/equity ratio should be aimed at, taking into account supplier credits, institutional loan financing and own funds. Although this may take a considerable amount of time, it may not be practicable to proceed with the project until the question of project financing is resolved.

There should also be a good understanding at the feasibility stage of all the implementation costs that will be encountered. Only with such a comprehensive assessment will it be possible to determine the mode of financing and the accruing financial cost that constitutes part of the total production costs. Although project financing should be elaborated in more detail at this point, it should be noted that the following chapter summarizes all the investment and production costs, and projects them using the results of implementation scheduling and production programming.

Construction period

Purchase of land

One of the critical steps in a project is the purchase of land and the regulation of access to the plant site. This may sometimes lead to long-lasting negotiations (for example, if no agreement on the sales price can be reached). Options for purchasing the land may be arranged at an early stage and 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 and which, if any, by consultants.

The construction of plant buildings and facilities cannot commence before a final plant layout plan has been prepared, land has been purchased at the selected site, and the site has been prepared and developed. Site preparation can generally be planned without any major problem; the process should not take long except where site development presents difficulties. The sequence of civil works and construction activities, in terms of construction time and building requirements, needs to be carefully defined in relation to infrastructure requirements, availability, and the arrival and erection schedule of different types of equipment.

While the construction of civil works and infrastructure facilities is proceeding at the 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 the site. All these aspects need to be adequately scheduled, so that there is no delay at any point.

Arrangements for erection and installation of equipment need to be taken up in good time, both when such erection work is subcontracted and when it is undertaken by the project authorities.

The main critical stages during the implementation phase are the testing of equipment, trial production and commissioning of the plant. The trial production 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 performed during the stages of construction). There are several project implementation techniques and schedules available to facilitate this task.

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. The administrative structure of the plant should be developed and set up during the implementation phase.

Supplies

It is also necessary to finalize arrangements for basic production materials during the implementation phase. Considerable time needs to be allowed for imported supplies; even in the 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, for example, if the input materials first have to be grown, such as sugar cane for a sugar plant.

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 can accumulate and the major assumptions made concerning the commercial profitability of the product would no longer be correct.

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

Governmental approvals

Government approvals may take much time in certain developing countries, even at the initial stage, particularly if foreign investment is involved. Government approval is also required, in many cases, to import 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 the sanction of governmental agencies at the production stage. In all these cases, adequate time should be provided to obtain such approvals, so that this does not constitute a bottle-neck. It is difficult to specify a fixed amount of time as conditions differ from country to country but, in those countries in which approvals have to be obtained, from one to six months is necessary in most cases.

Types of schedules

Good 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 equipment, 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 aspect would inevitably have an adverse effect on plant operations during early production stages. However, if factory buildings and constructions are ready too far ahead of machinery supplies (or vice cersa), if production personnel are recruited too early, or if unduly heavy production-material stocks are collected, funds may be unnecessarily trapped in unutilized capacity, manpower or inventories. An effective, balanced timing of the various input requirements must be established; this can only be done by accurate project scheduling.

While the periods required for various implementation activities can be defined for each such activity, a project schedule has to be well-knit and co-ordinated. This requires methodical and systematic analysis. Various methods of analysis and scheduling are available. The most simple and popular method involves the bar or Gantt chart, which divides project implementation into various component activities, and shows the time-periods required for each activity. It is then possible to work back to the date or time-period by which the activity should commence or by which particular decisions should be taken. The bar chart can be applied to every project and is not difficult to prepare.

In a complex project that involves a number of inter-related and sequential activities, this approach may not prove adequate and a netowrks diagram may be necessary. Two such techniques are the Critical Path Method (CPM) and the Project Evaluation and Review Technique (PERT).

Whatever technique is used, it is important to review the initial schedule from time to time in the course of project implementation and to identify and resolve problems and constraints during implementation. It is unlikely that an initial project schedule will be so comprehensive and accurate as not to require later revision and periodic updating. 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 projet implementation. In the feasibility study, it should be possible to indicate which activities are likely to be more critical during different stages of implementation. These can serve as useful guidelines at the review stage.

Cost estimates for project implementation

Project implementation costs are pre-production costs which are to be capitalized. They may be broken down as follows:

Project implementation management

Salaries and wages of managerial staff
Rent and operation of offices, motor cars, living quarters etc.
Travel and communication expenses
Duties and taxes during the implementation period

Detailed engineering of equipment and civil works, tendering and evaluation of bids

Salaries and wages of planning staff
Rent and operation of offices, motor cars etc.
Travels, transportation, communication
Fees for various types of consultants
Site and laboratory tests

Supervision and co-ordination of construction, installation, 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

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

Salaries and wages of administrative staff (including personnel recruitment staff)
Advertising costs related to recruiting personnel
Salaries and wages of training staff and/or fees of training experts and/or fees of 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, motor cars, living quarters etc.

Arrangements for supplies

Salaries and wages of purchasing staff
Travel and other related expenses
Communication

Arrangements for marketing

Salaries and wages for sales and marketing staff
Advertising
Training of salesmen and merchants
Travel expenses
Communication

Build-up of connections with authorities

Cost for necessary approvals of operation and the like

Preliminary and capital-issue expenses

Registration/incorporation fees
Printing and incidentals
Prospectuses and other printing expenses
Public announcement expenses

Underwriting commission
Brokerage
Legal fees
Other expenses

The cost estimates should be based on an organizational layout of project implementation and should include the following:

The decision of the investor as to the 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 workforce (in major projects this should be shown on a manning table) and their salaries and wages;
The local availability of offices, living quarters, transport facilities etc.;
The fees and rules of agreements of consultants and experts as well as possible additional allowances for their foreign staff.

Bibliography

Aggteleky, Béla. Fabrikplanung. Munich, Hanser, 1970.

Barkhoff, B. Planning the implementation of industrial projects in developing countries. *Industrialization and productivity,* Bulletin No. 17, 1970.
United Nations publication, Sales no.: 71.II.B.8.

Battersby, A. Network analysis for planning and scheduling. London, Macmillan, 1967.

Hed, Sven R. Project control manual. Geneva, 1973.

International Association for Bridge and Construction Engineering. Problems associated with design and construction in developing countries. Zurich, 1977.

Kilbridge, M. D. Problems often encountered in implementing industrial projects in developing countries. *Industrialization and productivity,* Bulletin No. 17, 1970.
United Nations publication, Sales No.: 71.II.B.8.

Marsh, P. V. D. Contracting for engineering and construction projects. London, Gower, 1971.

United Nations. Contract planning and organization. (ID/117)
Sales no.: 74.II.B.4.

______ Guidelines for contracting for industrial projects in developing countries. (ID/149)
Sales no.: 75.II.B.3.

______ Programming and control of implementation of industrial projects in developing countries. (ID/SER.L/1)
Sales no.: 70.II.B.18.

______ The initiation and implementation of industrial projects in developing countries; a systematic approach. (ID/146)
Sales no.: 75.II.B.2.

X. FINANCIAL AND ECONOMIC EVALUATION

Project preparation should be geared towards the requirements of financial and economic evaluation. Once all the elements of a feasibility study are prepared, the next step is to compute the total investment costs. In many cases it has to be assumed that project financing is available at the feasibility stage; the financial implications are then calculated and included in the total production costs. Financial evaluation should preferably rely on discounting methods and incorporate sensitivity analysis. Projects should also be evaluated from the aspect of their direct and indirect effects on the national economy.

*Total investment costs**

Calculate the total investment costs by summarizing all investment components as described in chapters II, III, IV, V, VI and IX. Use schedule 10-1/1, schedule 10-2/1, schedule 10-3/2, and summarize in schedule 10-6/1. Project the annual investment expenditures in schedule 10-6/2

Project financing

Describe and justify assumed or actual sources of finance
Prepare cash-flow table for financial planning using schedule 10-8/3
Estimate annual financial costs and insert total in schedule 10-11

Total production costs

Calculate total production costs by summarizing all cost items as described in chapters III-IX. Use schedule 7 to collect all overhead costs and schedule 10-11 to summarize total production costs. Project production costs in schedule 10-12
Estimate unit costs

Financial evaluation

Compute commercial profitability criteria
- Net present value
- Internal rate of return
- Pay-back period
- Simple rate of return
- Break-even analysis
- Sensitivity analysis

For cash-flow tables see schedules 10-13 and 10-14

*All schedules related to chapter X are given on page 190 and following.

National economic evaluation

Preliminary tests

Project exchange rate
Effective rate of protection

Cost-benefit analysis. When applying the UNIDO method of economic project evaluation, 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
Shadow price of investment

Estimate social rate of discount

NOTES ON FINANCIAL AND ECONOMIC EVALUATION

A feasibility study, as has been mentioned, is a tool that helps 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 arranged clearly, 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.

The basic components of investment and production costs of a project of defined capacity are determined in the early chapters of a feasibility study 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 so as to obtain an estimate of the total investment cost, total production costs and the financial and economic viability 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 should be paid to the timing of expenditures and costs, as it influences the cash flow of the project and its internal rate of return. Given the project implementation and production schedules, investment and production costs should be planned on an annual basis in line with the requirements of cash-flow analysis. The division into annual portions is best done at this stage of project planning, where all the 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, exact formula for computing the investment and production costs. Various ways to estimate these figures can be considered, given the cost data of the project components. Apart from such data, however, calculations of fixed assets, pre-production capital costs, working capital and production costs should have scope for correction 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 given specific assumptions.

Total investment costs

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

At the pre-investment stage, two mistakes are frequently made. Most commonly, working capital is included either not at all or in insufficient amounts, thus causing serious liquidity problems to the nascent project. Furthermore, total investment costs are sometimes confused with total assets, which correspond 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 net working capital which is the difference between current assets and current liabilities (see 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.

Fixed assets

As indicated, fixed assets comprise fixed investments and pre-production capital costs.

Fixed investments

Fixed investments should include the following:

(a) Land and site preparation;

(b) Buildings and civil works;

(c) Plant machinery and equipment including auxiliary equipment;

(d) 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 should 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.

Pre-production capital expenditures

Apart from fixed investments, every industrial project incurs certain expenditures prior to commercial production which are due, for example, to the aquisition or generation of capital assets. These expenditures, which have to be capitalized, include a number of items that originated during the various stages of project formulation and implementation. They are briefly outlined below.

Preliminary and capital issue expenditures. These include expenditures incurred during the registration and formation of the company, including legal fees for preparation of the memorandum and articles of association and similar documents, and for capital issue expenses. The capital issue expenditures include the preparation and issue of a prospectus, advertising, public announcements, underwriting commission, brokerage, expenses for processing of share applications and allotment of shares. Preliminary expenditures also include legal fees for loan applications, land purchase agreements etc.

Expenditures for preparatory studies. These are of three types:

(a) Expenditures for pre-investment studies: 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 expenditures. These include:

(a) Salaries, fringe benefit 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, living expenses, salaries and stipends of the trainees, fees payable to external institutions;

(f) Interest on loans during construction.

Trial runs, start-up and commissioning expenditures. 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 also have to be capitalized. Pre-production expenditures can be tabulated according to schedule 10-2/1.

In allocating pre-production capital costs, one of two practices is generally followed:

(a) To capitalize the entire pre-production capital costs and to amortize them over a period of time that should be briefer than the equipment depreciation period;

(b) Initially to 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 that are not attributable are capitalized as a total and are also amortized over a period of ten years. For the phasing of pre-production capital costs on an annual basis see schedule 10-2/2.

Net working capital

New working capital indicates the financial means required to operate the project according to its production programme. Net working capital is defined as current assets minus current liabilities. Current assets comprise receivables, inventories (raw material, auxiliary material, supplies, packaging material, spares and small tools), work-in-progress and finished products and cash. Current liabilities consist mainly of accounts payable (creditors) and are free of interest.

Accounts receivable (debtors)

The size of this item is determined 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 generalization. Each case should therefore be assessed individually according to the following formula:

$$\text{Debtors} = \frac{\text{Credit terms (in months)}}{12\text{ (months)}} \times \text{Annual gross sales}$$

Accounts receivable should be calculated as 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.

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.

Production materials. In computing production-materials 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, inventories equivalent to as much as six months consumption may have to be maintained. Other factors influencing the size of inventories are the reliability and seasonality of supplies, the number of suppliers, possibilities of substitution and expected price changes.

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. The plant is usually provided with an initial set of spare parts.

Work-in-progress. To assess work-in-progress requirements, a comprehensive analysis should be performed 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 (or days) of production, depending on the nature of the product. In machinery products, this can extend to several months. The valuation is made at the factory costs of work-in-progress.

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 (schedule 10-3/1, table 2) plus administrative overheads.

Cash-in-hand and bank accounts

Interest is sometimes added 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 the 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, depending on the case of course, could be around 5 per cent. Schedule 10-3/2 gives an example how to calculate the cash requirements.

Accounts payable (creditors)

Raw and auxiliary materials, supplies, utilities etc. are usually purchased on credit with a certain period elapsing before payment is effected. Accrued taxes are also paid after a certain period has elapsed, and are another source of funds similar to "accounts payable". Such credited payments reduce the amount of net working capital required.

Calculation of working capital requirements

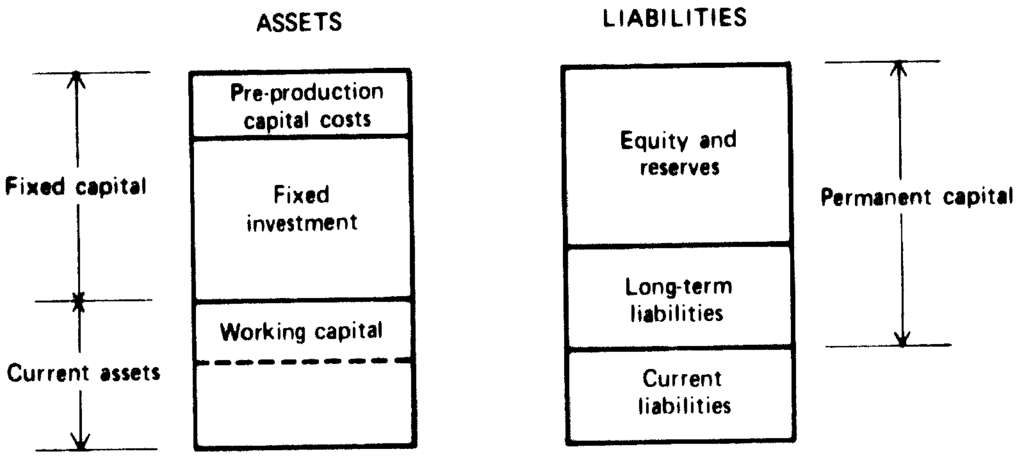
When calculating the working capital requirements, the minimum coverage of days for current assets and liabilities has to be determined first. Then, annual factory and production costs should be computed, since the values of some components of the current assets are expressed in these terms. Since working capital requirements increase as a project gradually becomes fully operational, it is necessary to obtain factory and production cost data for the start-up and full capacity production periods (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 (schedule 10-3/2). Subsequently, the cost data provided in schedule 10-3/1 for each item of the current assets and liabilities are divided by the respective coefficients of turnover and put in schedule 10-3/2. Finally, the net working capital requirements for the different production stages are 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 is divided into operational and non-operational periods. The working capital requirements during the operational phase are calculated on a normal basis. For the off-season, the working capital needed has to be scaled down, since only fixed costs are 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 period and decrease it during the non-operational period. The calculation of the working capital for seasonal firms is based on an annual forecast of payments and receipts. In the example in schedule 10-5 all payments are listed; these are compared with monthly receipts coming from sales. In schedule 10-4 the first column starts with the month during which larger payments have first to be made (May). The last column of schedule 10-5 shows the aggregate deficits of the year. \$3,180,000 being the lowest and \$13,500,000 the highest deficits. The table shows that a permanent working capital of some \$6,000,000 would be optimal, 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 operation of the project as compared with 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 the larger in size. The following diagram shows how working capital should be financed out of permanent capital, which is composed of equity capital, reserves and long and medium-term liabilities.



Working capital = current assets minus current liabilities
or = permanent capital minus fixed capital

Since current liabilities (mainly accounts payable) represent financial means put at the disposal of the project free of charge, they can be deducted from the current assets. This gives the net working capital needed to operate the plant. In this way, the amount of long-term financing (permanent capital) is reduced to the amount of fixed capital plus working capital. This amount (schedules 10-6/1 and 10-6/2) will be used further below when assessing the commercial profitability of the project proposal.

Total investment costs

From the figures of pre-production expenditures, fixed investments, and net working capital estimates, the total investment costs of the project under consideration can be calculated (schedule 10-6/1). The phasing of such costs is shown in schedule 10-6/2. It should be noted that, when phasing the total investment outlay, the initial investments should be inserted in the schedule first, and then all subsequent increments, until full capacity is reached.

Total assets

In order to obtain sufficient data for ratio analysis (covered later in this chapter) a special schedule covering total assets should be provided at the stage of project preparation. This can easily be done 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, the initial amounts should be inserted in the schedule first, and then all subsequent investments, until full capacity is reached.

Project financing

The allocation of financial resources to 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 that resources were available for a 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 is especially true if a project-opportunity or pre-feasibility study has previously been performed, as such studies would indicate the order of magnitude of capital outlay required. A feasibility study should only be made if financing prospects to the extent indicated by such studies can be defined fairly clearly.

As discussed earlier, resource constraints may define the parameters of a project well before an investment decision is made, 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. Financial constraints could exist at all levels of project sponsorship and could occur whether a particular project is under consideration by an individual entrepreneur, a major industrial group (domestic or foreign), or a governmental or semi-governmental agency.

Apart from some instances where resource constraints constitute a major limiting factor in the consideration of project possibilities and project size, 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 an estimation of the costs of a developed site, buildings and civil works, and technology and equipment.

It is equally necessary to define the financial requirements of a project at the operational stage in terms of working capital. This can only be determined once estimates are made of production costs, on the one hand, and sales and income on the other. These estimates should be over a period of time, and be reflected in a cash-flow analysis. Unless both these estimates 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 that ran into serious financing problems because of inadequate estimates of fund requirements at the initial investment or operational stages because investment and production costs were underestimated, or sales and income were overestimated.

Sources of financing

Equity

The general financing pattern for an industrial project is to cover the initial capital investment by equity and long-term loans to varying extents and to meet working capital requirements by additional short- and medium-term loans from national banking sources. Within this framework, however, various permutations are possible and need to be assessed.

In certain projects, equity and preference-share capital covers not only the initial capital investment but also net working capital requirements, 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 mobilize adequate investible resources. In other cases, where relatively inexpensive long-term or medium-term credit is available, there is a growing tendency to finance projects through such loans.

In all cases, a balance needs to be struck between long-term debt and equity. The higher the proportion of equity the less the income from individual share units, as dividends would have to be distributed among a larger number of units. The higher the proportion of loan finance, the higher the interest liabilities. In every project, therefore, the implications of alternative patterns and forms of financing must be carefully assessed; a financing pattern should be determined that is consistent with both availability of resources and overall economic returns.

Equity can be raised by issuing two types of shares: *(a)* ordinary shares, and *(b)* preference shares. Preference shares usually carry a dividend at least partly independent from profit with a limited voting right. They can be cumulative or non-cumulative in terms of dividends and can be redeemable or non-redeemable, with the redemption period varying between 5 and 15 years. Dividends on ordinary shares with full voting rights, however, depend on the profitable operation of the company.

Loan financing

Since it is relatively easy to obtain loans, the process of 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 *(a)* short- and medium-term borrowings from commercial banks for working capital purposes, or supplier credits of various forms, and *(b)* long-term borrowings from national or international development institutions.

Short-term loans

Short-term loans 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 the banks, and depend on banking practices in the country, the nature of the project and inventories, and the credit rating of the enterprise and its management. The limits usually vary between 50 and 80 per cent, leaving a margin of from 20 to 50 per cent of inventories and production costs to be financed by venture capital.

Bank borrowing for working capital can be arranged on a temporary basis. If at any time the cash flow statement suggests that sufficient liquid funds are available, such commercial bank borrowings should be substantially reduced or entirely eliminated, without however jeopardizing the overall liquidity of the project. In some cases, such a cash-flow surplus may be needed for further capacity expansion, so that the enterprise may need to rely on long-term bank credits for some time. Working capital needs should even be partly met out of long-term funds (equity capital and long-term loans) since the largest portion of working capital is permanently tied in inventories (raw materials, work-in-progress, finished goods and spare parts).

In the example given on page 161 one-quarter of the working capital orginally comes from equity funds. As shown in schedule 10-8.3, the loan for financing working capital requirements was repaid during the seventh year since sufficient cash surplus (line D) had already been accumulated. The overall liquidity of the project is not jeopardized by this repayment.

Imported machinery and spares can often be financed on deferred-credit terms. Machinery suppliers in industrialized countries are generally willing to sell machinery on deferred-payment terms with payments spread over 6-10 years, and sometimes even longer. Deferred-payment terms are available against bank guarantees; this enables such machinery suppliers to obtain refinancing facilities from financial institutions in their own countries.

Long-term loans

Loan financing is usually available with certain regulations, such as restrictions on the convertibility of shares, and declaration of dividends. Apart from these regulations, certain ratios in the capital structure of the company need to be maintained.

Investment may also be financed partly by issues of bonds and debentures. The market for bonds and debentures tends to be fairly limited as far as new projects are concerned, but such securities are often issued to finance the expansion of existing enterprises.

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.

In addition to share capital and loan finance, an important financial category at the operational stage is the internal cash generated by the project itself. This can take the form of retained profits, depreciation and accumulated reserves.

Example

Cost of the project. **The total initial investment outlay (schedule 10-6/1) amounts to $10.3 million.**

	$ thousand	$ thousand
Fixed investment costs		
Land	300	
Buildings	1 800	
Equipment	5 700	
Total initial fixed investment		7 800
Working capital (including bank borrowing)		2 000
Pre-production capital expenditures		500
Total initial investment costs		10 300

Means of finance. Financing of the total initial investment outlay is envisaged as follows (in $ thousand):

Sources	*Fixed investment*	*Working capital*	*Total*
Short-term borrowing (commercial bank)	–	1 500	1 500
Long-term borrowing (supplier's credit)	3 000		3 000
Promoters' and collaborators' contribution (equity capital)	5 300	500	5 800
Total	8 300	2 000	10 300

The impact of cost of financing and debt servicing on project proposal

Different financing institutions impose different financing charges. A government guarantee is even sometimes required for multinational financing. It is important that the enterprise is not obliged to start with loan amortization before the start-up of operation. The normal procedure is to capitalize the financial cost during the implementation period and to start the debt service out of cash generated through the operation of the new production facilities.

It may be possible to combine relatively short-term suppliers' credits (say, a three years' grace period and four years' amortization period) with longer-term financing from multilateral banks. In this case, suppliers' credits could be disbursed last and amortized first while leaving multilateral financing for early disbursement and late amortization. Thus, loan terms that are suitable overall can be obtained.

In new projects as well as expansion projects, the kind of debt service will also have to be decided on. There are two systems: *(a)* periodical debt service with equal instalments of amortization plus gradually decreasing interest and *(b)* periodical debt service with equal instalments of both amortization and interst. The first system requiies less total financing cost but a fairly substantial total debt-service from the start-up of the project. The second system, although it has a higher total financing cost, is less difficult for the new enterprise because the initial debt-service burden is smaller than under the first system.

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; their incidence on production costs should be determined and accounted for in the cash-flow analysis. National and international institutions that provide loan finance require that projects should be formulated in considerable detail, so that their full implications are adequately highlighted. In some cases, they insist that the feasibility study is prepared by recognized independent consultants or that management responsibilities for certain major projects are assumed by experienced and acceptable parties.

Public policy and regulations on financing

The hard core of the entrepreneurial decision in respect of financing is to choose between equity raised through the sales of shares and that raised through payments by the project sponsor. In most cases, the initial equity base is provided only 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. In the case of any resource gap, or where the sponsors wish to limit their risks to a particular proportion of equity, outside participation can be invited to provide additional equity or loans. Funds can be mobilized either from national sources (individual or institutional), or through foreign participation. When a developing country has a reasonably well developed capital market, equity funds can be raised through public issues of shares. Such share issues are usually underwritten by banks and other financial institutions. In some 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. In some developing countries, it may be necessary for institutional agencies to acquire majority holdings initially and release them gradually to domestic entrepreneurs as and when domestic entrepreneurship is willing to take over all, or a part of, such holdings.

In considering foreign equity participation, a basic policy question may arise regarding the extent (if any) of foreign influence after such participation. In a number of developing countries, foreign equity participation requires governmental approval. In some countries, such approval is often not granted, particularly to 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 investments or in projects with a great employment potential.

Thus, in cases where foreign equity participation is considered, the first need is to assess the policy implications and the reaction of government authorities. Thereafter, the implications of foreign equity participation on the project should be evaluated. In some cases, where foreign technological assistance and support may be required for a number of years or where access to improved and new technologies may be required, it may be desirable to have the technology supplier or licensor also participate in capital ownership.

In some cases, technical management may have to be entrusted to a foreign company, usually a licensor, and then 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 such factors as the nature and magnitude of investment outlay, and technological and management support required, the extent of the resource gap that could otherwise develop, and the relations between a technology licensor and licensee. It may not be possible to discuss all these aspects at the stage of a feasibility study; often only the policy and general implications of foreign capital participation can be elaborated.

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, as a matter of policy, such enterprises are not pemitted 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 with this basis.

Financing institutions

Most developing countries have established developmental financing institutions, usually called industrial finance corporations or industrial development banks. In most developing countries, there is more than one institution available to finance projects. Most countries have established financial institutions at the state and national levels. Some of the national institutions provide foreign currency loans which are financed by international institutions, such as the World Bank and its affiliates.

At least 50 multinational institutions exist for the financing of industries in developing countries. Some of these operate on a world-wide scale such as the World Bank (including the International Development Association and International Finance Corporation), the Organization of the Petroleum Exporting Countries (OPEC) Special Fund, the Kuwait Fund for Arab Economic Development and the International Investment Bank of the countries belonging to the Council for Mutual Economic Assistance (CMEA). Even though many of these funds will be used primarily for infrastructure and agriculture rather than for industry, the provision of funds on soft terms for infrastructure is one of the fundamental prerequisites of successful industrialization.

There are also institutions operating on a regional basis, such as the African Development Bank, the Asian Development Bank, the European Investment Bank, and the Inter-American Development Bank. Recently, funds have been set up by the oil-exporting countries, such as the Arab Fund for Economic and Social Development, and the Islamic Development Bank.

Bilateral institutions have been established in most of the countries of the Organisation for Economic Co-operation and Development (OECD) and, recently, in some oil-exporting countries, like Kuwait, the United Arab Emirates and Venezuela.

In this context the role of the export financing and guaranteeing agencies must be mentioned. Suppliers' credit guarantees are given by the EXIM Bank of the United States of America, Hermes of the Federal Republic of Germany, COFACE of France, and many other agencies in OECD countries. The primary task of such agencies is to help exporters from industrialized countries; only as a secondary task are they designed to help the developing countries.

Commercial banks, including those in the Euro-currency market, are becoming increasingly active in industrial development financing. However, they lend to only a few of the developing countries. A major step towards easier terms and availability of loans would be achieved with the establishment of a multilateral guarantee system for commercial loans. This is currently under consideration.

In many developing countries, the availability of industrial finance in the form of institutional finance and from other sources has grown to such an extent that new entrepreneurs can start industrial ventures while providing a relatively small share of the total equity required. The situation varies widely but, in some countries, the initial proportion of equity to be raised by sponsors of industrial projects can be as low as 10-25 per cent of the total equity needed.

The various aspects discussed above need to be fully assessed before evolving a financing package suitable for a project under consideration. Invariably, the package is determined by 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 both public policies and regulations, and the projected cash flows of the proposed enterprise. The various sources of finance can then be tabulated in schedule 10-8/1. Schedule 10-8/2 shows the utilization of these financial resources during the construction, start-up and full-capacity operation.

Required financial statements

To estimate the financial requirements of a new (or expanding) enterprise either a "projected-balance sheet" or a "cash-flow forecast" is used in addition to the net-income statement.

The balance-sheet method of determining future needs of funds is built around a forecast of the size of key balance-sheet items at a selected future date. The date selected is an important factor, and should be at a time of normal operation. Cautious forecasters would prepare a second balance sheet of a different future date, when for some reason (e.g. diminishing sales, delayed accounts receivable, increased costs of production), the enterprise might be in financial difficulties. A comparison of the two balance sheets would show where to allow for "cushions" of funds.

The cash-flow method is in many ways a "budgeting" method, and is more comprehensive than the balance-sheet method as a way of forecasting the amount and timing of funds needed. The theory of the cash-flow forecast is based on the anticipated receipt of cash at a certain time and the predicted outflow of cash at other times. As the cash-flow statement deals only with cash transactions, non-cash items, such as depreciation, bad debts write-offs, intangibles and others will not appear on it.

The present *Manual* focuses on the cash-flow method, since its main aim is to systematize project preparation and the subsequent financial analysis for the investor. The required financial statements are therefore ordered in the following sequence: *(a)* cash-flow table, *(b)* net income statement, and *(c)* projected-balance sheet. Financial institutions such as the World Bank tend to use the balance-sheet method when reviewing a bankable project. This is especially so in expansion projects. Banking institutions prefer to group the cash-flow table and the projected balance-sheet behind the net income statement. In order to comply with both approaches, the financial statements FP-1 to FP-3 in annex VIII are arranged as requested by industrial development banks. In either case, all accounts entered into the statements must match, as all the statements are interrelated.

In the case of expansion projects, financial statements should be provided for the past 3-5 years in addition to the projected pro formas.

Cash-flow table for financial planning

It is not sufficient only to find sources of finance; the timing of inflow of funds (from financial resources and sales revenue) must also be synchronized with the outflow of investment expenditures, production costs and other expenditures. If this is not done, significant losses of revenue, in terms of interest (as a result of idle funds) or delays in project implementation (as a result of financial bottle-necks) may ensue.

It is, therefore, necessary to prepare a cash-flow table showing the inflow and outflow of finance. Such a cash-flow table is of utmost importance in the investment phase of the project, when it should be drawn up at least once a month. At the pre-investment stage, however, an annual cash-flow table is usually sufficient.

Just as the planning of capital financing aims to ensure that capital is available to finance investment expenditure and that investment inflow and outflow are synchronized, 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. This is the case, for example, with supplier credits, which usually have to be repaid over 5-8 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 useful to prepare a separate cash-flow for the construction and trail-run period in addition to the integrated cash-flow, since the former can define the full implications, particularly of the foreign-exchange question, in greater detail than the latter. The disposable foreign exchange can be shown during the operating period. However, it may be unduly cumbersome to show the foreign-exchange component separately in the operational cash-flow. When required, a separate table can be prepared for the foreign-exchange component of the cash flow for the operating period.

The cash-flow table is designed so as to use data assembled during the preparatory stage of the feasibility study. For financial resources, see schedule 10-8/2; for sales revenue see schedule 3-1; for total assets see schedule 10-7/2[12] and for production costs see schedule 10-12. The scheduling of the debt service (payment

[12] As far as changes in inventories of raw materials, work-in-progress and finished products are concerned, please refer to schedule 10-3/2, 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 make the example overcomplicated. If such changes are to be shown the total assets schedule of the cash-flow tables schedule 10-8/3, line B.1 would need to be corrected, as well as lines C and D. It should be noted, however, that the cumulative cash-balance (line D) should not become negative and that the sources of funds would have to be increased to finance the larger stocks.

of 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. An additional schedule is needed only for the calculation of corporate tax and dividends (schedule 10-9). Corporate tax is computed as a percentage of the net profit after allowing for depreciation as prescribed by the Government, regardless of the depreciation actually applied and after interest paid on credits (but not repayment of principal).

The cash-flow table is closely linked to the projected-balance sheet since the cash-flow cumulative cash balance which should never become negative is eventually transferred to the cash balance (line A.1.a. of schedule 10-10) of the projected-balance sheet. In the example, the cash balance grows quite significantly, as do the reserves.

Since capital is frequently scarce, it is the general tendency of inexperienced promoters to perform pre-investment studies with the investment outlays and financial resources maintained as low as possible. A project analyst should resist the temptation of pleasing the sponsors of the study by such low figures. Bad financial planning in pre-investment studies will clog the progress of the project either while obtaining clearance by 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, in every pre-investment study alternative modes of financing must be considered and provided for and an attempt made to develop contingency plans. Cash-flow tables for financial planning proposals should therefore indicate the amounts and timing of finance needed and should be produced for all alternatives in order to facilitate the final choice of financing.

Net-income statement

This statement (schedule 10-9) is used to compute the net income or deficit of the project by periods for the entire duration of the project. It differs from the cash-flow statement inasmuch as it follows the accrued concept: revenues are associated with the costs that were needed to achieve the revenues during the period under consideration. To keep the example simple, changes in inventories of raw materials, work-in-progress and final products are assumed to be zero.

The net-income statement also serves as a link with the projected-balance sheet, with the accumulated losses/reserves (schedule 10-9, line 8) derived from the net-income statement and inserted in the projected-balance sheet (schedule 10-10, lines A.3 and B.4).

In the *Manual*, the net income statement serves as a subsidiary table for the computation of corporate tax (line B.4 of schedule 10-8/3). No explanatory notes on the concept of net-income statements are provided here, since this has been sufficiently covered in the literature.

Projected-balance sheet

This method (schedule 10-10) consists of the forecasting of key balance-sheet items, such as cash balance and other current assets (viz. raw materials, accounts receivable, work-in-progress and finished products), and fixed assets, as well as equity and loan capital and current liabilities that are required for the smooth performance of the enterprise. The projected-balance sheet gives the total financial picture at certain intervals during the life of the project. It is not possible in the present *Manual* to go into the details of balance-sheet analysis. However, a few observations which may be useful to loan-department officers are given below.

(a) It is essential to understand the difference between the balance sheet of a sole proprietor, and that of a partnership or a corporation, the most common being a limited company;

(b) The balance sheet of a sole proprietor will give a very incomplete picture as it shows only the assets employed in the business, and not the proprietor's private assets (with which he guarantees the business); again, only those liabilities that arise directly out of it are shown. The profit-and-loss statement will be more sueful, as it will show the scale of operations and the annual results;

(c) The balance sheet of a partnership or firm, if properly drawn up, will show all the assets and liabilities of a business. A creditor of the firm has recourse to the private means of all the partners;

(d) The balance sheet of a limited company will show its complete position. All assets and liabilities are clearly and unequivocally stated.

In summary, a limited company produces the most exact, a partnership the most conservative and a sole proprietorship the least complete or reliable of balance sheets.

Of special interest in the balance sheet are the reserves. There are true reserves, backed by accumulated profits, in the profit-and-loss account. If this were not the case reserves, or any item with a similar general designation, shown in the balance sheet would hint at frozen capital and a lack of ready cash.

The rate of turnover is a measure of the marketing capabilities of management. It is computed by the following equation:

$$\text{Rate of turnover} = \frac{\text{Cost of goods manufactured during the year}}{\text{Value of average stock}}$$

All other things being equal, the faster the stock turnover, the better for the finances of the company.

Over-trading, which is often found in developing countries, is caused by trying to maintain a scale of operations with insufficient cash resources. The effects of over-trading can be disastrous and can even lead to complete failure. Over-trading can be caused by inflation and rising prices, increased stocks, heavy taxation, depletion of working capital or over-expansion. The cure for over-trading is naturally in finding sources of additional cash, reducing operations, and reducing stocks.

Over-trading can be detected in balance sheets from the following indicators:

A progressive fall of the debtors/creditors ratio;

Without an increase in turnover the total loan amount increases, the creditor accounts increase or the stocks and work-in-progress increase;

New bills or promissory notes are issued;

Receivables decrease;

Above all, there is a reduction of liquid resources and a failure to raise fresh cash by borrowing, as one pledgeable asset after another is mortgaged.

All components of the balance sheet are contained in the schedules already designed, although a number of adjustments still have to be made. Current assets are shown on schedule 10-3/2,[13] and fixed assets on schedule 10-7/2 (it should be noted 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 shown as 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 should be listed cumulatively. The growth of reserves is reflected in the corresponding increase in the cash balance; this is obtained from schedule 10-8/3, line D.

It is a matter of company policy whether to maintain high accumulated reserves and retained profits as compared with equity capital, or to convert such reserves into equity capital. Tax laws frequently even encourage such conversion, since high taxes are imposed on retained profits.

Ratios for financial analysis

In financial analysis it is usual to refer to several well-known ratios. These are derived from data on the projected-balance sheet, the net-income statement and the cash-flow table for financial planning. The ratios discussed below are those that are most frequently used. Other ratios may be applied as well. Whichever choice is made by the project evaluator, he should not apply them mechanically, but rather consider them as tools for assessing the prevailing financial situation.

Long-term debt-equity ratio

The long-term debt-equity ratio is an indicator of the financial risk that a new project faces, 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 50:50 tends to be adopted, but this is by no means a standard pattern. A feasibility study should define the appropriate financing arrangement, taking the availability of resources and the nature and requirements of funds fully into account. Equity-debt ratios of 33:67 or 25:75 or even higher are practised in many countries. A generalization, however, cannot be made, since each project should be assessed on its own merits.

The debt-equity ratio is also a measure of investor leverage. The smaller the equity capital, the higher the income per unit share. Equity owners therefore favour high debt-equity ratios since such ratios give leverage to equity capital, and allow equity owners to control projects even with a small amount of capital.

Investment banks ask for a sound debt-equity ratio, since the largest portion of equity capital is always tied in land, buildings and equipment, which can be liquidated only with difficulty or only at a loss in case of bankruptcy of the project. Banks therefore frequently refuse to finance a project with loans greater than the amount the promoter is prepared to invest, thus limiting the loan to 50 per cent of the required investment outlay.

[13] Changes in inventories of raw materials, work-in-progress and finished products have been taken into account when calculating the working capital (see schedule 10-3/2 for the growth of current assets).

Current ratio

The current ratio is a liquidity measure computed by dividing current assets by current liabilities. This ratio is a very rough indicator of a company's ability to meet current liabilities. It is so rough that, for example, even a "satisfactory" ratio would be misleading as far as the liquidity situation is concerned, if the inventory could not, for example, be sold for cash. To guard against this, the "quick ratio" is frequently used in addition to the current ratio. The quick ratio is computed by dividing cash plus marketable securities and discounted receivables by current liabilities. The ratio thus eliminates inventory and prepaid expenses from current assets. In view of the danger of possible misinterpretations, the following ranges of "satisfactory" values can only be offered with great reservation:

Current ratio	2.0-1.2
Quick ratio	1.2-1.0

Operational performance and profitability

Operational performance is best measured by expressing the net profit (after tax and interest) as a percentage of sales. The actual percentage changes considerably, depending on the prevailing market conditions in a specific industrial sector. It is thus not possible to give any optimal values or margins.

Profitability calculations are dealt with in greater detail later in this chapter. At this stage it should only be noted that the simple rate of return (net profit after tax divided by the average equity, reserves and undistributed profits) should be higher than the interest rate in the capital market to reflect the premium for entrepreneurial work and risk. Again, it is difficult to offer any optimal values.

Cash generation

An important indicator is the amount of cash generated annually by the project: net profit plus depreciation plus amortization.

Long-term debt-service coverage

The long-term 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. Debt-service coverage is defined as the ratio of cash generation to debt service (interest plus repayment of principal). Ratios of 1.5-3.0 range between acceptable and satisfactory. Often this ratio increases considerably if the long-term debt service gradually decreases and no new borrowing is projected.

Other ratios

The financial autonomy of the project is best expressed by a number of ratios that compare the liabilities and capital, both equity and permanent. Thus it is, for example, possible to show current and long-term liabilities as a percentage of total liabilities, or the long-term liabilities as a percentage of the permanent capital (the total capitalization ratio).

The ratios of net receivables (after discounting) to gross sales, and inventory to gross sales, are specific to particular industrial sectors. The inventory turnover (cost of sales divided by average inventory) is another useful ratio. These ratios are very specific to individual industrial sectors, and so general value ranges cannot be offered.

In summary, these ratios make it possible to judge the profitability of the project with some confidence. Before submitting a project for financing, it should be checked in summary form to see that the major ratios are in line with standards established for the industrial branch under consideration.

Production costs

It is essential to make realistic forecasts of total production or manufacturing costs for a project proposal in order to determine the future viability of the project. One of the major deficiencies encountered in pre-investment studies is the inaccuracy of production-cost estimates. This frequently leads to unexpected losses which, if they are reinforced by low capacity utilization caused by wrong sales forecasts, may quickly push a nascent establishment out of operation. As will be seen later, risk analysis is a means of improving the accuracy of predictions. Risk analysis should not, however, become an excuse to pay too little attention to production-cost forecasting.

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. This is because it is less complicated at the feasibility stage to estimate all cost items in their entirety, irrespective of whether they are material, labour or overhead costs, than it is to calculate unit costs. For cash-flow analysis it is sufficient first to calculate total production costs at full capacity and then to project them as annual production expenditures over the life of the project.

Total production costs

As has been indicated, this *Manual* is geared towards the use of discounting methods for financial 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 schedule for each cost element separately. Once total production costs at full output level have been defined and their breakdown into variable and fixed costs established,[14] it is possible to adjust the variable costs proportionally to the

[14] Variable costs change roughly in close proportion to the variations in the level of production. Typical variable costs include materials, production labour and utilities. Variable costs can be divided further 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, repairs); *(c)* progressive costs, which change at a higher rate than the volume of production (e.g. overtime); and *(d)* regressive costs, which decrease with an increase in the volume of production (e.g. maintenance costs of unutilized machines).

Fixed costs remain unchanged regardless of changes in the level of activity and include mainly overhead and depreciation charges, the latter only if the calculation is time-based. Fixed costs include long-term contractual services, rents, and administrative salaries.

This differentiation is a considerable simplification, and is only valid for a specific range of capacity utilization. This simplification should be kept in mind when break-even analysis is discussed later in this chapter the assumed cost curve may actually have a different shape.

percentage of capacity utilization, keeping fixed costs constant. All of the cost elements entering into production costs have been described in the preceding chapters. These cost elements should now be assembled 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 earlier and as applied throughout the *Manual* divided total production costs into four major categories: factory costs, administrative costs, sales/distribution costs, financial costs and depreciation. The first three groups of costs together are the operating costs.

Factory costs. Factory costs include the following:

(a) Materials (variable costs);

(b) Manpower (in general, variable costs);

(c) Factory overheads (in general, fixed costs).

To arrive at factory costs, the final amounts derived from schedules 4-2, 7, 8-2 and 8-4 should be inserted in schedule 10-11, given at the end of this chapter.

Administrative overheads. The composition of administrative overhead costs, as well as procedures for their computation were described in chapter VII. All that is needed at this stage is to transfer the final amounts from schedules 4-2, 7, 8-2 and 8-4 to schedule 10-11.

Sales and distribution costs. The composition of sales and distribution costs as well as the procedures for their computation were described in chapter III. The estimated costs should be transferred from schedules 3-2, 8-2 and 8-4 into schedule 10-11.

Financial costs. Financial costs (interests) could be considered as part of the administrative overheads, particularly if they relate to an existing establishment or one that is being expanded and for which the financing scheme is already known. Since this is frequently not the case with new projects, financial costs will be kept as a separate heading. Most feasibility studies show a declining amount of external finance and, correspondingly, decreasing financial costs. The computation of financial costs was outlined earlier in this chapter. All that is required at this point is to insert the financial costs into schedule 10-11.

Depreciation. To make a gross- or net-profit estimate and to calculate net working capital requirements, supporting tables should list total production costs. In both calculations, as well as in simple financial evaluation, 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.

Project financing has frequently not been decided at the stage of a feasibility study and the project may therefore have to be presented with or without an estimated financial plan. Accordingly, interest payments and repayments of the principal would have to be added or deleted in the cash-flow tables (schedules 10-13 and 10-14).

When assembling all of the cost categories and cost items, it should be remembered for which purposes the total production cost estimate is needed:

(a) Gross or net profit estimates in the income statement (schedule 10-9);

(b) Simple methods of financial evaluation (later this chapter);

(c) Discounting methods (later this chapter);

(d) Calculation of net working capital requirements (schedules 10-3/1 and 10-3/2).

Figure IV shows the interaction of the various cost elements in a feasibility study and indicates the chapters of the *Manual* in which they are covered. This should help the reader to obtain a better comprehension of the cost structure and its impact on the profitability (return on equity) of a project.

Unit costs

For purpose of cash-flow analysis it is sufficient to calculate total costs; at the feasibility stage, however, an attempt should also be made to calculate unit costs. For a single-product project, unit costs are calculated simply by dividing total costs by the number of 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 in calculating overhead costs. The procedure normally adopted allocating unit overhead costs to direct material and direct labour[15] unit costs by means of different percentage surcharges is not applicable, since these surcharges would not be available for new projects. In addition comparative data from a developed country, such as surcharges calculated for an ongoing factory, cannot be applied to a new project in a developing country. Cost accounting surcharges vary from factory to factory and from country to country, and 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 might perhaps be thought that in the case of new, large-scale projects an *ex ante* cost-centre accounting scheme should be built up to compute *ex ante* surcharges. There are, however, too many imponderables for this procedure to be practicable.

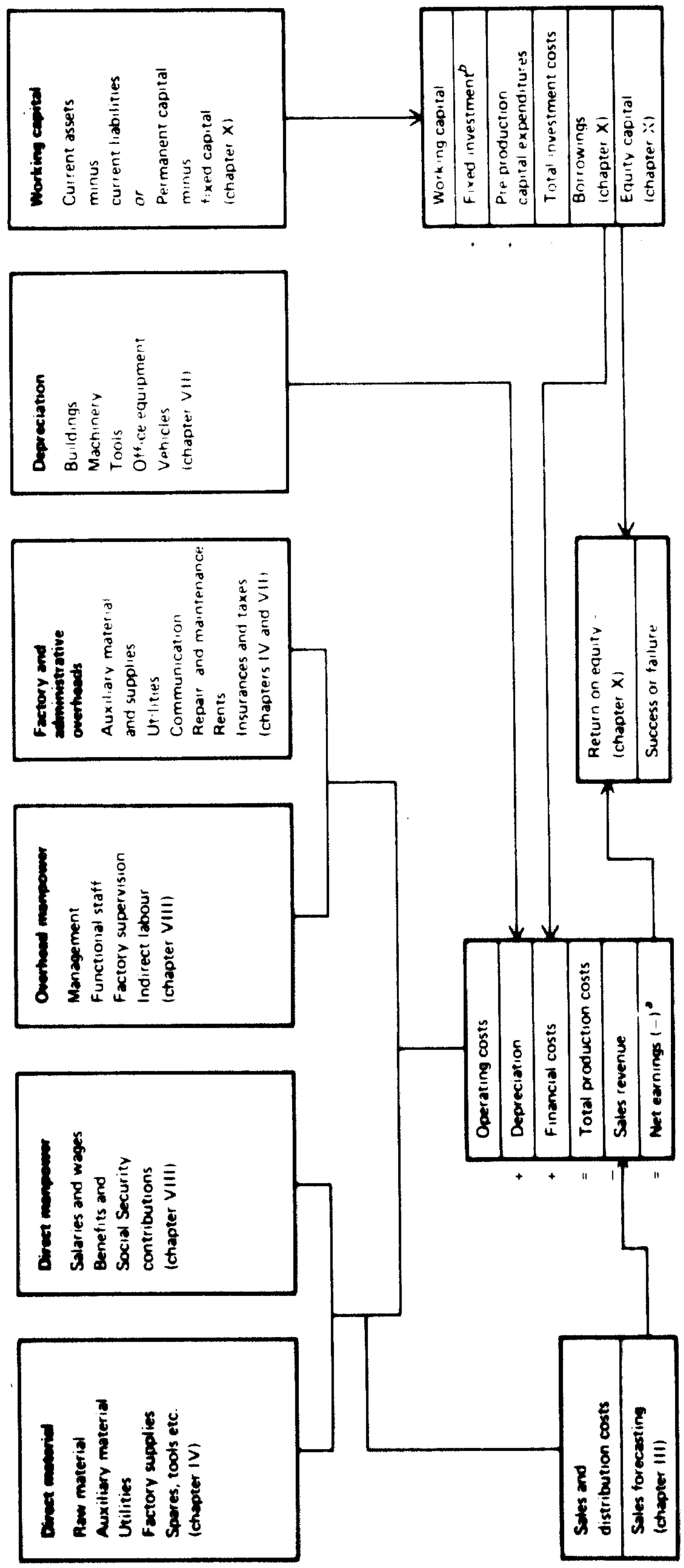
The solution adopted in the *Manual* is to consider only the variable unit costs and to deduct them and the expected profit from the anticipated unit sales price. The residual unit costs are then multiplied by the output. The resulting figure should be checked to see if it is sufficient to accommodate total fixed (overhead) costs.

Financial evaluation

As far as the entrepreneur is concerned, the investment criterion is the financial return on the invested capital, that is, the profit. Consequently, the investment profitability analysis consists essentially of determining the ratio between the profit and the capital invested.

[15] *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 in terms of 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 to the unit cost price by way of surcharges, which are to be obtained from the cost accounting department. This procedure does not cause any special problems in the case of existing establishments, which can rely on historical data. However, at the feasibility stage of a new investment proposal with no industrial data at hand, even an approximative calculation of surcharges for the purpose of allocating indirect costs to the unit cost price must be a doubtful exercise. Direct costs usually coincide with variable costs and indirect costs with fixed costs.

Figure IV. Origin of cost items for profitability calculation (return on equity)



ᵃ Calculate corporate income tax if applicable

ᵇ Fixed investments: Chapter X based on chapters V, VI

An entrepreneur, as a rule, finances a project partly through equity capital and partly through borrowed funds. His primary interest is to know the profitability of the equity capital, that is, the net profit after taxes divided by the total equity. However, when preparing a feasibility study, one generally does not know how the project will be financed, so that the analysis of the profitability of the equity can sometimes only be based on an hypothetical financial plan. In addition, it is sometimes necessary to choose among several project alternatives with different capital structures. For these reasons it is advisable to prepare the profitability analysis not only of equity capital, but also of the total investment (equity and loans), that is, net profit after taxes plus financial costs divided by the total investment. Such a calculation can be a way to judge project alternatives on their own merits, assuming equal conditions for loan financing. Moreover, the profitability of the total investment can be compared with the going rate of interest in the capital market.[16]

Financial 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 the lifetime of the project.

Selection of project alternatives

As mentioned, each project proposal should take account of possible alternative ways of achieving the same task. In case project preparation does not follow the rule of searching for alternatives at the opportunity, pre-feasibility and even feasibility stage, the solution chosen might become very costly if, due to insufficient preparatory work, the project concept has to be dropped during the investment phase in favour of another technical alternative.

Project alternatives should be regarded as different and mutually exclusive technical solutions. In general, the following alternatives exist:

(a) Different production processes, either for the same final product (these processes, 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) Different scales of production;

(c) Different locations and sites;

(d) Different project implementation scheduling, caused, for example, by scarcity of funds.

Obviously the number of alternatives can become very large and considerable funds may have to be spent to analyse and compare them all. As mentioned earlier,

[16] This statement needs some refinement since in many instances the method of financing the project proposal will not be known at the feasibility stage. To assume simply that the investor should earn a profit at least equal to the long-term lending rate (plus a premium for the entrepreneurial risk) that he would obtain if he lent the money away, would not do full justice to the problem. It may be assumed that a substantial part of the funds required will have to be borrowed. Therefore, the target profit rate of the project will also have to cover the cost of capital. Consequently, the average profit margin should be at best equal to a value computed from the long-term lending and borrowing rates for capital, plus a margin for the entrepreneurial risk. When calculating this average, the share of long-term debts and equity financing should be taken into account.

supporting studies have to be undertaken in parallel with the pre-feasibility and feasibility studies in order to pre-select alternatives and to restrict them in number.

It would be highly unsatisfactory, however, to go to the other extreme and to present only one proposal. The choice would then only be "yes" or "no", with no certainty that the most economic proposal possible was being considered. The question of commercial project selection will be dealt with later on in this chapter.

Discounting methods

Net present value

The net present value (NPV) of a project is defined as the value 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. This difference is discounted to the point at which the implementation of the project is supposed to start. The NPVs obtained for the years of the life of the project are added to obtain the project NPV as follows:

$$NPV = NCF_1 + (NCF_2 \times a_2) + (NCF_3 \times a_3) + ... + (NCF_i \times a_i) + ... + (NCF_n + a_n)$$

where NCF_i is the net cash flow of a project in years 1, 2, 3, . . ., i, . . ., n, and a_i is the discount factor in years 2, 3, . . ., i, . . ., n, appropriate to the discount rate applied. Discount factors are obtained from present value tables.

The discount rate (or cut-off rate) should be equal either to the actual rate of interest on long-term loans in the capital market or to the interest rate paid by the borrower. Since capital markets frequently do not exist, the discount rate should reflect the opportunity cost of capital: the possible return on the same amount of capital invested elsewhere. Expressed differently, this should be a minimum rate of return below which an entrepreneur considers that 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 generally between 10 and 15 years. Factory buildings of solid material will usually last 30 or 40 years, vehicles 4 or 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 fixed assets that last longer, assets like buildings, for example, must be given at their salvage value at the end of the discounting period. This is also true of the values of land and working capital, which remain practically constant during the life of the project.

The replacement of assets with a shorter life during the discounting period must be considered. In most cases the discounting period includes the construction period (say, two years) plus some 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. A project with a positive or zero NPV can thus be considered acceptable. If the NPV is negative, the profitability is below the cut-off rate, and the project should be dropped.

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 should be noted that depreciation is not taken into account since it does not involve any cash movement. However, repayments of credits are considered, since they are cash outflows.

Schedules 10-13 and 10-14 show that a total working capital of $2.0 million will be recovered by the end of the project and that the entire bank overdraft of $1.5 million will be repaid (schedule 10-14). If the overdraft was not repaid, the terminal value would only be $0.5 million (which is covered by the equity capital), but in this case interest payment would have to be taken into account throughout the whole discounting period.

The calculation of the NPV for the total investment costs (schedule 10-13) is identical to the case where the project is undertaken without any outside financing. However, the calculation of the NPV for the equity capital (schedule 10-14) corresponds to the case where outside financing (loans) is involved. In both cases, a supporting table should 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, bearing 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 the NPV is greater than or equal to zero.

If one of several project alternatives has to be chosen, the project with the largest NPV should be selected. This 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 where there are two or more alternatives, it is advisable to know how much investment will be required to generate these positive NPVs. The ratio of the NPV and the present value of the investment (PVI) required is called the net present value ratio (NPVR), and yields a discounted rate of return; this should be used for comparing alternative projects. The formula is as follows:

$$\text{NPVR} = \frac{\text{NPV}}{\text{PVI}}$$

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 project in the example, the following NPVRs are obtained:

	NPV	*PVI*	*NPVR*
Schedule 10-13 (end of line D)	1 473	2 871 + 3 780 + 928 + 154 + 43 + 94 + + 327 = 8 197	0.179
Schedule 10-14	1 026	2 871 + 1 890 + 327 = 5 088	0.201

Thus, it is more profitable for the entrepreneur's equity capital to finance the project from outside funds than to rely exclusively on own funds. Given alternative projects, the one with the highest NPVR should be chosen. When only one project is being considered a positive choice should only be made if the NPVR is greater than or equal to zero. When comparing alternatives, care should be taken to use the same discounting period and rate of discount for all projects.

In summary, the NPV has great advantages as a discriminatory method compared with 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. The NPV can also be considered as a calculated investment rate which the profit rate of the project should at least reach. The shortcomings of the NPV are the difficulty in selecting the appropriate discount rate and that the NPV does not show the exact profitability rate of the project. For this reason the NPV is not always understood by businessmen used to think in terms of a rate of return on capital. For these reasons, it is advised to use the internal rate of return.

Internal rate of return

The internal rate of return (IRR) is the discount rate at which the present value of cash inflows is equal to the present value of cash outflows; put another way, it is the rate at which the present value of the receipts from the project is equal to the present value of the investment, and the net present value is zero. The procedure used to calculate the IRR is the same as the one used to calculate the NPV. The same kind of table can be used and, instead of discounting cash flows at a predetermined cut-off rate, several discount rates may have to be tried until the rate is found at which the NPV is zero. This rate is the IRR, and it represents the exact profitability of the project.

The calculation procedure begins with the preparation of a cash-flow table. An estimated discount rate is then used to discount the net cash flow to the present value. If the NPV is positive, a higher discount rate is applied. If the NPV is negative at this higher rate, the IRR must be between these two rates. However, if the higher discount rate still gives a positive NPV, the discount rate must be increased until the NPV becomes negative.

If the positive and negative NPVs are close to zero, a precise (the closer to zero, the more precise) and less time-consuming way to arrive at the IRR uses the following linear interpolation formula:

$$i_r = i_1 + \frac{PV(i_2 - i_1)}{PV + NV}$$

where i_r is the IRR, PV is the NPV (positive) at the low discount rate of i_1, and NV is the NPV (negative) at the high discount rate of i_2. The numerical values of both PV and NV used in the above formula are positive. It should be noted that i_1 and i_2 should not differ by more than one or two per cent. The above formula will not yield realistic results if the difference is too large, since the discount rate and the NPV are not related linearly.

In the project without outside financing of the example (schedule 10-13), the NPV = 771,000 at a 15 per cent discount rate. In order to find the IRR, several discount rates greater than 15 per cent should be tried until the NPV is equal to zero. The NPVs at discount rates of 17 per cent and 18 per cent are shown below.

Year	*Net cash flow schedule ($ thousand)*	*Discount factor at 17%*	*NPV ($ thousand)*	*Discount factor at 18%*	*NPV ($ thousand)*
1	3 300	0.854	– 2 818	0.847	2 795
2	– 5 000	0.730	– 3 650	0.718	– 3 590
3	– 535	0.624	– 334	0.609	– 326
4	1 755	0.533	935	0.516	906
5	2 240	0.456	1 021	0.437	979
6	3 270	0.389	1 272	0.370	1 210
7	3 500	0.333	1 165	0.314	1 099
8	1 140	0.284	324	0.266	303

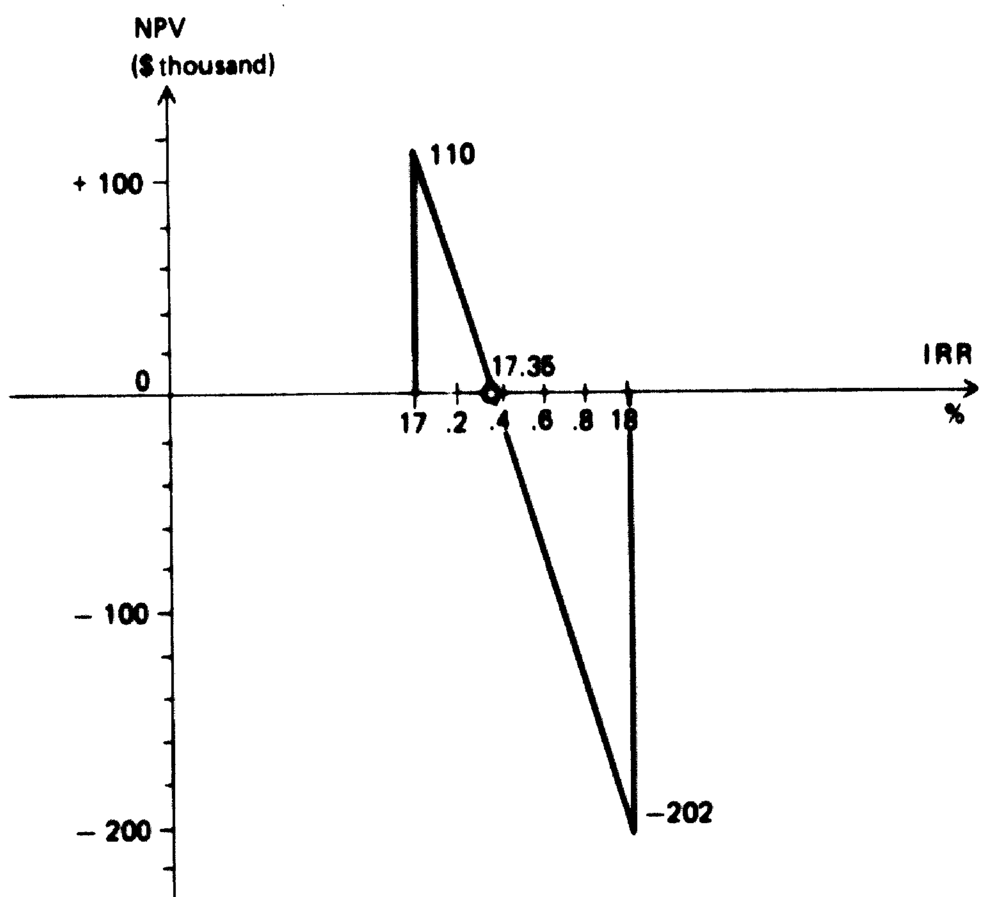
Year	Net cash flow schedule ($ thousand)	Discount factor at 17%	NPV ($ thousand)	Discount factor at 18%	NPV ($ thousand)
9	2 140	0.243	520	0.225	482
10	2 140	0.208	445	0.191	409
11	2 140	0.177	379	0.162	347
12	5 640	0.151	851	0.137	773
			110		– 203

The above table shows that, discounted at 17 per cent, the net cash flow is still positive, but it becomes negative at 18 per cent. Consequently, the IRR must lie between 17 per cent and 18 per cent. For practical purposes this would be sufficiently close to be able to calculate the exact IRR using the formula given and graphical interpolation.

Thus,

$$i_r = 17 + \frac{110\,(18 - 17)}{110 + 203} = 17.35\%$$

In the graphical method, the positive and the negative NPVs are plotted on the ordinate, and the discount rates are plotted on the abscissa. This is shown below.



The line connecting the negative and the positive NPV cuts the abscissa (NPV = 0) at a discount rate equal to the IRR. In the example, this is above 17.3 per cent.

The IRR indicates the actual profit rate of the total investment outlay and, if required, 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 that 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 may be accepted if the IRR is greater than the cut-off rate, which is the lowest acceptable investment rate for the invested capital. If several alternatives are being compared, the project with the highest IRR should be selected if IRR is greater than the cut-off rate.[17]

Simple methods of financial evaluation

The methods involving the pay-back period and the simple rate of return are usually called simple methods since they do not consider the entire life of the project but only brief periods of one year. In addition, the annual data used are taken at the actual, and not at the discounted, value. The project is assumed to be operating at full capacity for the periods considered, which means that normally only the third, fourth or fifth year of operation can be used for these calculations.

Pay-back period

The pay-back period is defined as the period required to recuperate the original investment outlay through the profits earned by the project; "profit" is defined as net profit after tax, adding financial cost and depreciation. In the example, the calculation is as follows (data are derived from schedules 10-3/1 and 10-9):

Item	*Year* 3	4	5	6	7
Net profit	280	920	1 270	2 540	2 630
Interests	370	330	280	180	90
Depreciation	780	780	780	780	780
"Profit"	870	2 030	2 330	3 500	3 500

When calculating the pay-back period, the computation usually starts with the construction period during which the initial investments will be made. The calculation of the pay-back period for the example is shown below.

Calculation of pay-back period

		Value[18] *($ thousand)*
1.	Total investment costs	10 300 (8 000)

[17]The IRR should be applied continuously in cases where major negative net cash flows occur repeatedly during the later life of the project. Although this occurs very seldom (occasionally in the oil and mining industry, for example), the NPV may go positive and negative more than once when applying different discount rates. More than one IRR may exist and the one to be applied to the project may not be possible to determine.

[18]Figures in brackets refer to calculation of the pay-back period while disregarding the value of land and working capital.

Calculation of pay-back period (continued)

2. Annual net profit plus interest plus depreciation

	Amount paid back (= "profit")	*Balance at end of year*	
Year 1 (construction period)	-	10 300	(8 000)
Year 2 (construction period)	-	10 300	(8 000)
Year 3	870	9 430	(7 130)
Year 4	2 030	7 400	(5 100)
Year 5	2 330	5 070	(2 770)
Year 6	3 500	1 570	
Year 7	3 500		

The calculation indicates that the original investment costs will be recovered after a little less than 6.5 years, including the construction period. The same result can also be obtained using the cumulative net cash-flow: schedule 10-13 shows that the initial investment outlay of $10.3 million will be repaid shortly before 6.5 years.

There are two ways of calculating the pay-back period: one is a modified version of the one described above, except that it does not include the construction period. The pay-back period for the example would thus be after 6.5 2 = 4.5 years.

In the second method, the value of land ($0.3 million) and of working capital ($2.0 million) are deducted from the total investment costs on the assumption that these values can be fully regained at the end of the project. Thus only $8.0 million of investment outlay must be recovered; this consists mainly of fixed assets, such as plant and equipment, as well as buildings and civil works. In this case the pay-back period would be 5.2 years. The figures for this calculation are given in brackets in the above example. If the construction time is disregarded, the pay-back period becomes 3.2 years.

A single project proposal may be accepted if the pay-back period is smaller than or equal to an acceptable time period; this period is usually derived from past experience with similar projects.

The major merit of the pay-back period as a project selection criterion is its easy calculation. It is particularly useful for risk analysis, which is relevant in politically unstable countries and in branches of industry that face rapid technological obsolescence. The main shortcomings of this method are that it does not consider what will happen once the project has paid for itself 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 can be a useful supplementary tool in some cases.

Simple rate of return

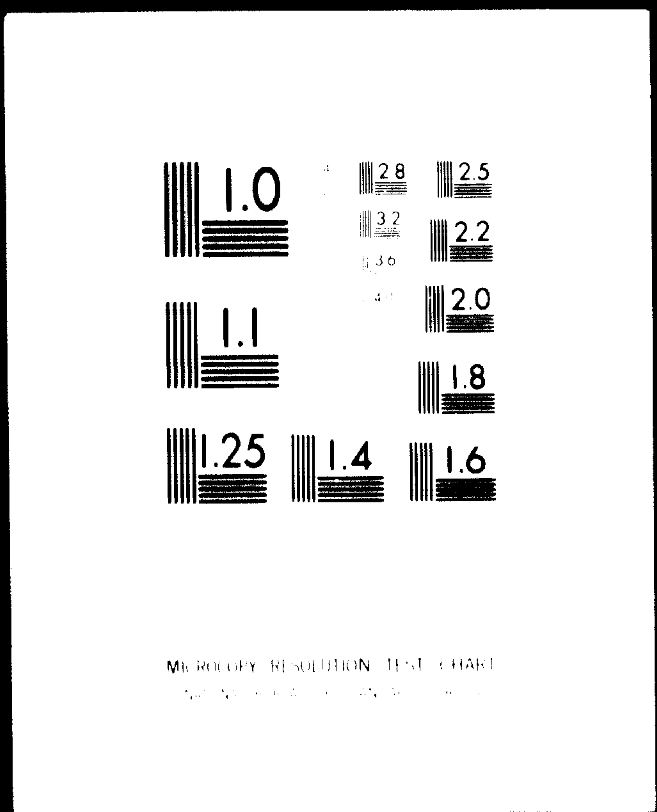
The simple rate of return method relies on the operational accounts. It is defined as the ratio of the profit in a normal year of full production to the original investment outlay (fixed assets, pre-production capital expenditures and net working

C-15

79.11.16

3 OF 3

08219



24x

C

capital).[19] 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 is to be assessed, or only that of the invested equity capital after paying taxes on profits and interests on borrowed capital. The simple rate of return thus becomes either

$$R = \frac{NP + I}{K} \times 100 \text{ (with outside financing)}$$

or

$$Re = \frac{NP}{Q} \times 100$$

where R is the simple rate of return on total investment costs, Re the simple rate of return on equity capital, NP the net profit (after depreciation, interest charges and taxes), K the total investment costs (fixed assets, pre-production capital costs and working capital), and Q the equity capital. Applying the above two equations for Year 6, the first year of full-capacity production, and Year 8, after expiration of the tax holidays, the following percentages are derived:

Year 6

$$R = \frac{(2{,}544 + 176) \times 100}{10{,}300} = 26.4\%$$

Year 8

$$R = \frac{(1{,}360 + 0) \times 100}{10{,}300} = 13.2\%$$

and

$$Re = \frac{2{,}544 \times 100}{5{,}800} = 43.8\%$$

$$Re = \frac{1{,}360 \times 100}{5{,}800} \ 23.4\%$$

[19] Without going into too much detail, it should be mentioned that the simple rate of return method is based on accounting conventions that frequently change from country to country depending on existing legislation, and that do not allow the method to reflect the real profitability of the project. However, existing legislation has to be considered as far as the profitability is concerned, in order to be able to assess the project under prevailing 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 are to be shown separately, they should be deducted from production costs (line 2), and gross profit would become sales minus production costs without depreciation charges. Taxable income would in turn become gross profit minus depreciation.

"Accounting profits" only become a meaningful way to evaluate a project if they are compared with invested capital, which can be defined in a couple of ways: *(a)* as permanent capital (equity capital, or equity + reserves, or equity + reserves + long-term loans); or *(b)* as total investment cost (fixed assets + pre-production capital costs + working capital).

In conclusion, the value of the simple rate of return really depends on how the terms "profit" and "capital" are defined, and so the ratio used should be explained before a final judgement is taken. Using the figures of the example, 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*
$\frac{\text{Gross profit or taxable profit}}{\text{Total investment outlay}}$ =	$\frac{2{,}544 \times 100}{10{,}300} = 24.6\%$	$\frac{2{,}720 \times 100}{10{,}300} = 26.4\%$
$\frac{\text{Net profit plus depreciation}}{\text{Total investment outlay}}$ =	$\frac{3{,}324 \times 100}{10{,}300} = 32.2\%$	$\frac{2{,}140 \times 100}{10{,}300} = 20.7\%$

This ratio explains the relationship between cash generation (net profit + depreciation) and the total investment costs.

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 costs are gradually recovered through depreciation (which is reinvested) and that, on 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, the average capital outlay will be $6.3 million and the rate of return as follows:

$$\text{Year 6:}\ R = \frac{(2{,}544 + 176) \times 100}{6{,}300} = 43.2\%$$

$$\text{Year 8:}\ R = \frac{(1{,}360 + 0) \times 100}{6{,}300} = 21.6\%$$

However the practice of computing the rate of return based on the original investment outlay prevails.

The simple rate of return method has a few serious disadvantages. For example, which year is the normal (representative) year to be taken as basis for computing the rate of return? Since the simple rate of return uses annual data, it is difficult and often impossible to choose the most representative year of the project. In addition to 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 that cause changes in the level of net profit in particular years (such as tax holidays, for instance).

Obviously, in years in which a tax concession is to be applied, the net profit will be quite different from that in years when the profit is subject to normal taxation. This shortcoming of the simple rate of return which is a consequence of its static character can to some extent be alleviated by calculating the profitability of the project for each year as shown in schedule 10-9. The difficulty of choosing the "normal" year is revealed by the varying annual rates of return shown in the following table:

ANNUAL RATE OF RETURN ON EQUITY CAPITAL
($ thousand)

Item \ Year	*Construction* 1	2	3	*Start-up and full capacity* 4	5	6	7	8	9
Net profit after tax			280	918	1 271	2 544	2 632	1 360	1 360
Equity capital			5 800	5 800	5 800	5 800	5 800	5 800	5 800
Rate of return			4.8	15.8	21.9	43.8	45.4	23.4	23.4

Even after this calculation, however, 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, income obtained in an early period is preferable to income obtained later. It is very difficult, however, to choose between two project alternatives that have different profitabilities over a number of years. For instance, how can one of the following two alternatives be selected, assuming both would have the same total investment costs:

	Profit (units)	
Year	*Project A*	*Project B*
1	50	170
2	60	120
3	120	90
4	160	80
5	200	70
Total	590	530

In such a case it is not sufficient to rely on an annual calculation of the profitability. Instead it is necessary to determine the overall profitability of the projects, and this is only possible by using discounting methods.

In conclusion, the simple rate of return method can be used for computing the profitability of the total investment costs when more or less equal gross profits are expected throughout the lifespan of the project. In such a case, it can be useful for a preliminary evaluation of competing projects and an elimination of the poor ones, keeping in mind that each country applies different legislative rules to depreciation and taxation; such rules make it difficult to evaluate the real benefits of the project.

Financial evaluation under uncertainty

As indicated in chapter III, forecasts of demand, production and sales may not be exact because of uncertainty about the future. Similarly, assumptions concerning the estimates of production and investment costs, prices or the lifetime of the project may not always be correct. Whichever form the final project proposal takes, its numerous components will have to be scrutinized with a view to increasing the precision of the proposal. Investment decisions underlie many political and social developments, as well as changes in technology, prices and productivity.

When deciding about the desirability of a project, all these elements have to be taken into account in the form of a foreseeable risk, which the project proposal either can or cannot carry. This is probably the most difficult decision to be made during the entire process of project preparation. The size of allowance provided for this purpose will have a decisive impact on the profitability of the project and may, in the case of a marginal proposal, tip the balance against the implementation of the project.

When dealing with an investment under conditions of uncertainty, three variables should particularly be examined: sales revenue, production and investment costs. A host of individual items enter into these variables, all of which are composed of a price and a quantity. The project planning team should identify the variables that could have a decisive influence on the profitability of a project and that should be subjected to uncertainty analysis. The problem of uncertainty is aggravated by the phasing of a project over time.

The most common reasons for uncertainty are inflation, changes in technology, false estimation of the rated capacity, and the length of the construction and running-in periods.

Uncertainty analysis can be undertaken in three steps: break-even analysis, sensitivity analysis and probability analysis. Since this *Manual* is more concerned with project preparation and treats financial analysis only in a complementary way, it refrains from going into the intricacies of probability analysis. Each project proposal should be reviewed by the project planner individually as to whether or not it would merit all three steps of uncertainty analysis, which require numerous computations. Only if great doubts prevail about the viability of an important project is it really worthwhile to go all the way.

Break-even analysis

Break-even analysis determines the break-even point (BEP) the point at which sales revenues equal production costs. The break-even point can also be defined in terms of physical units produced, or of the level of capacity utilization at which sales revenues and production costs match each other.

Prior to calculating the break-even point, the following conditions should be observed:

Production costs are a function of the volume of production or of sales (e.g. in the utilization of equipment);
The volume of production equals the volume of sales;
Fixed operating costs are the same for every volume of production;
Variable unit costs vary in proportion to the volume of production, and consequently total production costs also change in proportion to the volume of production;
The unit sales prices for a product or product mix are the same for all levels of output (sales) over time. The sales value is therefore a linear function of the unit sales prices and the quantity sold;
Data from a normal year of operation should be taken;
The level of unit sales prices, variable and fixed operating costs remain constant;
A single product is manufactured or, if several similar ones are produced, the mix should be convertible into a single product;
The product-mix should remain the same over time.

These conditions will not always exist in practice and the results of break-even analysis may, in turn, be influenced negatively. Therefore, break-even analysis should only be considered as a tool supplementary to other project evaluation methods.

Algebraic determination of the break-even point

When expressing the break-even point in physical units produced, the basic assumption can be put into the following equations (annual data):

Sales value = production costs (1)
Sales value = (sales volume) x (unit sales price) (2)
Production costs = (fixed costs) + (variable unit costs) x (sales volume) (3)

Writing x for production (sales) volume (at the break-even point), y for sales value (= production costs), f for fixed costs, p for unit sales price, and v for variable unit costs, the following algebraic expressions are derived:

Equation for sales $y = px$ (2a)
Equation for production costs $y = vx + f$ (3a)

Thus,

$$px = vx + f \qquad (1a)$$

and

$$x = \frac{f}{p - v} \qquad (4)$$

In these equations, the break-even point is determined by the relationship between fixed costs and the difference of the unit sales price and variable unit costs. Several practical conclusions can thus emerge from the break-even analysis:

A high break-even point is inconvenient since it renders a firm vulnerable to changes in the level of production (sales);

The higher the fixed costs, the higher the break-even point;

The larger the difference between unit sales price and variable operating costs, the lower the break-even point. In this case the fixed costs are absorbed much faster by the difference between unit sales price and variable unit costs.

Using the data of the example, the break-even point (BEP) would be reached at a production of

$$\text{BEP} = \frac{3{,}280{,}000}{6.25 - 3.25} = 1{,}093{,}333 \text{ units} \qquad \text{(from equation (4))}$$

Expressed in terms of sales revenue, equation (4) becomes:

$$\text{BEP} = p\left(\frac{f}{p - v}\right)$$

$$= 6.25 \times \frac{3{,}280{,}000}{6.25 - 3.25} = \$6{,}833{,}331 \qquad (4a)$$

Break-even analysis lends itself easily to sensitivity analysis, particularly with the following modified equation, which is used to calculate the rate of capacity utilization at the break-even point:

$$\text{BEP} = \frac{f}{r - v} \qquad (5)$$

where f and v are defined before and r is the sales revenue at full capacity.

For the example the break-even point would be reached at a capacity utilization of:

$$\text{BEP} = \frac{3{,}280}{12{,}500 - 6{,}500} = 55\%$$

In this way, break-even analysis can be useful in determining the impact of changes in unit prices, and in fixed and variable production costs, on the break-even point of a project.

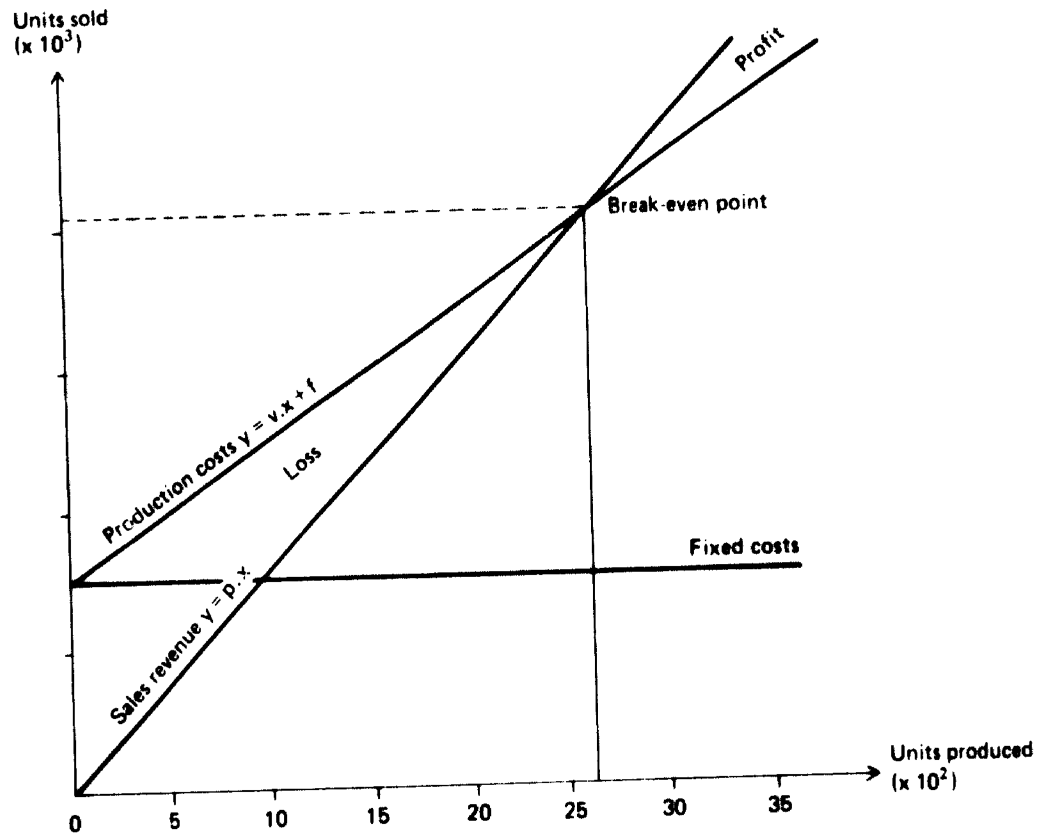
The above approach has the advantage of enabling the project planner to calculate several break-even points, taking into account alternative investment proposals resulting from different installed capacities or alternative technological processes. Changes in the installed capacity cause variations in the fixed costs. Changes in the technological process also have an impact on the variable costs since, for example, 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:

$$y = px \quad \text{and} \quad y = vx + f \text{ (see figure V).}$$

Figure V. Graphical determination of break-even point



The intersection of the lines is the break-even point, which in this case is defined in terms of 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.

Sensitivity analysis

With the help of sensitivity analysis it is possible to show how the profitability of a project alters with different values assigned to the variables needed for the computation (unit sales price, unit costs, sales volume). Sensitivity analysis is frequently used if, although the simple and discounted evaluation methods already described do not show a satisfactory profitability, an improvement is felt to be possible by changing some of the variables.

Sensitivity analysis should be applied already during the project planning stage, when decisions concerning major inputs are being taken. The element of uncertainty could be diminished at this stage by finding the optimistic and pessimistic alternatives, and so to determine the commercially most realistic combination of production factors. This exercise can be performed in many ways; for example, by selecting only the pessimistic solutions, one can determine the project's viability in the worst of all possible worlds. With the help of sensitivity analysis it is easy to identify the most important factors in a project, such as raw materials, labour and energy, and to determine any possibilities of input substitution.

To illustrate the application of sensitivity analysis in project formulation, the impact of changes in the unit sales price, variable production and fixed production costs (including depreciation) on the break-even point (as a percentage of capacity utilization)[20] are shown below.

(a) Assuming that the unit price first changes from \$6.25 to \$5.75 and, later on, to \$5.50:

$$\text{Break-even point} = \frac{\text{Fixed production costs}}{\text{Sales revenue} - \text{variable production costs}}$$

$$BEP_1 = \frac{3{,}280}{11{,}500 - 6{,}500} \times 100 = 65\% \text{ (or 1,300,000 units = \$7,475,000 sales)}$$

$$BEP_2 = \frac{3{,}280}{11{,}000 - 6{,}500} \times 100 = 73\% \text{ (or 1,460,000 units = \$8,030,000 sales)}$$

Applying formula (1a), it is also possible to find out the selling price at which the project breaks even:

$$2{,}000 \times p = (\$3.25 \times 2{,}000{,}000) + 3{,}280{,}000$$
$$\therefore p = \$4.89$$

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

$$\frac{6.25 - 4.89}{6.25} \times 100 = 21.8\%$$

which can be used for price manipulation, 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 by the envisaged full capacity utilization (100% − BEP). In the above example the margin is 100% − 65% = 35% for BEP_1 and 100% − 73% = 27% for BEP_2.

---

[20] The data are all taken from the example:

Item	*Value ($ thousand)*
Sales revenue	12 500
Fixed production costs	3 280
of which:	
Depreciation	780
Variable production costs	6 500

The amount of units produced is 2,000,000 and the break-even point is calculated for capacity utilization.

(b) Assuming that variable production costs

(i) increase by 10% while depreciation and fixed operating costs remain the same:

$$BEP_1 = \frac{3,280}{12,500 \quad (6,500 + 650)} \times 100 = 61\%$$

(or 1,220,000 units = \$7,625,000 sales)

(ii) decrease by 10% while depreciation and fixed operating costs remain the same:

$$BEP_2 = \frac{3,280}{12,500 \quad (6,500 \quad 650)} \times 100 = 49\%$$

(or 980,000 units = \$6,125,000 sales)

(c) Assuming that fixed production costs

(i) increase by 10%, while depreciation and variable operating costs remain the same:

$$BEP_1 = \frac{2,500 + 250 + 780}{12,500 \quad 6,500} \times 100 = 59\%$$

(or 1,180,000 units = \$7,375,000 sales)

(ii) decrease by 10%, while depreciation and variable operating costs remain the same:

$$BEP_2 = \frac{2,500 \quad 250 + 780}{12,500 \quad 6,500} \times 100 = 50\%$$

(or 1,000,000 units = \$6,250,000 sales)

(d) For changes in depreciation, depreciation charges are disregarded, while other fixed and variable production costs remain the same. If the residual production costs cannot be recovered by the project, it has to cease operations.

$$BEP = \frac{2,500}{12,500 \quad 6,500} \times 100 = 42\%$$

(or 820,000 units = \$5,125,000 sales)

Minimum production is therefore 820,000 units or \$5,125,000 sales. Considering the total output of 2,000,000 units, the project will have to recuperate at least \$9,000,000 of production costs at a unit sales price of not less than \$4.50 (according to equation (1a)) in order to break even.

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, annual instalments of say \$600,000 are assumed, the new break-even point will be at 65% capacity utilization or 1,300,000 units = \$8,125,000 sales.

Probability analysis

Probability analysis is carried out in the context of project preparation with the objective of improving the accuracy of cost estimates and, in turn, of profitability forecasts. Probability analysis attempts not only to forecast variables from optimistic and/or pessimistic estimates but to widen the range considerably and to determine the probability of occurrence for each value of a variable. Such an exercise naturally requires a number of judgements by people particularly qualified in the subject under review.

With the introduction of probability analysis the number of computations increases considerably since for each variable several values need to be computed in addition to the probability forecasts of occurrence.[21]

National economic evaluation

When it is desired to evaluate the contribution of industrial projects to the national economy, it is necessary to use one of the methods of cost-benefit analysis developed for the purpose. Since these are beyond the scope of this *Manual*, it will be sufficient to refer the reader to the latest publications in which they can be found. These are as follows:

Project Appraisal and Planning for Developing Countries, by I. Little and J. Mirrlees, London, 1974. The method in this book is being used by OECD and in United Kingdom bilateral co-operation.

Manuel d'Evaluation Economique des Projets, by M. Chervel and M. Le Gall, Paris, 1976. The method in this book developed by Prou and Chervel, is being used in French bilateral co-operation.

Economic Analysis of Projects, by L. Squire and H. van der Tak, Baltimore, 1975. The method in this book was developed by the World Bank.

Guidelines for Project Evaluation, United Nations, March 1972. The *Guidelines* were developed under the auspices of UNIDO. In addition, a manual based on the *Guidelines* is to be published in 1978 with the title *Guide to Practical Project Appraisal: Social Benefit/Cost Analysis in Developing Countries*.

Manual on the Evaluation of Industrial Projects in Arab Countries, to be published by IDCAS, Cairo in 1978. The method in this book was developed jointly by IDCAS and UNIDO.

The *UNIDO Guidelines* consider the raising of aggregate consumption to be a fundamental objective in project evaluation. Other objectives (especially the redistribution of income) may also be taken into account; the various objectives then have to be weighted and combined in order to determine the net contribution of the project to the national economy. The method involves *(a)* the identification and measurement of direct costs and benefits, and indirect costs and benefits to aggregate consumption; *(b)* the calculation of the shadow prices of labour, foreign exchange, and investment; and *(c)* the estimation of the social rate of discount, and also of relative weights to be attached to the net benefits accruing to various groups in the economy if redistribution of income is considered as a separate objective.

Although the *IDCAS/UNIDO Manual* appraises the soundness of a project primarily on the basis of the net national value-added expected to be generated, it also considers the effects of the project on employment, distribution of income, and foreign exchange. The *Manual* recommends using actual market prices mainly, but it

[21] Probability analysis receives more attention in the *Manual on the Evaluation of Industrial Projects in Arab Countries* (Cairo, Industrial Development Centre for Arab States, forthcoming).

also advocates the use of two national parameters – the social rate of discount and the adjusted rate of foreign exchange and provides simple operational procedures for their derivation.

Whatever the evaluation method adopted, it is recommended to test import substitution projects by calculating the project exchange rate and the effective rate of protection. The project exchange rate indicates how many units of local resources are required in order for the project to save one unit of foreign exchange. The effective rate of protection, which is best calculated as a ratio of excess value-added obtainable due to the imposition of tariffs to value-added obtainable in free-trade conditions, is an indication of the international competitiveness of a project. It is an interesting indicator because it does not penalize industries that utilize high-cost domestic inputs as is frequently the case in developing countries. In selecting projects one should give preference to those that would require the lowest effective protection.

Schedule 10-1/1. Initial fixed investment costs

(Insert totals in schedule 10-6/1)

Item	Investment category	From schedule	Foreign currency	Local currency	Total cost
				($ thousand)	
1.	Land	5-1			
2.	Site preparation and development	6-7			
3.	Structures and civil works				
	(a) Buildings and civil works	6-7			
	(b) Auxiliary and service facilities	6-7			
4.	Incorporated fixed assets	6-1			
5.	Plant machinery and equipment	6-3			
6.	Total initial fixed investment costs		2 880	4 920	7 800

Schedule 10-1/2. Fixed investment costs[a]

(Insert in schedule 10-6/2)

Period	Construction period (initial fixed investment)						Start-up and full capacity utilization (replacement investment)													
Year	1			2			3			. . .			8			. . .	Total		
Currency ($ thousand)	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt		FC	LC	Tt
Fixed investment costs	1 000	2 000	3 000	1 880	2 920	4 800	–	–	–				–	1 000	1 000		2 880	5 920	8 800
1. Land																			
2. Site preparation and development																			
3. Structures and civil work																			
4. Incorporated fixed assets																			
5. Plant and machinery																			

Note: FC = foreign currency; LC = local currency; Tt = total.

[a]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. Preproduction capital expenditures, by category

(Insert totals in schedules 10-6/1 and 10-7/1)

Item	Category	From schedule	Foreign currency	Local currency ($ thousand)	Total
1.	Pre-investment studies	2-1			
2.	Preparatory investigations	2-1			
3.	Management of project implementation	9-1			
4.	Detail planning, tendering	9-1			
5.	Supervision, co-ordination, test-run and take-over of civil works, equipment and plant	9-1			
6.	Build-up of administration recruitment and training of staff and labour	9-1			
7.	Arrangements for supplies	9-1			
8.	Arrangements for marketing	9-1			
9.	Build-up of connections	9-1			
10.	Preliminary and capital issue expenditure	9-1			
	Total		120	380	500

Schedule 10-2/2. Preproduction capital expenditure, by year

(Insert in schedule 10-6/2 and 10-7/2)

Period	*Construction*						*Start-up and full production*									*Total*		
Year	*1*			*2*			*3*			*4*			*5*					
Currency ($ thousand)	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*
Preproduction capital expenditure	70	230	300	50	150	200	—	—	—	—	—	—	—	—	—	120	380	500

Note: FC = foreign currency; LC = local currency; Tt = total.

Schedule 10-3/1. Calculation of working capital

I. 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 progress: 9 days at factory costs
- Finished products: 15 days at factory costs plus administrative overheads

(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

II. Annual production-cost estimate[a]

(Insert in schedule 10-3/2, line 4)

Period	Construction		Start-up			Full capacity		
Year	1	2	3	4	5	6	7	8
Production programme	0	0	55%	75%	80%	100%	100%	100%
Costs ($ thousand)								
Raw materials:								
Local material A			910	1 240	1 320	1 650	1 650	1 650
Local material B			275	320	400	500	500	500
Imported material			1 265	1 785	1 840	2 300	2 300	2 300
Labour			690	940	1 000	1 250	1 250	1 250
Utilities			250	340	360	450	450	450
Repair			180	260	280	350	350	350
Maintenance—spare parts			250	250	250	250	250	250
Factory overhead costs			1 350	1 350	1 350	1 350	1 350	1 350
Factory costs			5 170	6 485	6 800	8 100	8 100	8 100
Administrative overhead costs			500	500	500	500	500	500
Sales costs			250	250	250	250	250	250
Distribution cost			80	115	120	150	150	150
Operating costs[a]			6 000	7 350	7 670	9 000	9 000	9 000
Financial costs (interests)			375	330	280	180	90	—
Depreciation			780	780	780	780	780	780
Total production or manufacturing costs[b]			7 155	8 460	8 730	9 960	9 870	9 780

[a]For insertion into cash-flow tables 10-8/3, 10-13 and 10-14.

[b]When projecting total production costs, please refer to chapter X, 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.

Schedule 10-3/2. Calculation of working capital: working capital requirements

(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)

Item	*X* Minimum days of coverage	*Y* Coefficient of turnover	*Requirements ($thousand)* Start-up years 3	4	5	Full capacity years 6	7	8
I. *Current assets*								
A. Accounts receivable	30	12	500	612	640	750	750	750
B. 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-progress	9	40	130	162	170	202	202	202
(d) 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	–	–	1 588	1 971	2 066	2 410	2 407	2 403
II. *Current liabilities*								
A. Accounts payable	30	12	– 177	– 293	– 329	– 408	– 408	– 408
III. *Working capital*								
A. Net working capital			1 411	1 678	1 773	2 002	1 999	1 995
B. Increase in working capital			–	267	95	229	– 3	– 4

The cash balance schedule is based on the following calculation:

Item	*X*	*Y*	*3*	*4*	*5*	*6*	*7*	*8*
IV. *Total production costs*	–	–	7 155	8 455	8 730	9 960	9 870	9 780
less: Raw material	–	–	2 450	3 340	3 560	4 450	4 450	4 450
Utility	–	–	250	340	360	450	450	450
Depreciation	–	–	780	780	780	780	780	780
	15	24	3 675	3 995	4 030	4 280	4 190	4 100
V. *Required cash balance*	–	–	153	166	168	178	175	171

Note: A coefficient of turnover is calculated on the basis of minimum requirements of current assets and liabilities.

$$\text{Coefficient of turnover} = \frac{\text{360 days}}{\text{n days of minimum requirements}}$$

The cost figure 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

Month	Salaries and wages	Basic raw materials	Other mate-rials	Payment of taxes and profit ($ thousand)	Other pay-ments	Total
May	–	–	–	–	–	5 680
June	–	–	–	–		3 160
July	–	–	–	–	–	2 100
August	–	–	–	–	–	840
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 ($ thousand)	Surplus	Aggregated deficit
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 costs

(Insert in schedule 10-6/2)

Item	*Investment category*	*Foreign currency*	*Local currency ($ thousand)*	*Total*
1.	Initial fixed investment costs (from schedule 10-1/1)	2 880	4 920	7 800
2.	Pre-production capital expenditures (from schedule 10-2/1)	120	380	500
3.	Working capital (at full capacity) (from schedule 10-3/2, year 6, line III.A)	–	2 000	2 000
		3 000	7 300	10 300

Schedule 10-6/2.

(Insert in schedule

Period	*Construction*						*Start-up*		
Year	*1*			*2*			*3*		
Currency ($ thousand)	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*
1. Fixed in estment costs	1 000	2 000	3 000	1 880	2 920	4 800	–	–	
(a) Initial fixed investment costs	1 000	2 000	3 000	1 880	2 920	4 800	–	–	
(b) Replacement (from schedule 10-1/2)	–	–	–	–	–	–	–	–	–
2. Pre-production capital expenditures (from schedule 10-2/2)	70	230	300	50	150	200	–	–	–
3. Working capital increase (from schedule 10-3/2, line II/A,B)[a]	–	–	–	–	–	–	–	1 410	1 410
Total investment costs	1 070	2 230	3 300	1 930	3 070	5 000	–	1 410	1 410

Note: FC = foreign currency; LC = local currency; Tt = total.
[a]Figures are rounded off.

Schedule 10-7/1.

(Insert in

Item	*Investment category*
1.	Initial fixed investment costs
2.	Pre-production capital expendi·
3.	Current assets (at full capacity)

Total investment costs

10-13, line B.1)

Start-up						*Full production*									*Total*		
4			*5*			*6*			...	*8*			...				
FC	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*		*FC*	*LC*	*Tt*		*FC*	*LC*	*Tt*	
–	–	–	–	–	–	–	–	–	–	–	1 000	1 000		2 880	5 920	8 800	
–	–	–	–	–	–	–	–	–	–	–				2 880	4 920	7 800	
–	–	–	–	–	–	–	–	–		–	1 000	1 000		–	1 000	1 000	
–	–	–	–	–	–	–	–	–		–	–	–		120	380	2 000	
–	270	270	–	90	90	–	230	230		–	–	–		–	2 000	2 000	
–	270	270	–	90	90	–	230	230		–	1 000	1 000		3 000	8 300	11 300	

Total initial assets

schedule 10-7/2)

From schedule	*Foreign currency*	*Local currency ($ thousand)*	*Total*
10-1/1	2 880	4 920	7 800
10-2/1	120	380	500
10-3/2, year 6, line I.D	400	2 000	2 400
	3 400	7 300	10 700

Schedule 10-7/2.

(Insert in schedule 10-8/3, line B.1

Period	*Construction*						*Start-up and*		
Year	*1*			*2*			*3*		
Currency ($ thousand)	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*
1. Fixed investment costs	1 000	2 000	3 000	1 880	2 920	4 800	–	–	–
(a) Initial fixed investment costs	1 000	2 000	3 000	1 880	2 920	4 800	–	–	–
(b) Replacement (from schedule 10-1/2)	–	–	–	–	–	–	–	–	–
2. Pre-production capital expenditures (from schedule 10-2/2)	70	230	300	50	150	200	–	–	–
3. Current assets increase (from schedule 10-3/2, line I.D)[a]	–	–	–	–	–	–	180	1 410	1 590
Total assets	1 070	2 230	3 300	1 930	3 070	5 000	180	1 410	1 590

Note: FC = foreign currency; LC = local currency; Tt = total.
[a]Increment only.

Total assets

and schedule 10-10)

full production																			
4			*5*			*6*			. . .	*8*			. . .	*Total*		
FC	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*		*FC*	*LC*	*Tt*		*FC*	*LC*	*Tt*
–	–	–	–	–	–	–	–	–		–	1 000	1 000		2 880	5 920	8 800
–	–	–	–	–	–	–	–	–		–				2 880	4 920	7 800
–	–	–	–	–	–	–	–	–		–	1 000	1 000		–	1 000	1 000
–	–	–	–	–	–	–	–	–		–	–	–		120	380	500
110	270	380	40	90	130	70	230	300		–	–	–		400	2 000	2 400
110	270	380	40	90	130	70	230	300		–	1 000	1 000		3 400	8 300	11 700

Schedule 10-8/1. Sources of finance

(Insert in schedule 10-8/2)

Item	*Sources of finance*	*Local currency*	*Foreign currency* *($ thousand)*	*Total*
1.	*Promoters*			
	(a) Equity	3 500	–	3 500
	(b) Preference capital	–		–
	(c) Loans	–		–
	(d) Other forms such as deferred credits for supply of assets	–		–
	Total	3 500		3 500
2.	*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	2 300		2 300
3.	*Financial institutions or development agencies*			
	(a) Equity	–	–	–
	(b) Preference capital	–	–	–
	(c) Loans	–	–	–
	(d) Other forms	–	–	–
	Total	–	–	–
4.	*Government*			
	(a) Loans			
	(b) Subsidy			
	Total	–	–	–
5.	*Commercial banks*	1 500		1 500
6.	*Public subscriptions*			
7.	*Suppliers' credits*	–	3 000	3 000
8.	*Current liabilities*	–	400	400
	Total, all items	7 300	3 400	10 700

Schedule 10-8/2 follows

Schedule 10-8/2.

(Insert in schedule 10-8/3,

Period	*Construction*						*Start-up and*		
Year	*1*			*2*			*3*		
Currency ($ thousand)	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*
Equity capital	–	3 300	3 300	–	2 500	2 500			
Preference capital									
Loans[a]	–	–	–	–	1 500	1 500			
Suppliers' credits	–	–	–	3 000	–	3 000			
Current liabilities							180	–	180
Subsidies									
Public subscriptions									
Total		3 300	3 300	3 000	4 000	7 000	180	–	180

Note: FC = foreign currency; LC = local currency; Tt = total.

[a] Loans of different terms should be shown separately.

Sources of initial funds

line A.1, and 10-10)

full capacity operation														
4			*5*			*6*			...			*Total*		
FC	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*
												–	5 800	5 800
												–	1 500	1 500
												3 000	–	3 000
110	–	110	40	–	40	70	–	70				400	–	400
110	–	110	40	–	40	70	–	70				3 400	7 300	10 700

Schedule 10-8/3. Cash-flow

Period	*Construction*		*Start-up*		
Year	*1*	*2*	*3*	*4*	*5*
Production programme (from schedule 3-3)	*0*	*0*	*55%*	*75%*	*80%*
Costs ($ thousand)					
A. *Cash inflow*	3 300	7 000	7 055	9 485	10 040
1. Financial resources total (from schedule 10-8/2)	3 300	7 000	180	110	40
2. Sales revenue (from schedule 3-1)	–	–	6 875	9 375	10 000
B. *Cash outflow*	–3 300	–5 000	–8 797	–8 889	–9 511
1. Total assets schedule including replacements (from schedule 10-7/2)[a]	–3 300	–5 000	–1 590	–380	–130
2. Operating costs (from schedule 10-12)[b]	–	–	–6 000	–7 350	–7 670
3. Debt service (total)					
(a) Interest:					
Suppliers' credits	–	–	–240	–192	–144
Bank overdrafts	–	–	–135	–135	–135
Bank term loans	–	–	–	–	–
(b) Repayments:					
Suppliers' credits	–	–	–600	–600	–600
Bank overdrafts	–	–	–	–	–600
Bank term loans	–	–	–	–	–
4. Corporate tax (from schedule 10-9)	–	–	–	–	–
5. Dividends 4% on equity (from schedule 10-9)	–	–	–232	–232	–232
C. *Surplus/deficit* (from schedule 10-9)	0	2 000	–1 742	596	529
D. Cumulative cash balance[c]	0	2 000	258	854	1 383

[a]Not including interest during construction.

[b]"Production costs" do not include interests on loans and depreciation. Interest entered in B.3.a 'Interest'. Instead of depreciation allowances, the anticipated replacement expenditures are to be entered in B.1 'Replacements'.

table for financial planning

Full capacity							Salvage value in last year	Total
6	7	8	9	10	11	12		
100%	100%	100%	100%	100%	100%	100%		
12 570	12 500	12 500	12 500	12 500	12 500	12 500	–	124 450
70	–	–	–	–	–	–		10 700
12 500	12 500	12 500	12 500	12 500	12 500	12 500	–	113 750
–10 758	–10 370	–11 592	–10 592	–10 592	–10 592	–10 592	3 500	107 085
–300	–	–1 000	–	–	–	–	3 500	–8 200
–9 000	–9 000	–9 000	–9 000	–9 000	–9 000	–9 000	–	–84 020
–96	–48	–	–	–	–	–	–	–720
–80	–40	–	–	–	–	–	–	–525
–	–	–	–	–	–	–	–	–
–600	–600	–	–	–	–	–	–	–3 000
450	–450	–	–	–	–	–	–	–1 500
–	–	–	–	–	–	–	–	–
–	–	–1 360	–1 360	–1 360	–1 360	–1 360	–	–6 800
232	–232	–232	–232	232	–232	–232		–2 320
1 812	2 130	908	1 908	1 908	1 908	1 908	3 500	–
3 195	5 325	6 233	8 141	10 049	11 957	13 865	17 365	17 365

[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; line 8 in schedule 10-10, A.3 and/or B.4)

Period	*Construction*		*Start-up*			*Full capacity*				
Year	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*. . .*	*12*
Production programme	—	—	55%	75%	80%	100%	100%	100%	100%	100%
Costs ($ thousand)										
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[b]	—	—	—	—	—	—	—	–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 undistributed 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 in the cash-flow table for a project with outside financing. (Use line 4)

[b] Tax holiday up to year 7.

Schedule 10-10. Projected balance sheet

($ thousand)

Period	Construction		Start-up			Full capacity						
Year	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) Cumulative	–	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 schedule 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 schedule 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[a]
2. *Fixed assets* (net of depreciation)	3 300	8 300	7 520	6 740	5 960	5 180	4 400	4 620	3 840	3 060	2 280	1 500
Initial fixed investment, replacement and pre-production capital expenditures	3 300	8 300	7 520	6 740	5 960	5 180	4 400	4 620	3 840	3 060	2 280	1 500[b]
3. *Losses* (from schedule 10-9, line 8)	–	–	510	–	–	–	–	–	–	–	–	–
8. *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	5 800	5 800	5 800	5 800	5 800	5 800	5 800	5 800	5 800	5 800	5 800
4. Reserves (from schedule 10-9, line 8)	–		–	170	1 210	3 520	5 920	7 050	8 180	9 310	10 440	11 570

[a]Salvage value: 2 000 working capital.
[b]Salvage value: 1 500 fixed assets.

Schedule 10-11. Total production costs[a]

(See also schedule 10-3/1)

Cost item		*Foreign currency*	*Local currency ($thousand)*	*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, line K, column 12)	–	. .	. .
	Factory costs	2 550	5 550	8 100
4.	Administrative overhead costs	–	500	500
	4.1 Manpower costs (from schedules 8-2 and 8-4)	. .	. .	. .
	4.2 Overhead materials (from schedule 4-2)	. .	. .	. .
	4.3 Other administrative overheads (from schedule 7, line K, column 17)	. .	. .	. .
5.	Sales and distribution costs	–	400	400
	5.1 Manpower costs (from schedules 8-2 and 8-4)	–	. .	. .
	5.2 Others (from schedule 3-2)	–	. .	. .
	Operating costs	2 550	6 450	9 000
6.	Financial overhead costs: interests (from chapter X)	100	80	180
7.	Depreciation (from schedule 7, line M, column 18)		780	780
	Total production or manufacturing costs	2 650	7 310	9 960

[a]At full capacity year 6.

Schedule 10-12 follows

Schedule 10-12.

(See also schedule 10-3/1. Insert total production costs in schedule 10-9.

Period	*Start-up*								
Year	*3*			*4*			*5*		
Production programme	*55%*			*75%*			*80%*		
Currency ($ thousand)	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*	*FC*	*LC*	*Tt*
1. Direct materials	1 265	1 615	2 830	1 785	2 160	3 945	1 840	2 360	4 200
2. Direct manpower	–	690	690		940	940		1 000	1 000
3. Factory overheads	250	1 350	1 600	250	1 350	1 600	250	1 350	1 600
Factory costs	1 515	3 665	5 170	2 035	4 450	6 485	2 090	4 710	6 800
4. Administrative costs	–	500	500	–	500	500	–	500	500
5. Sales and distribution	–	330	330	–	365	365	–	370	370
Operating costs	1 515	4 485	6 000	2 035	5 315	7 350	2 090	5 580	7 670
6. Financial costs	240	135	375	190	140	330	140	140	280
7. Depreciation	–	780	780	–	780	780	–	780	780
Total production costs	1 755	5 400	7 155	2 225	6 235	8 460	2 230	6 500	8 730

Note: FC = foreign currency; LC = local currency; Tt = total.

Production-cost schedule

line 2, and total operating costs in schedules 10-8/3, 10-13 and 10-14)

Full capacity operation											
6			7			8			12		
100%			100%			100%			100%		
FC	LC	Tt	FC	LC	Tt	FC	LC	Tt	FC	LC	Tt
2 300	2 950	5 250	2 300	2 950	5 250	2 300	2 950	5 250	2 300	2 950	2 550
	1 250	1 250	–	1 250	1 250	–	1 250	1 250	–	1 250	1 250
250	1 350	1 600	250	1 350	1 600	250	1 350	1 600	250	1 350	1 600
2 550	5 550	8 100	2 550	5 550	8 100	2 550	5 550	8 100	2 550	5 550	8 100
–	500	500	–	500	500	–	500	500	–	500	500
–	400	400	–	400	400	–	400	400	–	400	400
2 550	6 450	9 000	2 550	6 450	9 000	2 550	6 450	9 000	2 550	6 450	9 000
100	80	180	50	40	90	–	–	–		–	–
	780	780		780	780	–	780	780	–	780	780
2 650	7 310	9 960	2 600	7 270	9 870	2 550	7 230	9 780	2 550	7 230	9 780

Schedule 10-13. Cash-flow table and calculation of

(Economic value for

Period	*Construction*		*Start-up*		
Year	*1*	*2*	*3*	*4*	*5*
Production programme (from schedule 3-3)	*0*	*0*	*55%*	*75%*	*80%*
Values ($ thousand)					
A. *Cash inflow*					
1. Sales revenue (from schedule 3-1)	0	0	6 875	9 375	10 000
B. *Cash outflow* (1+2+3)	−3 300	−5 000	−7 410	−7 620	−7 760
1. Total investment outlay (from schedule 10-6/2)	−3 300	−5 000	−1 410	−270	−90
2. Operating costs (from schedule 10-3/1)			−6 000	−7 350	−7 670
3. Corporate tax[b] (from schedule 10-9)					
C. Net cash flow (A-B)	−3 300	−5 000	−535	1 755	2 240
D. Present value (at 15%)	−2 868	−3 780	−351	1 002	1 113
E. Cumulative net cash flow	−3 300	8 300	−8 835	−7 080	−4 840

[a]*Salvage values.* Land: 300; $^2/_3$ of buildings: 1 200; working capital: 2 000.

[b]Tax holidays up to year 7.

present value for a project without outside financing

the entrepreneur)

Full capacity								
6	*7*	*8*	*9*	*10*	*11*	*12*	***Salvage value in last year***[a]	***Total***
100%	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*		
12 500	12 500	12 500	12 500	12 500	12 500	12 500	–	113 750
−9 230	−9 000	−11 360	−10 360	−10 360	−10 360	−10 360	3 500	−98 620
		—						
−230	–	1 000					3 500	−7 800
−9 000	−9 000	−9 000	−9 000	−9 000	−9 000	−9 000		−84 020
		−1 360	−1 360	−1 360	−1 360	−1 360		−6 800
3 270	3 500	1 140	2 140	2 140	2 140	2 140	3 500	15 130
1 413	1 312	371	608	528	458	398	567	771
−1 570	1 930	3 070	5 210	7 350	9 490	11 630	–	15 130

Schedule 10-14. Cash-flow table and calculation of

(Economic value

Period	*Construction*		*Start-up*		
Year	*1*	*2*	*3*	*4*	*5*
Production programme (from schedule 3-3)	*0*	*0*	*55%*	*75%*	*80%*
Values ($ thousand)					
A. *Cash inflows*					
1. Sales revenue (from schedule 3-1)	–	–	6 875	9 375	10 000
B. *Cash outflows* (total)	–3 300	–2 500	–6 975	–8 277	–9 149
1. Total investment costs (fixed investment)	–3 300	–2 500	–975	–927	–1 479
(a) Equity funds	–3 300	–2 500			
(b) Replacement of cars (from schedule 10-8/2)					
(c) Repayment of supplier's credit[a]			–600	–600	–600
(d) Interest on supplier's credit			–240	–192	–144
(e) Repayment of bank overdraft			–	–	–600
(f) Interest on bank overdraft			–135	–135	–135
2. Operating costs (from schedule 10-3/1)			–6 000	–7 350	–7 670
3. Corporate tax[b] (from schedule 10-9)					
C. Net cash flow (A-B)	–3 300	–2 500	–100	1 098	851
D. Present value (at 15%)	–2 868	–1 890	–66	627	423

[a]Depending on the contract, interest payments could start during the construction period.
[b]Tax holidays up to year 7.

present value for a project with outside financing

for the entrepreneur)

	Full capacity								
	6	*7*	*8*	*9*	*10*	*11*	*12*	*Salvage value in last year*	*Total*
	100%	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*		
	12 500	12 500	12 500	12 500	12 500	12 500	12 500	—	113 750
	−10 226	−10 138	−11 360	−10 360	−10 360	−10 360	−10 360	3 500	−99 865
	−1 226	−1 138						3 500	−9 045
								3 500	−2 300
			−1 000						−1 000
	−600	−600							−3 000
	−96	−48							−720
	−450	−450							−1 500
	−80	−40							−525
	−9 000	−9 000	−9 000	−9 000	−9 000	−9 000	−9 000		−84 020
			−1 360	−1 360	−1 360	−1 360	−1 360		−6 800
	2 274	2 362	1 140	2 140	2 140	2 140	2 140	3 500	13 885
	982	886	372	608	529	458	398	567	1 026

Bibliography

Alfred, A. M. *and* J. B. Evans. Discounted cash flow, principles and some short cut techniques. 2. ed. London, Chapman and Hall, 1969.

Biermann, Harold, Jr. *and* Seymour Smidt. The capital budgeting decision, economic analysis and financing of investment projects. 3. ed. New York, Macmillan, 1971.

Bussery, André. Case study; Example of import substitution: Ironworks with an output of 30,000 tons per year for the production of (concrete) reinforcement bars from scrap iron. *Industrialization and productivity*. Bulletin No. 19, 1973.
United Nations publication, Sales no.: 72.II.B.8.

_______ Evaluation of economic viability of production projects in developing countries. *Industrialization and productivity*, Bulletin No. 19, 1973.
United Nations publication, Sales no.: 72.II.B.8.

Chervel, M. *and* M. Le Gall. Manuel d'évaluation économique des projets; la méthode des effets. Paris, Sede, 1976.

Gittinger, J. Price. Compounding and discounting tables for project evaluation. 3. ed. Washington, D.C., International Bank for Reconstruction and Development, 1974.

Grant, E. L. *and* W. G. Ireson. Principles of engineering economy. 5. ed. New York, Ronald, 1964.

Industrial Development Centre for Arab States. Manual for evaluation of industrial projects in Arab countries. Cairo, forthcoming.

Little, I. *and* J. A. Mirrlees. Project appraisal and planning for developing countries. London, Heinemann Educational Books, 1974.

Merrett, A. J. *and* A. Sykes. The finance and analysis of capital projects. London, Longman. 1966.

Park, William A. Cost engineering analysis. New York, Wiley, 1973.

Pilcher, Roy. Appraisal and control of project costs. London, McGraw-Hill, 1973.

Reutlinger, Shlomo. Techniques for project appraisal under uncertainty. World Bank Staff Occasional Papers No. 10. Baltimore, Johns Hopkins, 1972.

Solomon, Morris J. Analysis of projects for economic growth. New York, Praeger, 1970.

Taylor, G. A. Managerial and engineering company. New York, Van Nostrand, 1964.

Tucker, Spencer A. The break-even system. Englewood Cliffs, New Jersey, Prentice-Hall, 1973.

United Kingdom. Foreign and Commonwealth Office, Overseas Development Administration. A guide to project appraisal in developing countries. London, H.M. Stationery Office, 1972.

_______ Civil Service College. The economies of investment analysis. Occasional Paper No. 17. London, H.M. Stationery Office, 1973.

United Nations. Guidelines for project evaluation. [Prepared by P. Dasgupta, S. Marglin and A. K. Sen] 1972.
Sales no.: 72.II.B.11.

_______ Guide to practical project appraisal; social benefit/cost analysis in developing countries [Prepared by John R. Hansen]
Sales no.: 78.II.B.3.

Van der Tak *and* L. Squire. Economic analysis of projects. IBRD Staff Working Paper No. 194. Washington, D.C., World Bank, 1975.

Weiss, Dieter. Economic evaluation of projects; a critical comparison of a new World Bank methodology with the UNIDO and the revised OECD approach. Berlin, German Development Institute, 1976.

Annexes

ANNEX I. OUTLINES OF GENERAL OPPORTUNITY STUDIES

A. Outline of an area study

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, and socio-economic background of the area, all set in the context of the country's socio-economic structure, highlighting differences of the area compared.

3. Leading exports from and imports to the area.

4. Basic exploited and potentially exploitable production factors.

5. Structure of any existing manufacturing industry utilizing local resources.

6. Infrastructural facilities, especially of transport and power, conducive to development of industries.

7. A comprehensive check-list of industries that can be developed on the basis of the available resources and infrastructural facilities.

8. A check-list revising the one mentioned in item 7 by a process of elimination, excluding the following industries:

(a) Those for which present local demand is too small and transportation costs too high;

(b) Those which face too severe competition from adjoining areas;

(c) Those which can be more favourably located in other areas;

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

(e) Those requiring substantial export markets, if the area is located in the interior and transportation to the port is difficult or freight costs are high;

(f) Those for which markets are distantly located;

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

(h) Those 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 list of industries left after the revision of item 8.

10. Identification (by considering the best economic sizes of plants and transportation costs) of the approximate capacities of new or expanded units that could be developed.

11. Estimated capital costs of selected industries (lump sum) taking the following into account:

(a) Land;

(b) Technology;

(c) Equipment;

(i) Production equipment;
(ii) Auxiliary equipment;
(iii) Service equipment;
(iv) Spare parts, wear-and-tear parts, tools;

(d) Civil engineering works including:

(i) Site preparation and development;
(ii) Buildings;
(iii) Outdoor works;

(e) Project implementation;

(f) Pre-investment capital expenditures, including expenditures for preparatory investigations;

(g) Working capital requirements.

12. Major input requirements. For each project approximate quantities of essential inputs should be estimated, so as to obtain the total input requirements. Sources of inputs should be stated and classified (i.e. local, shipped from other areas of the country, or 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 item 12.

14. Estimated annual sales revenue.

15. Organizational and management aspects of project sponsor(s), or a 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 finance (estimated).

19. Estimated foreign exchange requirements and earnings (including savings).

20. Financial evaluation: approximate pay-off period, approximate rate of return. Assessment of possible 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, and economic diversification.

Indicative figures based on reference programming data, such as surveys and related studies, secondary data, performance of other similar industrial establishments should be sufficient for this purpose.

B. Outline of a sub-sector opportunity study

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 items that are not imported and of those wholly or partially imported.

4. Rough projections of demand for each item.

5. Identification of the items in short supply that have growth and/or export potential.

6. A broad survey of the raw materials indigenously available.

7. Identification of opportunities for development based on headings 2, 5 and 6, and other important factors, such as transport costs, and available or potentially available infrastructure.

Items 10-21 from section A of this annex follow 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. Outline of resource-based opportunity studies

1. The characteristics 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 resources, 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 export of items that could utilize the resource.

6. Identification of investment opportunities based on items 3, 4 and 5.

Items 11-21 from section A of this annex follow item 6 of the resource-based opportunity studies, since the structural requirements of the studies are the same once the investment opportunities have been identified.

ANNEX II. OUTLINE OF A PRE-FEASIBILITY STUDY

1. Executive summary—a synoptic review of all the essential findings of each chapter.

2. Project background and history:

   (a) Project sponsor(s);

   (b) Project history;

   (c) Cost of studies and/or investigations already performed.

3. Market and plant capacity:

   (a) Demand and market

   (i) 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;

   (ii) Past imports and their future trends, volume and prices;

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

   (iv) The approximate present size of demand, its past growth, major determinants and indicators;

   (b) Sales forecast and marketing

   (i) Anticipated competition for the project from existing and potential local and foreign producers and supplies;

   (ii) Localization of market(s);

   (iii) Sales programme;

   (iv) Estimated annual sales revenues from products and by-products (local/foreign);

   (v) Estimated annual costs of sales promotion and marketing;

   (c) Production programme (approximate)

   (i) Products;

   (ii) By-products;

   (iii) Wastes (estimated annual cost of waste-disposal);

   (d) Determination of plant capacity

   (i) Feasible normal plant capacity;

   (ii) Quantitative relationship between sales, plant capacity and material inputs.

4. Material inputs (approximate input requirements, their present and potential supply positions, and a rough estimate of annual costs of local and foreign material inputs):

   (a) Raw materials;

   (b) Processed industrial materials;

   (c) Components;

   (d) Auxiliary materials;

   (e) Factory supplies;

   (f) Utilities, especially power.

5. Location and site (preselection, including, if appropriate, an estimate of the cost of land).

6. Project engineering:

   (a) Preliminary determination of scope of project;

   (b) Technology(ies) and equipment

(i) Technologies and processes that can be adopted, given in relation to capacity size;
(ii) Rough estimate of costs of local and foreign technology;
(iii) Rough layout of proposed equipment (major components):
a. Production equipment;
b. Auxiliary equipment;
c. Service equipment;
d. Spare parts, wear and tear parts, tools;
(iv) Rough estimate of investment cost of equipment (local/foreign), classified as above;

(c) Civil engineering works
(i) Rough layout of civil engineering works, arrangement of buildings, short description of construction materials to be used:
a. Site preparation and development;
b. Buildings and special civil works;
c. Outdoor works;
(ii) Rough estimate of investment cost of civil engineering works (local/foreign), classified as above.

7. Plant organization and overhead costs:

(a) Rough organization layout
(i) Production;
(ii) Sales;
(iii) Administration;
(iv) Management;

(b) Estimated overhead costs
(i) Factory;
(ii) Adminsitrative;
(iii) Financial.

8. Manpower:

(a) Estimated manpower requirements, broken down into labour and staff, and into major categories of skills (local/foreign);

(b) Estimated annual manpower costs, classified as above, including overheads on wages and salaries.

9. Implementation scheduling:

(a) Proposed rough implementation time schedule;

(b) Estimated implementation costs given the implementation programme.

10. Financial and economic evaluation:

(a) Total investment costs
(i) Rough estimate of working capital requirements;
(ii) Estimated fixed assets;
(iii) Total investment costs, obtained by summing the estimated investment cost items from chapters II-X;

(b) Project financing
(i) Proposed capital structure and proposed financing (local/foreign);
(ii) Interest;

(c) Production cost (summary of estimated production costs from chapters II-X, classified by fixed and variable costs);

(d) Financial evaluation based on above estimated values

(i) Pay-off period;
(ii) Simple rate of return;
(iii) Break-even point;
(iv) Internal rate of return;

(e) National economic evaluation

(i) Preliminary tests:

a. Project exchange rate;
b. Effective protection;

(ii) Approximate cost-benefit analysis, using estimated weights and shadow-prices (foreign exchange, labour, capital);
(iii) Economic industrial diversification;
(iv) Estimate of employment-creation effect;
(v) Estimate of foreign exchange savings.

Note: Additional information may be taken from the detailed check-lists and schedules given in each chapter of the *Manual.*

ANNEX III. PROJECT OPPORTUNITY
A COMPARISON OF STUDY COMPONENTS HIGHLIGHTING THE

Item A.1 (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 ($ million)[a]	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 (per cent)

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[a]	x xxx	x xxx	x xxx
Imports[a]	x xxx	x xxx	x xxx
Trade balance	-288	-280	-244
Overall balance	-200	-116	-116

Gross foreign exchange reserves ($ million; end of period)

	1972	*1973*	*1974*	*1975 (June)*
Total	268	300	312	–
Central bank	120	176	160	108

Total external debt outstanding	$ million 1,400
Ratio of debt service 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

STUDY (A) AND PRE-FEASIBILITY STUDY (B):
INCREASING PRECISION OF DATA WHILE PROCEEDING FROM (A) TO (B)

(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

Items A.2/3/4/5/6 (A) PROJECT OPPORTUNITY STUDY (*continued*)

A.2 *PROJECT SPONSOR*

State Paper Corporation and Industrial Development Bank

A.3 *MARKET AND DEMAND FOR SPECIFIC PRODUCT*

About 30,000 tons of paper have been imported in recent years.

Demand was not fully covered and is rising at a rate of about 5-10% a year.

Additional capacity of 12,500 tons a year paper board under construction.

Further capacity addition of 10,000 to 20,000 tons a year recommendable, mainly printing and writing paper as well as packaging 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; so good supply of straw available.

A.6 *PROJECT ENGINEERING*

A.6.1 *Approximate capacity* = 15,000 a year (50 tons per day). Output expected approximately 80-100% of capacity, i.e. 12,000-15,000 tons a year.

A.6.2 *Existing process*

Several different processes are known, they are fully developed and require normal skill in operation only.

(B) PRE-FEASIBILITY STUDY *(continued)* *Items B.2/3/4/5/6*

B.2 *PROJECT SPONSOR*

State Paper Corporation and Industrial Development Bank

B.3 *MARKET AND DEMAND FOR 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 a year.

Consumption restricted by import regulation. Assumed open demand in 1973 about 10,000 tons.

Yearly increase of consumption in the past about 7% a year (printing, writing and packaging paper); similar increase to be expected in the near future.

Additional capacity of about 15,000 tons a year would find market outlets since sales price of locally produced product is fixed at about $1,000/ton against 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 a year within a range of about 50 km. Estimated price free centre about $26/ton.

Waste paper collection favourable 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: towns A + B, village C. Town B has best essential process facilities: favourably placed within wheat-growing area, no housing problems for staff, power-line connections to factory easy.

Essential process pre-facilities: water (sufficient quantity/quality), disposal for waste water, owers supply, road connections, low humidity, good construction ground

B.6 *PROJECT ENGINEERING*

B.6.1 *Anticipated annual capacity + production programme: output = 100% of capacity*

Printing paper	4,000 tons (Printing press A)
Writing paper	5,000 tons (Stationery factory B)
Packaging paper	6 000 tons (Packaging composition)
	15,000 tons

B.6.2 *Possible processes*

Soda, sulphate and sulphide process, chemicals for caustic soda process available locally to a large extent, caustic soda process might produce best paper products (specific consumption figures not produced here).

A.7 ***MANPOWER AND MANAGEMENT***

Approximate labour requirement: 800-900

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*** **($ million)**

Operating cost	9.0
Depreciation (6.7%)	2.4
Interest (6%)	1.1
Production costs	12.5

(B) PRE-FEASIBILITY STUDY (*continued*) *Item B.7/8/9*

B.7 *MANPOWER AND MANAGEMENT*

Foreign supervisors	about 2
Skilled staff	about 200
Unskilled labour	about 600
Total	about 800

B.8 *PROJECT SCHEDULING*

Total construction time about four 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 + technical assistants	2.4	–	2.4
Overheads	2.4	3.2	5.6
	13.0	15.0	28.2
Contingency (10%)	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*
Equity	11.7	–	11.7
Foreign aid	–	11.7	11.7
Supplier's credit	–	10.1	10.1
	11.7	21.8	33.5

B.9.3 *Production costs* ($ million)

Operating costs	8.3
Depreciation (6.7%)	2.2
Interest (6%)	1.0
Production costs	11.5

Item A.9 (A) PROJECT OPPORTUNITY STUDY (*continued*)

A.9.4 *Commercial profitability*

(a) ***Rate of return***

	$ million
Sales revenue 15,000 x 1,000	15.0
Operating cost	9.0
Depreciation (6.7%)	2.4
Operating profit	3.6
Interest (average 6%)	-1.1
Gross profit before tax	2.5
50% corporate tax	1.25
Net profit	1.25

$$\text{Rate of return} = \frac{\text{net profit + interest}}{\text{total investment outlay}} \times 100$$

$$= \frac{1.25 + 1.1}{35} \times 100 = \underline{6.7\%}$$

(b) ***Repayment period***

$$\text{Repayment period} = \frac{\text{total investment outlay}}{\text{net profit + interest + depreciation}}$$

$$= \frac{35 \times 100}{1.25 + 1.1 + 2.4} = \underline{7.4 \text{ years}}$$

(B) PRE-FEASIBILITY STUDY *(continued)* *Item B.9*

B.9.4 *Commercial profitability*

(a) Rate of return (average)

	$ million
Sales revenue	15.0
Operating cost ($ million)	
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
	-8.3
Depreciation (6.7%)	-2.2
Operating profit	4.5
Interest (6% average)	-1.0
Gross profit before tax	3.5
50% corporate tax	-1.75
Net profit	1.75

$$\text{Rate of return} = \frac{1.75 + 1.0}{33.5} \times 100 = \underline{\underline{8.2\%}}$$

(b) $$\textit{Repayment period} = \frac{33.5}{1.75 + 1.0 + 2.2} = \underline{\underline{6.8 \text{ years}}}$$

(c) Specific investment cost of plant

$$\frac{\$(33.5 - 2.5) \text{ million}}{15{,}000 \text{ tons}} = \underline{\underline{\$2{,}066/\text{ton}}}$$

(d) Specific production cost

	$ million
Operating cost	8.3
Depreciation	2.2
Interest (6%)	1.0
	11.5

$$\frac{\$11.5 \text{ million}}{15{,}000 \text{ tons}} = \underline{\underline{\$766/\text{ton}}}$$

Item A.10 (A) PROJECT OPPORTUNITY STUDY *(continued)*

A.10. *National economic benefits*

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

Annual foreign exchange savings ($ million)

Import substitution (15,000 x 720)		10.8
Depreciation[b]	2.4	
Interest	1.1	
Current imports	3.0	−7.5
Foreign exchange savings		3.3

Enumeration of social costs and benefits (not produced here)

[a]Figures to be supplied.
[b]On foreign exchange parts only.

(B) PRE-FEASIBILITY STUDY *(continued)* *Item B.10*

B.10 *National economic benefits*

Job creation, specific capital requirements

Total $\dfrac{\$33.5 \text{ million}}{800} = \$42{,}000/\text{job}$

Foreign exchange $\dfrac{\$16.7 \text{ million}}{800} = \$20{,}000/\text{job}$

Foreign exchange savings ($ million)

Import substitution		10.8
Export		–
Depreciation[c]	2.2	
Interest[c]	1.0	
Current imports	2.7	–5.9
		4.9

Cost/benefit evaluation

		$ million
Revenue 15,000 x 720[c]		10.8
Operating cost[d] ($ million)		
Straw	–	
Pulp	1.2	
Waste paper	–	
Chemicals	1.8	
Others + power	1.0	
Labour	0.2	
Administration	0.3	
Distribution	0.3	
Sales tax	–	–4.8
		6.8
Depreciation		2.8
		3.8

Rate of return $\dfrac{3.8}{0.5 \times 33.5} = 22\%$

[c]Based on world market prices.
[d]Social costs.

ANNEX IV. TYPES OF DECISIONS TO BE TAKEN DURING DIFFERENT PRE-INVESTMENT STAGES

Decision	*Analysis tool study*	*Decision goal*
Identification	General or project opportunity studies	Identify opportunity Determine critical areas for support studies Determine area for pre-feasibility or feasibility study
Preliminary analysis	Support studies	Determine which of the possible choices is the more viable Identify the choice of project criteria
	Pre-feasibility study	Determine provisional viability of the project Appraise if the feasibility study should be launched
Final analysis	Support studies	Investigate in detail selected criteria requiring in-depth study
	Feasibility study	Make the final choices of project characteristics Determine the feasibility of the project and selected criteria
Project evaluation	Evaluation study	Make final investment decision

ANNEX V. THE STATUS OF AN EXISTING INDUSTRIAL ENTERPRISE

The structure of the check-list given below is the same as that of a feasibility study as outlined in the *Manual* in order to facilitate their eventual merger.

1. Executive summary (gives a brief summary of the findings of the inquiries performed):
   - *(a)* The enterprise (chapter II);
   - *(b)* General indicators (chapter II);
   - *(c)* Existing market and plant capacity (chapter III);
   - *(d)* Material inputs (chapter IV);
   - *(e)* Location and site (chapter V);
   - *(f)* Engineering situation (chapter VI);
   - *(g)* Administration and plant overheads (chapter VII);
   - *(h)* Manpower (chapter VIII);
   - *(i)* Plant implementation (chapter IX);
   - *(j)* Financial standing (chapter X).

2. Background and history:
   - *(a)* Background
     - (i) Describe task of the enterprise within the economic, as well as industrial, financial, and social policies; private and public sector;
     - (ii) Describe international, regional, national, area and local relationships;
   - *(b)* The enterprise
     - (i) State the name, address, date of incorporation, ownership, and control of the enterprise;
     - (ii) Corporate set-up;
     - (iii) Affiliation to other companies, groups or individuals;
     - (iv) Competitors (firms, status, management assessment, plant and machinery, efficiency etc.);
   - *(c)* History
     - (i) Investigations made before foundation (studies performed);
     - (ii) Historical development, year of foundation, major events etc.

3. Market and plant capacity:
   - *(a)* Market
     - (i) Describe existing market for products and by-products, and show its location on maps;
     - (ii) Describe its historic development;
   - *(b)* Sales of products and by-products
     - (i) Existing sales volume, domestic/export, historical development;
     - (ii) Seasonal variations of sales;
     - (iii) Percentage of replacement parts;
     - (iv) Sales organization:
       - a. Channels (own salesmen, brokers, agents, direct to consumer);
       - b. Sales organization, staff;
       - c. Marketing, advertising etc;
       - d. Competitors, capacity;
     - (v) Prices, discounts, commissions;

(vi) Annual sales revenues;
(vii) Sales and distribution costs;
(viii) Value of stock of semi-finished and finished products;

(c) Production programme

(i) Production programme of products and by-products: quality specifications, quantities produced, time schedule of production (seasonal variations), percentage of spoilage and wastes;
(ii) Emissions: specifications, quantities, time schedule means of treating emissions and waste disposal;
(iii) Cost of emissions disposal;

(d) Plant capacity

(i) Installed nominal maximum capacity;
(ii) Feasible nominal plant capacity of entire plant, main departments, major equipment units.

4. Materials and inputs:

(a) Characteristics of materials and inputs (specify and list sources of materials and inputs, classified into raw materials, processed industrial materials, components, auxiliary materials, factory supplies and utilities);

(b) Supply programme

(i) Quantitative supply programme, seasonal variations, subdivided into programme for entire plant, project components, and cost centres;
(ii) Development of supplies, seasonal restrictions;
(iii) Possible substitutes;
(iv) Organization of supplies (purchase, transport etc.);
(v) Prices;
(vi) Annual cost of supplies, seasonal variations;
(vii) Inventory of materials and inputs in terms of quantities and seasonal variations, as well as book and market value of inventories.

5. Location and site:

(a) Location

(i) Describe the location of the plant and show it on appropriate maps;
(ii) Give country, district, town;
(iii) Show connections to existing infrastructure (traffic, electricity, water, population etc.);
(iv) Describe socio-economic environment, nearness to market etc.;

(b) Site(s)

(i) State town, street, number;
(ii) Show situation and size on geodetical maps;
(iii) Existing rights of way, easements etc.;
(iv) Value of land;
(v) Annual costs of rights of way, rents, taxes, payments to neighbours etc.;

(c) Local conditions;

(d) Impacts on environment due to plant operation

(i) Describe impacts of project on population, infrastructure, ecology, landscape etc.;
(ii) Evaluate the tendency of impacts (positive or negative).

6. Project engineering:

(a) Plant layouts and charts (show existing structure of plant on physical layouts, and on functional charts and layouts);

(b) Scope of enterprise (show scope of enterprise on layout drawings, and divide it into project components and/or cost centres);

(c) Technology(ies)

(i) List and describe technologies used, historic development;
(ii) Sources of technologies;
(iii) Type of acquisition: licensing, purchase, joint ventuie;
(iv) Experiences (positive or negative);
(v) Annual costs of technologies (royalties, fixed payments);

(d) Equipment

(i) List and specify equipment, classify into production equipment, auxiliary equipment and service equipment;
(ii) Show equipment on plant layouts;
(iii) Describe sources, age, type (automatic, semi-automatic etc.);
(iv) State capacity, condition (up-to-date, obsolete etc.);
(v) Value of installed equipment;
(vi) Annual depreciation and repair costs;
(vii) Estimated life and replacement costs;

(e) Civil engineering works

(i) List and specify civil engineering works, classify into works for site preparation and development, buildings and special civil works, outdoor works;
(ii) Show situation and dimensions on maps and drawings;
(iii) Describe construction and status (up-to-date, obsolete etc.);
(iv) Value of civil works and buildings;
(v) Annual depreciation and repair costs;
(vi) Estimated life and replacement costs.

7. Plant organization and overhead costs:

(a) Cost centres

(i) List cost centres, classify them into production cost centres, service cost centres, administration and finance;
(ii) Show structure on charts and layouts;

(b) Overhead costs (list overhead costs and classify into factory overheads, administrative overheads, depreciation charges and financial overheads).

8. Manpower:

(a) Labour

(i) List and describe labour force;
(ii) Describe skill and availability;
(iii) State annual cost of labour at nominal feasible capacity, subdivide into production labour (variable) and non-production labour (fixed);

(b) Staff

(i) List and describe staff, show structure on manning tables;
(ii) State annual costs of staff.

9. Project implementation (describe date and duration of implementation, contracts for equipment and civil works, consultants and architects employed).

10. Financial standing of the enterprise:

(a) Reputation, with reference to:

(i) Bankers: credit standing, balances carried, type and length of loans, guarantees, general performance;

(ii) Major creditors: buying policies, special terms, payment record, general performance;

(iii) Customers: standing of the enterprise and its products in the trade and its advantages or disadvantages over other companies in the same trade;

(b) Capital structure

(i) Capital stock:

a. Distribution into shares shown as follows:

	No. issued	*Total nominal amount*	*Total paid-up amount*	*No. of votes per share*
Ordinary				
Preference				
Deferred				

b. Is any unissued stock held for special purposes?

c. Voting, pre-emptive rights, liability to further calls, stock issue in the last years;

d. Securities listed on stock exchange: annual price range for the last years, ratio of current security prices to earnings;

(ii) Bonds and/or mortgages:

a. Security provisions (secured/unsecured);

b. Type and priority of mortgages or other liens;

c. Redemption provisions:

d. Convertibility;

(c) Production costs

(i) Direct materials and inputs;

(ii) Direct manpower (labour and staff);

(iii) Factory overhead costs (manpower and materials);

(iv) Depreciation;

(v) Administrative overheads;

(vi) Financial overheads;

(vii) Sales and distribution/total production costs;

(viii) Fixed and variable costs as percentage of production costs;

(ix) Maintenance expenditures for recent years;

(x) Cost system (inventory control, burden determination and charge, charge of labour and material, check of cost system with operating figures);

(d) Accounts and statements

(i) Copies of the last four (or more) annual reports, income statements, cash-flow tables and balance sheets;

(ii) Auditors report and certificate;

(e) Analysis of financial statements

(i) Prepare a summary of comparative balance sheets, cash-flow tables and income statements;

(ii) Analyse important changes during the period under review in assets, liabilities, income or cost items;

(iii) When a parent-company/subsidiary relationship exists, a thorough investigation of the inter-company relations is necessary;

(f) Balance sheets (analyse major balance sheets, identify significant items, note variations in accounting methods)

(i) Receivables: financing by discounting or other methods, terms, amount of claims overdue, amount of debt written off;
(ii) Inventory: method of valuation, unsaleable or obsolete stock;
(iii) Fixed assets: changes in fixed assets, depreciation rates, accelerated or extraordinary depreciation;
(iv) Investments: itemized list of investments at book value;
(v) Short-term debt: original amount, outstanding amount, interest;
(vi) Notes payable;
(vii) Long-term debt: list of outstanding issue (date, amount, interest rate, maturity);
(viii) Deficiencies: amount, period, debt interest and/or principal in arrears, preferred dividends in arrears;
(ix) Capital: share capital (authorized, issued, subscribed, paid-up), capital account (balance, plus net profit and deposits, minus losses, withdrawals and tax);
(x) Owners' account: amounts outstanding from or due to partners;
(xi) Surplus: earned, unearned (appreciation of assets, premium on bonds or stocks);
(xii) Reserves: bad debts, depreciation, inventory, tax, hidden reserves;
(xiii) Contingencies: notes and receivables discounted, guarantees, endorsements, contingent liabilities with regard to subsidiaries;
(xiv) Bad debt: average annual amount written off;

(g) Tax position

(i) Tax legislation applicable to company;
(ii) Production or turnover tax;
(iii) Income tax;
(iv) Property tax;
(v) Others;

(h) Insurance (coverage of fixed assets, inventories etc.);

(i) Pending litigations by or against the company.

ANNEX VI. DEMAND FORECASTING TECHNIQUES

Trend (extrapolation) method

This relatively common technique is based on the extrapolation of past data, and involves *(a)* the determination of a trend; and *(b)* the identification of its parameters. Some of the alternative trend curves for forecasting are listed below.

Arithmetic (linear) trend

The equation used is $Y = a + bT$; where Y is the variable being forecast, and T is to be estimated.

Exponential (semi-log) trend

The equation used is $Y = ae^{bT}$, or $\log Y = a + bT$. The semi-log trend assumes a constant growth rate b each period.

Second and higher degree polynomial trends

The second-degree equation used is $Y = a + bT + cT^2$. If the second or higher order differences are approximately constant, a second or higher order polynomial will best explain the desired trend curve.

Cobb-Douglas (double log) function

The equation used is $Y = aT^b$ or $\log Y = \log a + b \cdot \log T$. The double-log trend assumes a constant elasticity b every period.

Auto-regression

The variable being forecast is regressed on a past value:

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

where, Y_n is the value of Y in period n. Since the past values of Y are known, the value in the next period can be forecast.

Annual demand figures are bound to fluctuate, and in order to identify a long-term trend, it is usually necessary to have demand figures covering a considerable period. In many developing countries, 10-15 years of production and import figures may not be available. In such a case it may be necessary to limit the analysis to a period of less than 15 years—even as little as 10 years. A short-term trend should normally not be used for future projection unless it is very clearly defined. A period of at least 5 years without abnormal oscillations should be considered the minimum.

The first step in measuring a trend is to take a moving average of 2-3 years to correct for major annual fluctuation. Where such a moving average results in a smooth curve, a growth pattern will be discernible. It is, however, possible that fluctuations may cover a period longer than a year (such as the demand for equipment for power generation, when this is undertaken as an intensified programme). Correction should be made for such fluctuations. Sometimes, figures for a particular year may be missing, in which case statistical interpolation may be necessary.

Consumption level method

This method considers the level of consumption using standard and defined coefficients, and can be usefully adopted when a particular product is directly consumed. The demand for motor cars, for example, can be estimated by determining the ratio of motor cars per 1,000 inhabitants or the coefficients of motor car ownership among identified income levels, industrial units and government. Once the total requirements are known, the actual motor car population is subtracted from the total to arrive at the new demand. Replacement requirements can be added to this projection.

A major factor determining the consumption level of products is consumer income, which, among other things, influences the family budget allocations that consumers are willing to make for a given product. 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. However, the degrees of correlation differ from product to product. An example of products being negatively correlated with income levels is the consumption of items such as cheaper varieties of cloth and paper by the poor.

Income elasticity of demand

The extent to which demand changes in response to variations in income is measured by the income elasticity of demand. Income elasticities differ not only between products but also, for a given product, between different income groups and different regions. Therefore, whenever it is possible to determine variations in *per capita* income by income groups and regions, the analysis should not be limited to the average *per capita* income in the whole national economy, but should be extended to occupational, socio-economic and geographical sectors.[22]

When relatively small changes are involved, a coefficient may be developed and applied to changes in *per capita* incomes. Thus, if it is found that in a country an increase in *per capita* income by one per cent leads to an increase in consumption of paper of two per cent, the demand of paper for future years may be estimated by the application of the income elasticity coefficient. This is illustrated in the example below.

[22] A point that is often ignored in demand studies is that income elasticity changes from one income level to another. Products that are commonly supposed to have a negative correlation with incomes can show positive correlation up to certain levels of income. The high income-elasticity evident at lower income levels declines as high income barriers are crossed. This is true of most products. In developing countries, these barriers are not crossed quite so often over the life span of industrial projects; none the less, the tendency for lower income-elasticities with increased incomes is repeatedly found within lower income brackets. The aggregate result will, therefore, depend on the income structure. The demand for refrigerators is low up to a fairly high level of income. Over these levels the income elasticity rises and then reaches a plateau. The demand for radios shows a similar pattern.

Year	Per capita income ($)	*Increase in* per capita *income (relative to base years)*	*Increase in demand for paper (%)*	Per capita *demand for paper (kg)*	*Population (million)*	*Demand for paper (thousand tons)*
Base year						
1975	90.0			2.00	540	1 080
Projection						
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

The following formula gives the income elasticity coefficient:

$$E_I = \frac{\log Q_2 - \log Q_1}{\log I_{P_2} - \log I_{P_1}}$$

or

$$E_I = \frac{Q_2 - Q_1}{I_{P_2} - I_{P_1}} \times \frac{I_{P_1} + I_{P_2}}{Q_2 + Q_1}$$

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 the subsequent observation year, I_{P_1} is the *per capita* income in the base year, and I_{P_2} is the *per capita* income in the subsequent observation year.

Values of E_I above 1.0 imply elasticity; values below 1.0 imply inelasticity.

Using the data from the table given before as an example on *per capita* incomes and *per capita* demand for paper in 1975 and 1978, the income elasticity of paper in the country of the example would be

$$E_I = \frac{\log(2.20) - \log(2.00)}{\log(94.5) - \log(90.0)} = 2.0$$

The income elasticity of demand for paper is thus elastic. Once the coefficient of income elasticity has been determined, it can be applied to any future year to obtain the (unadjusted) *per capita* consumption of paper in that year. Thus if the *per capita* income in 1980 is 15 per cent higher than in 1975, the *per capita* consumption of paper in 1980 would be 30 per cent higher than in 1975. The figure for projected *per capita* consumption may then be multiplied by the consumer population to arrive at the absolute size of demand.

Price elasticity of demand

The determination of the price elasticity coefficient of demand of a particular product is a valuable adjunct to demand projections. The price elasticity of demand, that is, the ratio of relative variations in the volume of demand to the relative variation in price may be expressed as a coefficient as follows:

$$E_P = \frac{Q_1 - Q_0}{Q_1 + Q_0} \bigg/ \frac{P_0 - P_1}{P_0 + P_1} = \frac{Q_1 - Q_0}{P_0 - P_1} \times \frac{P_0 + P_1}{Q_1 + Q_0}$$

where E_P is the price elasticity coefficient, Q_1 is the new price, Q_0 is the existing demand at the present price, P_1 is the new price, and P_0 is the present price.

The application of the formula may be demonstrated by a simple example. If 500,000 and 400,000 refrigerators sell at $500 and $600 respectively, the price elasticity of demand is:

$$\frac{500{,}000 - 400{,}000}{500{,}000 + 400{,}000} \div \frac{600 - 500}{600 + 500}$$

or

$$\frac{100{,}000}{900{,}000} \times \frac{1{,}100}{100} = 1.22$$

Thus, a decrease in price of 5 per cent will increase demand by $5 \times 1.22 = 6.1$ per cent.

It is often assumed that the price of the end-product of a proposed project will remain constant. This is seldom true in practice; the volume of demand that is estimated for future years should thus be directly related to price changes in the product through application of the price elasticity coefficient.

The price elasticity coefficient is a very useful tool for studying sensitivities in the economics of a project by making it possible to consider the variable prices that might prevail in future. Price variations not only affect sales revenues directly, but have a significant impact on market size, and consequently on production levels, which in turn affect production costs. The coefficient does assume, however, that other conditions of the market structure and behaviour remain constant. Furthermore, the coefficient is only applicable to relatively small variations in prices, since it does not remain constant over a wide range of price variations.

Cross elasticity

The demand for a product is determined not only by its own price, but also by the price of complementary or substitute products. It is often necessary to identify which products have price variations that may affect the demand for 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:

$$C_{AB} = \frac{Q_{2A} - Q_{1A}}{Q_{2A} + Q_{1A}} \div \frac{P_{2B} - P_{1B}}{P_{2B} + P_{1B}}$$

The cross elasticity of product A to product B, C_{AB}, is thus the ratio of proportionate change in the demand of product A to the proportional change in the price of product B. The value of C_{AB} is interpreted as follows:

If $C_{AB} > 0$, the product is a substitute for A;
If $C_{AB} < 0$, the product is complementary to A; and
If $C_{AB} = 0$, there is no cross elasticity between A and B.

We may take three examples to demonstrate the application of the cross elasticity ratio

		Value 1	*Value 2*
(X)	Price of petrol ($/litre)	0.40	0.50
	Demand for cars (thousands)	200	160
(Y)	Average price of electric shavers ($)	25	30
	Demand for safety razors (thousands)	6	9
(Z)	Price of milk ($/litre)	0.20	0.25
	Quantity of cloth (million metres)	100	100

The value of C_{AB} in each case is calculated as follows:

$$\text{Case X} = \frac{-40}{360} \Big/ \frac{0.10}{0.90} = -1.0$$

$$\text{Case Y} = \frac{3}{15} \Big/ \frac{5}{55} = 2.2$$

$$\text{Case Z} = \frac{0}{200} \Big/ \frac{0.05}{0.45} = 0$$

Since C_{AB} is less than zero in Case X, the demand for cars is complementary to, or positively dependent on, the price of gasoline. Since C_{AB} is greater than zero, and as high as 2.2 in Case Y, safety razors are a sensitive substitute for electric shavers. As may be expected, since C_{AB} is zero in the Case Z, there is no cross elasticity between milk and cloth. Whe complementarity or substitutability of products is established, demand forecasts should be amended to provide for the impact of expected price changes in a complementary of substitute product.

End-use or consumption coefficient method

This method is particularly suitable for assessing intermediate products. The method is as follows:

1. All possible uses of a product are identified, including, for example, input into other industries, direct-consumption demand, imports and exports.

2. The input-output coefficient of the product and the industries using the product are obtained or estimated. It is then possihle to derive the demand for a product for consumption plus its exports and net of imports, from the projected output levels of the consuming industries.

Thus, in order to forecast the demand for methanol, for instance, industries that use methanol would initially he identified. These would include the formaldehyde, fertilizer and pharmaceuticals industries. The planned manufacturing programmes of these three industries would define the future requirements of methanol, after allowing for demand from other users (these would be grouped together).

A similar approach could he adopted for some items of machinery, such as compressors or industrial turbines. The 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 of cement for various construction activities, such as private and public housing, factories, dams, public works and other constructions.

The end-use method makes use of consumption coefficients and is therefore also called the consumption coefficient method. Once identified, the coefficient appropriate for a consumption goal is multiplied by the size of the activity to arrive at the forecast consumption level. The following example demonstrates the application of the method.

	Annual petrol consumption per vehicle (thousand litres)
Private motor cars	3.20
Taxis	8.60
Commercial vehicles using petrol	11.20
Scooters, motorbikes, three-wheelers	0.12
Other uses (10% of figure for private cars)	0.32

Projections of demand for petrol based on the above consumption coefficients:

Type of vehicle	*1975* Petrol consumption *(thousand)*	*1975* Petrol consumption *(million l)*	*1980* Petrol consumption *(thousand)*	*1980* Petrol consumption *(million l)*	*1985* Petrol consumption *(thousand)*	*1985* Petrol consumption *(million l)*
Motor cars	110	352	150	480	210	672
Taxis	40	344	60	546	90	774
Commercial vehicles	80	996	110	1 232	140	1 568
Two-wheeled vehicles (scooters etc.)	280	37	410	49	700	84
Others	-	35		48		67
Total	510	1 764	730	2 355	1 140	3 165

Consumption coefficients vary over time from one market to another in size of producing units and as a function of technological change.

As shown in the case of petrol consumption, the consumption coefficients were different for each type of vehicle. Each one of these coefficients can vary from one period to another. It is therefore necessary to be extremely cautious in determining past, and in projecting future, coefficients.

In case of intermediate products, coefficients can vary with the size of the consuming unit and with technological changes. In steel-plate production, for example, consumption of steel might be reduced by reducing the thickness of 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 hence demand), even though the data may be precise and dependable.

In conclusion, this forecasting technique can be utilized fairly effectively, provided adequate projections of changes in the consuming industries are available. This is often not the case. To some extent, such projections can be obtained from national plans.

Regression models

In the regression technique, forecasts are made on the basis of a relationship estimated between the forecast (or dependent) variable and the explanatory (or independent) variables. Different combinations of independent variables can be tested with data, until an accurate forecasting equation is derived. The projection of the independent variables is, however, difficult.

Leading indicator method

The leading indicator method is a variant of the consumption-coefficient and regression methods. Leading indicators are variables that react to change before, and that can be used to predict, other variables. It has been found that, for example, the demand for electric fans lagged by about two years behind the housing investment of various agencies. To use these indicators for forecasting purposes, the appropriate leading indicators need to be identified, and the relationship between the leading indicator and the variable being forecast needs to be determined.

This method obviates the need for projecting an explanatory variable, but it is not always possible to determine the leading indicator, and the lead time may not be stable. The relationship itself may also change with time. The method is only used to a limited extent.

ANNEX VII. MARKET SURVEYS

Although the indirect methods that involve assessing the current demand and projecting it into the future on the basis of secondary data are sound, the more scientific approach is to conduct a full market survey. Secondary data may not be available, or, when available, may not be adequate. The only alternative then is to launch a consumer survey.

To economize on cost, effort and time, surveys almost always involve taking a random sample representative of the "population" or the aggregate on which the studies are being made. The sample should be selected carefully to avoid biasing of results, and for this the assistance of a statistician should be sought. Once a sampling policy is established, estimates can be obtained of the required information and the precise limits of the sampling errors can also be determined.

There are three main types of market survey.

1. Industry surveys. These cover the production and development plans of industries. Respondents to the questionnaire will include development agencies and organizations, industrial establishments, development financial institutions and investors.

2. Consumer surveys. These are based on a random sample when the number of respondents is very large, and on universal coverage otherwise.

3. Trade surveys. The respondents to those are trade outlets.

A market survey should not merely ascertain the total demand or rate of growth of demand, but also identify many other characteristics and facets of the market, such as localization of demand, growth of demand in different sectors, consumer preferences, changes in the consumer tastes or different component classes, income elasticities, price elasticities, consumer motivations, and distributive trade practices and preferences. 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.

The main steps in conducting a market survey are as follows:

Selection of the product qualities, sizes, colours;
Identification of the field-horizon – the categories of consumers, trade outlets or producers;
Selection of specific market segments;
Determination of the size and the design of the random sample;
Recruitment of field enumerators;
Training of field enumerators;
Organization of field work;
Scrutiny of collected data;
Analysis of data;
Interpretation of data.

The precision and dependability of market surveys depend on a number of factors: the representative character of the sample, the background of the field investigators/enumerators/interviewers, the participation of the respondents (consumers, individual or industrial), the quality of the questionnaire, and the accuracy of data interpretation and processing. Many consumer surveys in developing countries produce data of doubtful validity because investigators are not properly trained and respondents do not participate adequately. The investigators should be given a detailed explanatory memorandum defining the terminology used in the questionnaire. They should also be trained to get the respondents to give accurate answers.

Industry and trade market surveys, as distinct from consumer surveys, generally involve more intricate, technical and specialized questions. Investigators conducting such surveys should be fully qualified: in surveys dealing with engineering products, for example, qualified technical people are needed.

Market surveys require both specialized skills and a trained field force. There are agencies that specialize in market surveys, and these should be used as much as possible. Recourse to specialized market research consultants may prove expensive, but can be vital in projects that depend critically on the size and characteristics of its market.

An economist with a statistical background or a statistician with an economic background will be needed to interpret and lay down the basic rules for the analysis of the data. Statistical information should, first of all, be cleared of data that are inconsistent or of doubtful validity. For example, a respondent with a high income and large family may say that he owns a small refrigerator, or a respondent may list a price for a refrigerator that does not conform to its size. Such information is probably inaccurate, and should be deleted. Sometimes, data inconsistencies are not discovered until the data are analysed and abnormal correlations are obtained.

Errors in market surveys occur chiefly because of *(a)* imprecise questions; *(b)* a failure to understand by the respondent (the investigator may not have been able to communicate adequately; *(c)* deliberately distorted answers by respondents (this may be due to the fear of divulging personal information, such as income levels); *(d)* incorrect interpretation or association.

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

The commodity;
The size of the investment proposed;
The structure and size of the market;
The cost of conducting the survey;
The significance of the size of the market to the viability of the project;
The extent and dependability to secondary data.

Results derived from data obtained on the basis of a sample, the sample being only a representative component of the total population, will need to be extrapolated for the population. When a sample is taken from the population as a whole, the extrapolation is only valid for the whole population. Extrapolation can only be done for strata, say consumer classes, if the original sample is selected on a stratified basis. Thus a random sample of 600 from a total population of 30,000 car owners in the Syrian Arab Republic may be selected on a stratified basis as follows: 400 from cities with populations of over 100,000, 150 from towns with populations of from 10,000 t0 100,000, and 50 from the rural areas (assuming that this split is representative of the population as a whole). In this case, characteristics can be extrapolated into three population groups separately.

Extrapolation is accomplished by multiplying the sample result by the appropriate inflatory factors. Inflatory factors are the ratios between the sample size and the total size of the population. Thus, if the number of car owners in the large cities is 20,000, the inflatory figure is 500 (20,000 divided by the sample size of 400). If it was 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 estimated at 1,250.

As mentioned earlier, a questionnaire needs to be designed with a considerable degree of skill. It should be compact and concise and yet comprehensive. If it is too involved, the respondents may not answer. The questions should be clear and not confusing. They should not arouse the suspicion of the respondents. Each question should be purposeful and should lead to the information on the structure of demand and on behaviour desired.

A questionnaire is usually tested on a selected small number of respondents before it is used on a large scale. The test should determine that *(a)* the questionnaire is not too long; *(b)* questions are not misunderstood or evoke imprecise answers; *(c)* no question arouses the suspicion of the respondents.

Schedule FP-1. Net income statement[a, b]

(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)

Period	*Construction*		*Start-up*			*Full capacity*				
Year	*1*	2	*3*	*4*	*5*	*6*	*7*	*8*	...	*12*
Production programme	–	–	55%	75%	80%	100%	100%	100%	100%	100%
Source ($ thousand)										
1. Sales (from schedule 3-1)	–	–	6 875	9 375	10 000	12 500	12 500	12 500		12 500
2. Operating costs (from schedule 10-3/1)	–	–	-6 000	-7 350	-7 670	-9 000	-9 000	-9 000	...	-9 000
3. Depreciation (from schedule 10-3/1)	–	–	-780	-780	-780	-780	-780	-780	...	-780
4. Operating profit	–	–	95	1 245	1 550	2 720	2 720	2 720		2 720
5. Interests (from schedule 10-8/3)	–	–	-375	-327	-279	-176	-88	–		–
6. Gross profit or profit before tax	–	–	-280	918	1 271	2 544	2 632	2 720		2 720
7. Corporate tax[b]	–	–	–	–	–	–	–	1 360		1 360
8. Net profit (3-4)	–	–	-280	918	1 271	2 544	2 632	1 360		1 360
9. Dividends (4% on 5 800 equity)	–	–	-232	-232	-232	-232	-232	-232		-232
10. Retained profits (losses)	–	–	-512	686	1 039	2 312	2 400	1 128		1 128
11. Accumulated retained profits (losses)	–	–	-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 in the cash-flow table for a project with outside financing. Use line 4.

[b]Tax holidays up to year 7.

Schedule FP-2. Cash-flow

(\$

Period	*Construction*		*Start-up*		
Year	*1*	*2*	*3*	*4*	*5*
Production programme (from schedule 3-3)	*0*	*0*	*55%*	*75%*	*80%*
A. *Cash inflow*	3 300	7 000	1 055	2 135	2 370
1. Financial resources total (from schedule 10-8/2)	3 300	7 000	180	110	40
2. Operating profit (from schedule FP-1, line 4)			95	1 245	1 550
3. Depreciation (from schedule 10-3/1)			780	780	780
B. *Cash outflow*	3 300	5 000	2 797	1 539	1 841
1. Total assets schedule including replacements (from schedule 10-7/2)[a]	3 300	5 000	1 590	380	130
2. Debt service (total)					
(a) *Interests:*					
Suppliers' credits			240	192	144
Bank overdrafts			135	135	135
Bank term loans					
(b) *Repayments:*					
Suppliers' credits			600	600	600
Bank overdrafts					600
Bank term loans					
3. Corporate tax (from schedule FP-1)					
4. Dividends 4% on equity (from schedule FP-1)			232	232	232
C. *Surplus/deficit* (from schedule FP-1)	0	2 000	1 742	596	529
D. *Cumulative cash balance*[b]	0	2 000	258	854	1 383

[a]Not including interest during construction.

[b]The cash-flow balance should be so programmed 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 FP-3, line A.1.a.

table for financial planning

thousand)

			Full capacity					
6	*7*	*8*	*9*	*10*	*11*	*12*	*Salvage value in last year*	*Total*
100%	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*		
3 570	3 500	3 500	3 500	3 500	3 500	3 500		40 430
70								10 700
2 720	2 720	2 720	2 720	2 720	2 720	2 720		21 930
780	780	780	780	780	780	780		7 800
1 758	1 370	2 592	1 592	1 592	1 592	1 592	3 500	23 065
300		1 000					3 500	8 200
96	48							720
80	40							525
600	600							3 000
450	450							1 500
		1 360	1 360	1 360	1 360	1 360		6 800
232	232	232	232	232	232	232		2 320
1 812	2 130	908	1 908	1 908	1 908	1 908	3 500	
3 195	5 325	6 233	8 141	10 049	11 957	13 865	17 365	17 365

Schedule FP-3. Projected balance sheet

($ thousand)

Period	Construction		Start-up			Full capacity						
Year	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) Accumulated cash balance (from schedule FP-2, 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 schedule 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[a]
2. *Fixed assets* (net of depreciation) Initial fixed investment, replacement and pre-production capital expenditures (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[b]
3. *Losses* (from schedule FP-1, 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. Medium-term loans (lines 1.3 and 1.4)	–	4 500	3 900	2 100	1 050					–	–	–
3. Paid up equity (line 1.1)	3 300	5 800	5 800	5 800	5 800	5 800	5 800	5 800	5 800	5 800	5 800	5 800
4. Retained profits (from schedule FP-1, line 11)	–	–		170	1 210	3 520	5 920	7 050	8 180	9 310	10 440	11 570

[a] Salvage value: 2 000 working capital.
[b] Salvage value: 1 500 fixed assets.

INDEX

	Page
Accounts	
payable	156
receivable	155
Administration	125
Aggregate consumption	189
Alternatives:	
Inputs	78
Projects	174
Analysis:	
Break-even	184
Demand	45
Financial	152
Area studies	220
Assets:	
Fixed	153
Total	158
Auxiliary materials	77
Background of the project	34
Balance sheet	167
Balance sheet, projected	166
Bar chart	148
Benefits (direct and indirect) to aggregate consumption	189
Break-even analysis	184
Break-even point:	
Algebraic determination	184
Graphical determination	186
Buildings	117
Capacity:	
Feasible normal plant	63
Installed plant	64
Nominal maximum plant	64
Projected plant	66
Capital:	
Equity	159
Working	156
Capital-issue expenditures	154
Cash-flow table	165
Cash generation	169
Cash-in-hand	156
Charts, project	108
Civil construction facilities	97
Civil engineering	
works	117
cost of civil engineering works	117
Climate and weather	91, 94
Commercial profitability	172
Commissioning expenditures	154

	Page
Commission of pre-investment studies	154
Communication facilities	90
Constraints:	
Equipment	64
Input	65
Construction	
period	146
stage	5
Consumption level method of demand forecasting	243
Contingencies	20
Cost centres:	
Administration	126
Production	125
Service	125
Cost estimates:	
Accuracy	25
Methods	16
Costing, direct or partial	59
Cost of	
civil engineering works	117
distribution	61
equipment	116
financing	161, 171
labour	132
land	92
materials and inputs	73, 80
pre-investment studies	24
preparatory studies	34
production	58, 65, 170
project implementation	148
sales	61, 171
staff	134
technology	114
waste disposal	44
Cost/price relationship	58
Costs:	
Definition	18
Direct and indirect to aggregate consumption *see also* Overhead costs	189
Cost structure	18
Critical path method (CPM)	148
Current ratio	169
Data, requirements for a feasibility study	16
Debt/equity ratio	168
Debt service	169
Debt service coverage	169

	Page
Decisions, investment	152
Definitions of cost terms used	18
Demand	
analysis	45
analysis, by segments	48
forecasting techniques	49, 242
present effective	47
projections	48
study	45
total	52
Depreciation	127, 171
Diagrams	108
Discount, social rate of	189
Discounting methods	175
Discounts	58
Distribution	
costs	42
system	60
Economic size, minimum	64
Elasticity of demand:	
Cross	245
Income	243
Price	244
Electrical power supply	78
End-use method of demand forecasting	246
Engineering:	
Civil	117
Project	108
Environmental impacts	85
Equipment	115
Equipment, cost of, *see* Cost of equipment	
Equipment selection studies	13
Equity capital	159
Estimate of cost, *see* Cost estimate	
Evaluation:	
Economic	189
Financial	172
Exchange, local and foreign	20
Expansion projects	24
Expenditures, definition, *see also* Costs	18
Experts, foreign	137
Export projections	50
Factory	
costs	171
supplies	77
Financial evaluation	152, 172, 179
Financial planning	165

	Page
Financial ratio analysis	168
Financial statements:	
Cash flow table for financial planning	165
Net income	166
Projected balance sheet	166
Financing	
costs, *see* Cost of financing	
institutions	163
loans	159
project	158
regulations	162
Finished goods	156
Fiscal regulations	91
Fixed capital	153
Fixed costs	170
Fixed investments	153
Forecasting techniques	49
Functional studies	12
Grey line	3
History of project	34
Implementation management	144
Implementation scheduling	144
Income redistribution	189
Incomes, definition	18
Inflation	20
Information, sources of	17
Infrastructure	89
Input alternatives	78
Input requirements	79
Interest	171
Internal rate of return	177
Inventories	155
Investment costs	19, 65, 153
Investment, fixed	153
Investment phase of a project	5
Laboratory tests	13
Labour	135
Labour costs, *see* Cost of labour	
Labour norms	136
Land costs, *see* Cost of land	
Layouts	108
Legal regulations	97
Licensing	112
Liquidity ratio	160
Loan financing	159
Local conditions	89, 94
Location	88
Location, choice of	88, 92
Locational studies	13

	Page
Man-month calculation	25
Manpower	135
Manpower, source of	135
Manning table	131, 133
Manufacturing costs	19
Market	
analysis	45
penetration	53
study	12
survey	50, 248
Marketing	57
Materials and inputs	
characteristics	78
costs, *see* Costs of materials and inputs	
Materials, classification	75
Minimum economic size, *see* Economic size, minimum	
National planning, the role of	190
Net-income statement	166
Net present value	175
Net working capital	155
Operating costs	20
Operational phase	7, 136
Opportunity studies:	9
General	10
Area	10, 220
Sub-sector	10, 222
Resource-based	10, 222
Specific project	10
Optimization of projects	14
Organization, plant	125
Orientation of study material vs. market	15
Overhead costs:	
Administrative	126, 171
Factory	126
Financial	127
Manpower	139
Outdoor works	121
Partial studies	12
Pay-back period	179
Performance, operational	169
Period of construction	146
Physical layout drawings	108
Plant capacity	63, 66
Plant organization	125
Policies, the role of public financing	162
Pre-feasibility study	11, 223

	Page
Pre-investment phase	8
Pre-investment studies. basic aspects and categories of	8
Preliminary expenditures	154
Preparatory studies, costs of, *see* Cost of preparatory studies	
Pre-production capital expenditures	153
Pre-production expenditures	154
Presentation of chapters	3
Pricing	59
Probability analysis	188
Processed industrial materials	76
Production	
costs, *see* Cost of production	
materials	75, 155
programme	62
Project	
alternatives	174
charts and layouts	108
components	16
development cycle	6
economic evaluation	151
engineering	108
Evaluation and Review Technique (PERT)	148
financial evaluation	172
financing	158
history	34
implementation scheduling	144
indicators	31
promoter	8
team	23
Promotional activities	8, 60
Property rights	112
Qualitative properties of materials and inputs	78
Rate of return:	
Internal	177
Simple	180
Ratios for financial analysis	168
Raw materials	75
Raw material studies	13
Recruitment of staff and labour	146
Reference data	17
Regression models	247
Regulations on financing	162
Resource-based studies	15
Resource-based opportunity study	13
Resource constraints	65
Revenues, definition	18

	Page
Sales	
costs, *see* Cost of sales	
forecast	57
promotion	60
revenues	61
Scope of project	16
Sensitivity analysis	53, 186
Shadow price:	
Foreign exchange	189
Investment	189
Labour	189
Short-cut methods	12
Site	93
Site preparation and development	93
Size, minimum economic, *see* Economic size, minimum	
Soil conditions	93
Sources of financing	159
Sources of materials and inputs	79
Spare parts	116, 155
Staff	137
Staff costs, *see* Cost of staff	
Start-up	154
Statistical analysis of demand	55
Structures	117
Sub-sector opportunity study	222
Sub-sectoral studies	10
Supplies	77
Supply programme	81
Support studies	12
Surcharges	
on salaries and wages	139
for unit cost calculation	80, 172

	Page
Technology:	109
Cost of, *see* Cost of technology	
Selection	110
Testing of equipment	146
Tools	116
Training	138
Transport facilities	90
Trend method	242
Trial runs	154
Total	
assets	158
demand	52
investment costs	19, 157
production costs	19, 170
Uncertainty, financial evaluation under	183
Unit production costs	172
Utilities	77
Verification of alternatives and assumptions	17
Waste disposal	91
Waste disposal, cost of, *see* Cost of waste disposal	
Water supply	90
Working capital, calculation of net	156
Work-in-progress	155

كيفية الحصول على منشورات الامم المتحدة

يمكن الحصول على منشورات الامم المتحدة من المكتبات ودور التوزيع في جميع انحاء العالم · استعلم عنها من المكتبة التي تتعامل معها أو اكتب الى : الامم المتحدة ،قسم البيع في نيويورك او في جنيف ·

如何购取联合国出版物

联合国出版物在全世界各地的书店和经售处均有发售。请向书店询问或写信到纽约或日内瓦的联合国销售组。

HOW TO OBTAIN UNITED NATIONS PUBLICATIONS

United Nations publications may be obtained from bookstores and distributors throughout the world. Consult your bookstore or write to: United Nations, Sales Section, New York or Geneva.

COMMENT SE PROCURER LES PUBLICATIONS DES NATIONS UNIES

Les publications des Nations Unies sont en vente dans les librairies et les agences dépositaires du monde entier. Informez-vous auprès de votre libraire ou adressez-vous à : Nations Unies, Section des ventes, New York ou Genève.

КАК ПОЛУЧИТЬ ИЗДАНИЯ ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ

Издания Организации Объединенных Наций можно купить в книжных магазинах и агентствах во всех районах мира. Наводите справки об изданиях в вашем книжном магазине или пишите по адресу: Организация Объединенных Наций, Секция по продаже изданий, Нью-Йорк или Женева.

COMO CONSEGUIR PUBLICACIONES DE LAS NACIONES UNIDAS

Las publicaciones de las Naciones Unidas están en venta en librerías y casas distribuidoras en todas partes del mundo. Consulte a su librero o diríjase a: Naciones Unidas, Sección de Ventas, Nueva York o Ginebra.

Printed in Austria

Price: $U.S. 9.00
(or equivalent in other currencies)

United Nations publication

78-150–July 1978–10,000

Sales No.: E.78.II.B.5

ID/206

C-15

79.11.16