MANUAL FOR THE PREPARATION OF INDUSTRIAL FEASIBILITY STUDIES

Newly revised and expanded edition

W. Behrens P. M. Hawranek

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Foreword to the second printing

Developing and developed countries alike are increasingly in need of properly prepared feasibility studies for taking sound investment decisions. In the past, too many investment projects did not produce the outputs for which they were originally designed or their actual construction costs exceeded those that had been envisaged. For this reason, many financial institutions are increasingly relying on well-prepared investment studies to avoid cost overruns later on, for the investors as well as for themselves. One result of this growing interest was that the first printing of the revised and expanded edition of the *Manual for the Preparation of Industrial Feasibility Studies* was sold out sooner than anticipated.

The *Manual* was first published by UNIDO in 1978. By early 1992 more than 150,000 copies had been sold in 20 different languages, making it one of the best-selling publications of the whole United Nations system. The *Manual* was originally designed to provide developing countries with a tool for improving the quality of investment proposals and to contribute to the standardization of industrial feasibility studies, which had often been found to be both incomplete and ill-prepared. UNIDO efforts to achieve those objectives have since met with a positive response in both developing and developed countries. The approach promoted by UNIDO for the preparation of feasibility studies has been adopted by investment promotion agencies, government ministries, universities and other institutions of higher learning, as well as by banks, consulting firms and the investors themselves. To improve their ability to make investment decisions, many institutions and firms have cooperated with UNIDO, either by applying the advanced project preparation systems, appraisal methodologies and group training programmes developed by the organization or using them as models for their own efforts.

The revised and expanded edition of the *Manual*, of which this is a second printing, focuses on a strategic approach to investment. It devotes particular attention to environmental impact assessment, technology transfer, marketing, human resources and the mobilization of funds. It should be used in conjunction with other UNIDO publications on economic analysis and with the latest version of the UNIDO Computer Model for Feasibility Analysis and Reporting (COMFAR III Expert), which was issued in 1994.

I hope that this second printing of the revised and expanded edition will attract further interest from all who are concerned with improving the industrial development process in developing countries and that it will be of continued practical value to an ever broader range of users.

Mauricio de Maria y Campos
Director-General
1995

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Preface

The publication of this revised and expanded second edition of the *Manual for the Preparation of Industrial Feasibility Studies* is the result of the long and dedicated efforts of all those involved in this production. The revision of the text required a careful analysis of voluminous correspondence and comments from readers before a decision could be made on its scope and contents. The complexities of drafting the final version were increased by the inclusion of new subject-matter based on contributions by selected experts.

In its conception, organization and scope, this *Manual* is due to the close collaboration of its principal authors, Werner Behrens and Peter M. Hawranek, of the UNIDO Division of Industrial Operations Support, who drafted the bulk of the text and shared overall responsibility for its final preparation. In carrying out this task, they received valuable assistance and advice from numerous UNIDO consultants and staff. The authors are particularly grateful to UNIDO consultants for the contributions described below.

The introduction of the concept of strategic orientation was proposed by H. R. Arm, who drafted the analysis of this concept presented in part one, section B, and who also made a valuable contribution to the contents and restructuring of part two, chapter III, which covers market analysis and the marketing concept. R. Irvine revised the annexes covering demand forecasting techniques, sampling principles and field surveys, and helped with the revision of chapter III. The analysis of maintenance and replacement requirements, as well as various revisions in the treatment of organization, personnel training and implementation planning, were drafted by B. Knauer, who also checked the whole manuscript from the point of view of the practical application of the *Manual* by engineers. Rana K. D. B. Singh, who had already contributed to the first edition, drafted the revision of chapter VI, which deals with engineering and technology. Increasing concern about the environmental impact of industrial projects has led to the expansion of chapter IV, which now covers location, site and evironment. Valuable material, including information on the practical application of environmental impact assessment, was provided by R. Schoenstein, G. Schoerner and D. Sussman. The text of chapters IV, V and VIII was reviewed by B. Andersson, and that of chapter X by J. Bendeković and G. Eckstein.

Although this *Manual* is based on the first edition, as well as on contributions by consultants, responsibility for the final text remains that of the authors, who hope that readers will find this revised and expanded *Manual* as useful for their work as the first edition published over 10 years ago.

Explanatory notes

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

In tables:

Totals may not add precisely because of rounding.

A hyphen indicates that the item is not applicable.

An em dash (—) indicates that the amount is nil or negligible.

Two dots (..) indicate that data are not available or are not separately listed.

The following abbreviations are used in this publication:

c.i.f.	cost, insurance, freight
COMFAR	Computer Model for Feasibility Analysis and Reporting
FAO	Food and Agriculture Organization of the United Nations
ILO	International Labour Organisation
INTIB	Industrial and Technological Information Bank
IRR	internal rate of return
NCU	national currency unit
NPV	net present value
NPVR	net-present-value ratio
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

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Introduction

Since its first publication in 1978, the *Manual for the Preparation of Industrial Feasibility Studies* has demonstrated the usefulness of its methodological approach by having been translated into 18 languages and applied throughout the world, with 11 reprints of the English edition alone, and four of the French.[1] In recent years many developing countries have standardized their project planning in line with the UNIDO approach. Consulting firms, industrial enterprises, banks and investment promotion agencies in developed countries have also introduced the UNIDO procedure or have adapted it to their own requirements.

Many new problems have emerged during the 1980s. In particular, there has been a great change in the general economic situation, with high foreign debts, low raw-material prices and a widespread shortage of foreign exchange making it difficult for developing countries to secure fresh investment resources. In addition, major projects completed in the 1970s very often failed to generate the cash flow necessary to service the debt and finance new investment in expansion, modernization, rehabilitation and other projects. A shortage of international capital and foreign exchange earnings, combined with a low level of national savings, have created a need for more efficient project planning and for project design with a strategic orientation, on the basis of an integrated financial and economic analysis.

UNIDO has had more than 10 years to accumulate wide experience in applying the *Manual* in the preparation of a vast number of feasibility studies carried out under its technical cooperation programme. The *Manual* is also used in UNIDO institution-building and training programmes. The successful identification, formulation, preparation, appraisal and promotion of industrial investment projects rests to a large extent on the availability of national institutions capable of performing such tasks. The UNIDO technical cooperation programme, which focuses mainly on the establishment and strengthening of consulting firms, investment promotion agencies, project appraisal units in development finance institutions and industrial development centres, contributes to the upgrading of national capabilities of developing countries in the preparation of pre-investment studies and the appraisal of investment projects. This activity has expanded considerably and led to the creation of an inter-university cooperation network, with members from developing and developed countries, using UNIDO manuals and guidelines on pre-investment studies as student textbooks and conducting joint training programmes and research.

[1] After its publication in English, UNIDO provided translations of the *Manual* into Arabic, Chinese, French, Russian and Spanish. Users of the *Manual* prepared translations into Czech, Dari, Farsi, German, Greek, Hungarian, Japanese, Laotian, Polish, Portuguese, Serbo-Croatian, Turkish and Vietnamese.

Practitioners working in the pre-investment field all over the world provided UNIDO with many valuable suggestions on how to adapt the *Manual* to the needs of contemporary investment consultancy. Its close dialogue with readers and its own experience thus led to the preparation on the present revised edition of the *Manual.*

The following new topics feature prominently: the strategic orientation of business planning as a basis for the preparation of investment projects; and the inclusion of environmental impact assessment in the selection of the project location, sites and technologies. The market chapter has been completely rewritten to reflect the increasing importance of the development of proper marketing concepts for the feasibility of investments. Several chapters of the original text were recast and a case-study was added to produce a coherent whole and achieve even wider utilization for the *Manual* in training activities. The use of computers for financial and economic analysis has become commonplace. The working forms and schedules originally designed for manual computations have therefore been adapted to reflect that change and made fully compatible with the third generation of the UNIDO Computer Model for Feasibility Analysis and Reporting (COMFAR).[2]

The *Manual* consists of three parts. The first deals with categories and basic aspects of pre-investment studies. Part two—the main part—covers the different chapters of the feasibility study, and part three contains additional supporting material, including a case-study and descriptions of techniques used for the assessment and projection of data.

New in part one is the introduction of the concept of strategic orientation of business planning as a useful instrument for the preparation of pre-investment studies. The different phases of the investment project cycle are outlined and their interlinkages described, as well as the stages of the pre-investment phase and the activities that should be carried out simultaneously, such as investment promotion and planning of both investment financing and project implementation. Part one also shows that the *Manual* applies not only to the establishment of new industrial plants, but also to the rehabilitation and expansion of existing factories. It closes with a brief introduction to the institutional infrastructure for pre-investment studies and the use of electronic data processing in the pre-investment phase.

Part two constitutes the core of the *Manual* and its outline corresponds to the framework of a feasibility study. It includes a number of important changes as compared with the first edition. Those changes are described below.

Chapter III was almost entirely rewritten and is now entitled "Market Analysis and Marketing Concept". It is conceived in a much broader way and presents marketing research as a basic tool for defining the marketing concept to be adopted by the project. It concludes with the determination of the sales programme and the forecast of sales revenues. The design of the production programme and of the plant capacity is now covered in chapter VI.

Chapter IV, "Raw Materials and Supplies", deals with the classification and specification of input requirements, contrasting them with supplies available.

[2]COMFAR is the property of UNIDO and protected by copyright 1982, 1984, 1985, 1988 and 1990.

Chapter V, "Location, Site and Environment", has been considerably revised with the addition of a new part dealing with the environmental impact of industrial investment projects on the choice of location and site. Check-lists and worksheets for the classification of different types of environmental impact are provided in the appendix to chapter V. The coverage of environmental aspects is extended throughout the *Manual.*

Chapter VI, "Engineering and Technology", now begins with the determination of the production programme and the plant capacity which in the earlier version were covered in chapter III. It is the task of the engineering team to design the functional and physical layout required for the industrial plant to meet production goals. This edition highlights the fact that project engineering is concerned not only with engineering design, the computation of investment expenditures and the determination, for the operational phase, of human and material inputs, including their costs, but also with a wide range of interrelated activities such as the choice, acquisition and transfer of technology, which have to be carefully planned, assessed and coordinated.

In chapter VII, "Organization and Overhead Costs", the question of organizational design received particular attention, whereas in chapter VIII, "Human Resources", more emphasis is placed on the need, already at the project planning stage, to identify training requirements and to estimate ensuing costs during the investment and operational phases. In chapter IX, "Implementation Planning and Budgeting", the stages of project implementation planning are presented in a coherent manner in order to facilitate the projection of the implementation budget and the outflow of capital expenditures during the construction period.

Chapter X, "Financial Analysis and Investment Appraisal", has been restructured and expanded. After a discussion of the objectives and scope of financial analysis, the basic criteria for investment and financing decisions are introduced. Those criteria concern the role of private and public interests, the impact of pricing of project inputs and outputs, the planning horizon and the problems relating to risks and decisions in conditions of uncertainty. The structure of investment, production and marketing costs is analysed, taking into account the reliability of data and the need to identify critical variables as a precondition for the appraisal of investment projects by investors and financing institutions. Basic investment appraisal methods, including the computation of the discounted cash flow (internal rate of return, net present value) and conventional ratios, as well as the interpretation of figures, are discussed in detail, with investment being defined[3] as a long-term commitment of economic resources with the objective of producing and obtaining net gains in the future, and with the transformation of financial resources (that is, liquidity) into productive assets being viewed as the main aspect of that commitment. After consideration of project financing and various aspects of risk and uncertainty (sensitivity, break-even and probability analysis), chapter X closes with a brief review of the objectives of economic analysis and a bibliography of publications recommended for use in practical work.

To ensure clarity and facilitate its practical use, each chapter in the second part of the *Manual* is presented in four parts, as follows: chapter review; detailed examination of the subject, starting with basic principles and the

[3]See part two, chap. X, sect. A.

definition of terms used, then continuing with the preparation of the corresponding chapter of the feasibility study; bibliography; and check-lists, working forms and schedules.

The detailed text given in each chapter is intended to acquaint the reader with the conceptual problems to be faced in completing the study. These texts 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.

Each chapter of the *Manual* contains several pro-forma schedules suitable for data collection.[4] The 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.

For a number of reasons the *Manual* does not address problems related to economic evaluation. First of all, the subject would require too much space for appropriate coverage. Secondly, when preparing an investment proposal, an investor or promoter is normally not very much concerned with the costs and benefits the projects may represent for the economy as a whole. Interest is focused on commercial considerations, that is, 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.

Another important reason why economic evaluation is not a part of this *Manual* is that various publications[5] cover the subject at great length, paying particular attention to socio-economic factors having an impact on project choice. Only in the final chapter of this *Manual* 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 preparation of a feasibility study is a task which, if it is to be done well, requires inputs from many professional disciplines for the various

[4]The schedules in the first edition were designed basically with manual computations in mind. Since then the use of personal computers has spread rapidly, and commercial as well as user-developed programmes are now used for discounting, the computation of debt-service schedules etc. With the development of computer applications in project analysis the scope and quality of financial analysis has been increased considerably. The schedules were therefore redesigned to better reflect this development, and also to correspond with the UNIDO COMFAR software of the third generation, to be released with the publication of this *Manual*. The figures shown in the schedules contained in the appendix to chapter X are based on the data given in the example case presented in annex I to this *Manual*.

[5]In particular, *Guidelines for Project Evaluation* (United Nations publication, Sales No. 72.II.B.11), *Guide to Practical Project Appraisal* (United Nations publication, Sales No. E.78.II.B.3) and *Manual for Evaluation of Industrial Projects* (United Nations publication, Sales No. E.80.II.B.2).

components of the study, the most important of which are as follows: market analysis and marketing; location, site and environment; engineering and technology; and financial analysis. The intended audience of this *Manual* therefore includes market and financial analysts, economists, engineers and social scientists. Having such a wide readership, the *Manual* can deal with each of the above-mentioned topics only in the depth required to present the concepts and methodologies needed for the preparation of a feasibility study. Each of the topics referred to could be the subject of separate publications. As a compromise in this regard, a comprehensive bibliography is provided at the end of each chapter in part two of the *Manual*.

X. Financial analysis and investment appraisal

Given the conditions for investment appraisal, project preparation should be geared towards the requirements of financial and economic analysis. In this chapter, after an introduction to the scope and objectives of financial analysis, the principal aspects of the analysis and the concept of investment appraisal are explained. Basically, financial analysis should accompany the design of the project from the very beginning, which is only possible when the financial analyst is integrated into the feasibility studies team at an early stage. From a financial and economic point of view, investment can be defined as a long-term commitment of economic resources made with the objective of producing and obtaining net gains (exceeding the total initial investment) in the future. The main aspect of this commitment is the transformation of financial resources (that is, the investor's own and borrowed funds) into productive assets, represented by fixed investment and net working capital. While the interest in future net gains is common for each party investing in a project, the expected gains or benefits may differ considerably between them, and may also be valued differently.

Important aspects of financial analysis, such as basic criteria for investment decisions, pricing of project inputs and outputs, the planning horizon and project life, as well as risks and uncertainty, will be discussed, and then detailed consideration will be given to cost analysis, basic accounting principles, methods of investment appraisal (discounting and conventional methods), financing, financial efficiency and ratios, and financial analysis and project evaluation in conditions of uncertainty.

The chapter concludes with a brief characterization of the objectives and commonly accepted methods of economic evaluation. Examples of the various schedules required for financial analysis are given in the appendix to the chapter. The example presented in annex I to this *Manual* contains the background information and data needed for the computation of all schedules shown in chapter X.

A. Scope and objectives of financial analysis

A feasibility study, as mentioned earlier, is a tool for providing potential investors, promoters and financiers with the information required to decide whether to undertake an investment, and whether and how to finance such a project. The scope and objectives of financial analysis are determined to a great extent by the definition of what investment is.

Investment may be defined as a long-term commitment of economic resources made with the objective of producing and obtaining net gains[76] in the future.[77] The main aspect of this commitment is the transformation of liquidity—the investor's own and borrowed funds[78]—into productive assets, represented by fixed investment and net working capital, as well as the generation of liquidity again during the use of these assets.

The above definition comprises all types of investment, including industrial investments. With this characterization in mind, it becomes evident that financial analysis and final project appraisal involves the assessment, analysis and evaluation of the required project inputs, the outputs to be produced and the future net benefits, expressed in financial terms. The methods applied for this purpose are as follows: analysis of the reliability of projected data; analysis of the structure and significance of costs and income projections in order to identify the critical variables that could have a significant impact on the feasibility of an investment; determination and evaluation of the annual and accumulated financial net benefits, expressed as profitability, efficiency or yield of the investment; and consideration of the time factor with regard to prices, cost of capital, and decisions taken in conditions of uncertainty (norm l business risks and specific project risks).

The above-mentioned transformation of liquid financial resources (funds) into productive assets (fixed assets and net working capital) corresponds to the financing of an investment. Project financing includes the design of a proper financial structure, considering the conditions under which funds would be available, and the optimization of project financing from the point of view of the enterprise and the investors.

As noted earlier, the conditions for the appraisal of an investment are that a technically feasible solution is also financially feasible, can be implemented within the socio-economic and ecological environment identified for the investment project (socio-economic and ecological feasibility), and is likely to continue to be feasible for the minimum time determined by decision makers as the planning horizon for their decisions. The scope and objectives of financial analysis are therefore to determine, analyse and interpret all the financial consequences of an investment that may be relevant to and significant for the investment and financing decisions.

Furthermore, financial analysis and evaluation[79] should ensure that for the objectives determined by the decision makers, and within the given confidence levels of a feasibility study, the following conditions are fulfilled:

[76]The term net gains is used to indicate that the objectives of investment projects are not limited to the net income as computed in a net income statement.

[77]See P. M. Hawranek, "Investitionsentscheidungen—Entscheidungen ueber die Umstrukturierung von Leistungen in der Wirtschaft", in *Entwicklungsmanagement, Beiträge zu einer neuen Dimension im internationalen Management*, M. Hofmann and K. Schedl, eds. (Berlin, Duncker and Humblot, 1982).

[78]In order to achieve or maintain a particular capital structure, a project could obtain funds from preferred and common stocks, bonds, use of retained earnings, leases and loans from banks (see chap. X, sect. F). The cost of capital is the weighted average cost of each money source. This weighted average takes into account the joint cost and the desired long-run relative proportions of each type of capital, including the impact of inflation.

[79]The term analysis (financial and economic) as used in this *Manual* comprises the pure analytical work required to identify the critical variables likely to determine the success or failure of an investment. The analysis must not be limited to mathematical computations, but would have to include the critical interpretation of all relevant data.

The term evaluation refers to the determination of the values of project inputs and outputs. In the case of feasibility studies the evaluation of a project is made by the investors and financiers who may approve or reject the proposed project. Formalized ex-ante evaluation corresponds to the concept of project appraisal used by the World Bank. Evaluation in the terminology of the World Bank is an ex-post evaluation of projects financed by that institution.

- The most attractive of the possible project alternatives is determined under the prevailing conditions of uncertainty;
- The critical variables and possible strategies for managing or controlling risks are identified;
- The flow of financial resources required during the investment, start-up and operational phases is determined, and the financial resources available at the lowest cost are identified for the time required and used in the most effective way.

These objectives are interrelated. Their conversion into project reality requires sound judgement, useful concepts, techniques for analysing situations and principles for the guidance of action. Financial analysis uses a family of highly developed concepts and techniques for decision-making, planning and monitoring, which have to be mastered by drawing on related subjects and techniques such as financial and management accounting, economics, quantitative methods, law and taxation. As the financial analyst must work with all specialists engaged in the preparation of the feasibility study, he or she must have a broad appreciation of their functions and working methods. These matters are dealt with in the following sections, which present an accepted conceptual framework from a practical point of view.

B. Principal aspects of financial analysis and concept of investment appraisal

Financial analysis of industrial investment projects is not an isolated activity performed only towards the end of the project design in order to complete a primarily technical study or project proposal and to show the financial implications of a project for promoters and potential investors. It should rather accompany the various alternatives and the design of the *project strategies* that basically determine the marketing strategies, project scope, resources, location, production capacities and technology, as already described in this *Manual*, thus providing a yardstick for the evaluation of the financial and economic success or failure of a project. This will make it possible to avoid being burdened, after detailed technical design work and data assessment, with a project proposal that is found to be financially unfeasible because investment, production and marketing costs are not sufficiently covered by projected incomes from operations in the business environment assessed during the feasibility study. If found unfeasible at this terminal stage of the study, it is usually too late, and definitely too costly, to start the whole work again for another project alternative.[80]

Another important aspect to be considered when undertaking financial analysis is that the decision makers usually give different weights to the various criteria used for investment appraisal. This would force the analysts to identify such criteria[81] and select proper methods to produce the information required

[80]A typical reaction in such situations is to propose an increase in production capacity, making use of economies of scale, but ignoring the possible consequences for the marketing concept (the demand and market volume may not be large enough, or a supply increase may result in a considerable drop in market prices) or other consequences with regard to location, availability and supply of resources, total finance available for a single project etc.

[81]For example, rapid amortization at a lower profitability might be given priority over high long-term profitability, or investors may wish to expand their market position *vis-à-vis* a major competitor even at marginal returns because they hope that such a strategy will help to maintain high profitability in an already existing firm.

by investors. However, financial analysis should not limit itself to answering questions raised by investors, but should also indicate and highlight any other critical impacts that would have to be considered when appraising a project. The orientation of financial analysis towards the needs of decision makers and their investment and financing criteria, as well as the principal conceptual aspects, are discussed below.

Interest of parties involved

While the interest in future net benefits is common for each party participating in a project, the expected benefits may differ considerably between them and may also be valued differently. To cope with this situation the financial analysis should begin with the determination of the required project inputs and generated outputs, valued at market prices, and determine the annual as well as accumulated net surpluses. Using the methods described in the following sections, the net benefits (yield or profitability) generated by the investment are determined in financial terms. Basically, two groups of financial resources can be distinguished: equity provided by the investors; and loans of financing institutions or other similar sources of funds (including owners).[82] The conditions under which the project may obtain funds reflect the interest of the financiers, in particular their *opportunity cost of capital* and the margin added for the various risks expected and evaluated by each party individually.

The expected net benefits may not always be the only gains resulting from participation in an investment project. An investor may expect to obtain additional financial gains elsewhere as a result of the investment. For example, a joint venture partner could have additional cash flows in the parent company as a result of participation in the venture. Such additional flows may include the supply of components and services (technical assistance, marketing research, management contracts etc.), transfer of technology and know-how (lump-sum and royalty payments), marketing of products (including exports) etc. These activities of joint venture partners, as well as any other advantages resulting from their participation (obtaining supplies possibly at lower prices, securing or opening new markets etc.), would have to be taken into account when determining the feasibility of participation for each individual party.[83] When assessing the criteria applied by individual investors and financiers, it is also important to determine their individual profits net of income tax. For example, an annual dividend of 10 per cent payable to shareholders would correspond to an effective profitability of 5 per cent in the case of a 50 per cent

[82]The debt-equity mix affects the flow of funds from and to the different sources of finance. As a result of the leverage effect, the IRR on equity would increase with an increasing debt-to-equity ratio if the IRR of the project is higher than the cost of loan capital. On the other hand, the profitability of equity capital would become lower with a decreasing debt-equity ratio. This effect would be the reverse if the cost of loan capital exceeded the overall profitability of the total capital invested. The debt-equity ratio also has an impact on overall profitability, in so far as the cash outflow for the payment of corporate (income) taxes usually is a cost item for the firm. Therefore, any increase of the annual interest payable on the debt balance—owing in the present example to an increase of the debt-equity ratio—would reduce the gross or taxable profit, and consequently also the cash outflow of the project. This tax effect on the net cash flow and the leverage effect are important criteria for the determination of an optimal combination of the sources and types of finance. See also sect. F on project financing.

[83]Similarly, such indirect gains may determine the financing decisions of commercial banks. If development finance institutions are likely to participate, various development objectives requiring the incorporation of economic cost-benefit analysis in the feasibility study may have to be taken into account.

income tax. It may therefore be interesting for the shareholder to leave the profit in the firm and reinvest at a profitability rate above 5 per cent.[84] The computation of discounted net cash returns on equity and of the profitability of invested equity capital is described later in the section on investment appraisal methods.

Public interest

Investment has been identified as oriented towards the generation of future net gains. This objective can be achieved only when an investment is properly integrated within the business environment, as described in chapter III. Therefore, any industrial investment is not only a part of a system of supply and demand of goods and services, but also an integrated part of a socio-economic and ecological system within which it performs. To be successful, investments also have to serve the needs and development objectives of this socio-economic system. Since it is in the public interest that investments make efficient use of scarce resources and contribute as much as possible to national development, various fiscal and administrative measures are applied to control investment. These measures, in the form of incentives as well as restrictions, must be identified and included in the financial analysis and appraisal of a project in so far as they affect or could affect the financial feasibility of an investment.[85]

Basic criteria for investment decisions

Although the return on capital invested is the main criterion for investment decisions, it is not the only one in the case of industrial investments, because if financial returns alone counted, financial resources could as well be invested in bonds, securities etc. However, for the purpose of industrial feasibility studies, investment is defined not only as a benefit-oriented long-term commitment of resources, but also as the transformation of liquidity into productive assets. Considering that the net benefits would be solely the result of the productive use of such assets, any decision on industrial investments should be based on the following criteria relating to the overall feasibility of investment projects:

- Is there any possible conflict, at present and in the long run, between the basic project (corporate) objective and the development objectives valid for the socio-economic environment?
- How suitable is the proposed strategy[86] for the achievement of the project objective; have alternative strategies been taken into consideration; and why has the proposed strategy been selected?
- How does the project design, that is, the scope of the project, the marketing concept, the production capacity and the technology and location selected, match with the project strategy and the availability of the required resources?

[84]This example is a simplification, since risk elements and the market value of the share have not been taken into account.

[85]The role of public policies and possible conflicts is also dealt with in chap. V.

[86]See the sections on marketing and project strategy in chap. III.

- Will the project make efficient use of economic resources, and are there better alternative uses of the main inputs required for the project?
- Are projections of total investment costs and production and marketing costs within the acceptable confidence level?
- Are the total investment costs within the financial limits determined by the availability of capital?
- Does the structure of cash outflows and inflows and of the corresponding net cash returns meet with the minimum requirements and expectations of the investors and financiers?
- Will the supply of local money and foreign exchange be sufficient to meet outstanding financial obligations at any time during the life of the project?
- How sensitive are the accumulated discounted returns and the annual returns to the planning horizon, to errors in data assessment and project design, to inflation and relative price changes and to changes in the business environment (mainly those involving competitors, consumers, markets, supplies and public policies)?
- Have critical variables been identified? What risks are associated with these variables, and what strategies exist to manage or control those risks?
- What are the financial consequences of the risks; in other words, do they entail additions to investment costs, to the funds required, to production and marketing costs, and to finance costs, or lower than expected production, sales volumes and sales prices?
- How likely is the projected scenario or business environment required as a minimum condition for the investment to be appraised by investors, by financing institutions etc.

The methods applied for financial analysis and investment appraisal are described in detail in the following sections, starting with cost analysis, then dealing with discounting and conventional methods, project financing, ratio analysis and financial evaluation in conditions of uncertainty.

Accounting systems

Financial analysis relies on a systematic presentation and processing of relevant business data on assets and liabilities, costs and income, and the related flows of goods, services and financial resources. Accounting systems serving the various purposes of management have been developed, and basic accounting methods are as old as business itself. The quality of financial analysis and investment appraisal depends basically on the reliability of the information processed and on the methodology applied. Although accounting systems are not always identical in different countries, basic accounting principles are the same everywhere.[87]

Accounting systems always cover the financial status of the firm in terms of the wealth (assets) and obligations (liabilities) recorded in its balance sheet,

[87]While there are many ways of determining net income, there is only one way of determining cash flow.

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the costs accounted for over the reporting period, and the corresponding income shown in the net income statement. In addition, a cost accounting system is needed in order to determine production and marketing costs, which is necessary not only for the preparation of the net income statement, but also for efficient financial planning, product pricing and cost control.

For liquidity planning the cash flow statement is used. It should be pointed out that depreciation allowances are not classified among the cash outflows. The inclusion of depreciation charges (costs) would result in the double-counting of fixed project costs, since they are already accounted for as fixed capital investments. This is why depreciation charges are regarded as a cost item, but not as a cash item. The financial costs (interest paid) are included among the cash outflows. However, for the computation of the discounted cash flow (IRR and NPV), the financial costs must be excluded, because they constitute—like the dividends paid on equity—a yield generated by the investment and are reflected in the discount rate.

Cost accounting is intended to provide a measurement of budgeted material costs, wages and salaries, and other expenses involved in producing and marketing the goods and services generated by the project. These contemplated costs are examined in an effort to establish the relationship between them and the level of business activity of the project, for which an indication of the variable and fixed costs is required. With this information a profit plan that defines the cost-volume-profit relationships may be constructed. Measuring profits involves separating costs applicable to units sold from the cost applicable to the units remaining in inventories. Finally, to establish rational sales prices requires a knowledge of both the costs and their relationship to the sales volume (see also chapter III). The contemplated costs budgeted for normal capacity permit the analyst to price goods and services for the recovery of costs and a normal profit.

Standard costs representing a predetermined cost may be calculated in advance of operations for later comparison with actual costs. During plant operation costs may be recorded on a chronological or other predetermined basis under any applied system, such as job-order costing or process costing. After completion of the operations, the actual costs incurred are recorded chronologically. Both, chronological and pre-determined costs may be utilized in a cost accounting system.

The classification of costs is necessary in order to facilitate cost planning (budgeting) and to permit the determination of cost items that could be critical for the feasibility of a project. The classification described below in the section on the analysis of cost estimates has already been used in the schedules given in the appendices to chapters III to IX.

Pricing of project inputs and outputs

The inputs and outputs of a project appear in physical form, and prices are used to express them in value terms in order to obtain a common denominator. Ideally, for the purpose of the feasibility study prices should reflect the real economic values of project inputs and outputs for the entire planning horizon of the decision makers. Prices may be defined in various ways, depending on whether they are:

- Market (explicit) or shadow (imputed) prices

- Absolute or relative prices
- Current or constant prices

Market or explicit prices are those present in the market, no matter whether they are determined by supply and demand or by the Government; in other words, they are the prices at which the firm will buy the inputs and sell the outputs. In financial analysis market prices are applied. Later, at the stage of economic cost-benefit analysis, the question will have to be raised as to whether market prices reflect the real economic value of project inputs and outputs. If this is not the case, that is, if market prices are distorted, then shadow or imputed prices will have to be introduced for economic analysis.

Absolute prices reflect the value of a single product in an absolute amount of money, while relative prices express the value of one product in terms of another. For instance, the absolute price of 1 tonne of coal may be 100 monetary units and an equivalent quantity of oil may be 300 monetary units. In this case the relative price of coal in terms of oil would be 0.33, meaning that the relative price of oil is three times the price of coal.[88]

The level of absolute prices may vary over the lifetime of the project because of inflation or productivity changes. This variation does not necessarily lead to a change in relative prices, in other words, relative prices may sometimes remain unchanged despite variations in absolute prices. Both absolute and relative prices are relevant for the financial analysis.

Current and constant prices differ over time as a result of inflation, which is understood as a general rise of price levels in an economy. If inflation can have a significant impact on project input costs and output prices, such an impact must be dealt with in the financial analysis presented in the feasibility study. Whenever relative input and output prices remain stable, it is sufficiently accurate to compute the profitability or yield of an investment at constant prices. Only when relative prices change and project input prices grow faster (or slower) than output prices, or vice versa, then the corresponding impacts on net cash flows and profits must be included in the financial analysis. If inflation impacts are negligible, the problem of choosing between current and constant prices does not exist, since they are equal and the planner may use either.

Inflation may have to be considered in financial planning, even when the relative prices remain basically unchanged, because additional equity and loan financing may be needed to deal with significant annual inflation rates, especially during the project implementation phase (construction and start-up).[89] 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, 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; price changes must also be anticipated.

If relative prices change significantly over time, the analyst is confronted with the delicate task of estimating the future inflation rate and its impact on

[88] Depending on whether tonnes or calorific values are used as a reference, relative prices may be different.

[89] In the case of hyperinflation, it is also necessary to re-evaluate the fixed and current assets on a yearly basis, or even for shorter periods, and to convert unemployed liquidity into short-term investments (such as bonds).

relative prices, and of deciding whether to use current or constant prices. The use of constant prices may still require some adjustments to account for the expected change in relative prices. If the analysis is made using current prices, the analyst will have to anticipate the future inflation rate. In this case, possible inflation rates should be projected by item—for the main cost and revenue items—in order to consider any significant changes in relative prices of locally produced and of imported goods and services.

Planning horizon and project life

Planning is understood as a consciously programmed activity having as its focus the objective consideration of the future. The anticipations and assumptions about the future need to be made explicit and should be analysed in order to find the optimal development path. This is why the planning process integrates futuristic thinking with careful analysis. The project planning horizon of a decision maker may be defined as the period of time over which he decides to control and manage his project-related business activities, or for which he formulates his investment or business development plan. The planning horizon determined by decision makers must also consider the lifetime of a project.

The economic life, that is, the period over which the project would generate net gains, depends basically on the technical or technological life cycle of the main plant items, on the life cycle of the product and of the industry involved, and on the flexibility of a firm in adapting its business activities to changes in the business environment. When determining the economic life span of the project various factors have to be assessed, some of which are as follows:

- Duration of demand (position in the product life cycle)
- Duration of the raw material deposits and supply
- Rate of technical progress
- Life cycle of the industry
- Duration of building and equipment
- Opportunities for alternative investment
- Administrative constraints (urban planning horizon)

It is evident that the economic life of a project can never be longer than its technical life or its legal life; in other words, it must be less than or equal to the shorter of the latter. For project planning purposes only the economic life is relevant.

Considering that the accumulated net cash flows of an investment project are a function of the time period covered in the feasibility study, the planning horizon may have a considerable impact on the results of the financial analysis. Since the values obtained for the discounted cash flows and the various profitability and efficiency ratios vary sometimes considerably with the length of the planning period, the determination of the planning horizon of a feasibility study is often a very critical task. The relationship between the planning horizon and project life should therefore be considered when appraising an investment project.

Risk and uncertainty

Investment projects are by definition related to the future, which a project analyst cannot forecast with certainty. Thus financial analysis and evaluation have to be carried out under conditions of risk and uncertainty. The difference between risk and uncertainty is related to the decision maker's knowledge of the probable occurrence of certain events. Risk is present when the probabilities associated with various outcomes may be estimated on the basis of historical data. Uncertainty exists when the probabilities of outcomes have to be assigned subjectively, since there are no historical data. The aspects and methods of financial analysis under uncertainty are discussed later in this chapter in the section on break-even analysis, sensitivity analysis and probability analysis.

C. Analysis of cost estimates

Since reliable cost estimates are fundamental to the appraisal of an investment project, it is necessary to check carefully all cost items that could have a significant impact on financial feasibility. The sensitivity analysis described later permits the identification of critical cost items, and the cost structure analysis helps to identify possible inconsistencies and unbalanced cost structures, especially when data for similar projects are available from a feasibility-studies data bank. In case of questionable estimates, it may be necessary to verify such cost projections by using other data sources. The preparation of cost estimates has been described in chapters III to IX and comprises the pre-investment, project implementation (investment) and operational phases. It covers the corresponding costs of initial investment, production, marketing and distribution, plant and equipment replacement, working capital requirements and decommissioning at the end of the project life.

The estimates should be grouped into local and foreign components and may be expressed either in constant or current prices (real or nominal terms). Depending on the price basis used in the feasibility study and for the financial analysis, allowances for price increases (contingencies) should be provided for. Since inconsistency in the use of accounting and financial terminology often causes problems for the analysis, it is recommended that the terms defined and explained below be strictly adhered to.[90]

Total investment costs

Initial investment costs

Initial investment costs are defined as the sum of fixed assets (fixed investment costs plus pre-production expenditures) and net working capital, with fixed assets constituting the resources required for constructing and equipping an investment project, and net working capital corresponding to the

[90]The terminology introduced with the first edition in 1978 is based on the most important publications in the fields of project appraisal, analysis of capital projects, accounting and financing, and has been widely accepted.

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 for the nascent project. Furthermore, total investment costs are sometimes confused with total assets, which correspond to fixed assets plus pre-production expenditures 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, the latter being the difference between current assets and current liabilities (see below).

Investment required during plant operation

The economic lifetime is different for the various investments (buildings, plant, machinery and equipment, transport equipment etc.). In order to keep a plant in operation, each item must therefore be replaced at the appropriate time, and the replacement costs must be included in the feasibility study. Other types of investment occurring during the operational phase are investments for rationalization, modernization and plant expansion. In general these investments should be analysed in separate studies, and only in exceptional cases should the costs be incorporated in the feasibility study of the initial investment project.

Pre-production expenditures

In every industrial project certain expenditures due, for example, to the acquisition or generation of assets are incurred prior to commercial production. These expenditures, which have to be capitalized, include a number of items originating during the various stages of project preparation and implementation. They are briefly outlined below.

Preliminary capital-issue expenditures. These are 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 issues. The capital-issue expenditures include basically the preparation and issue of a prospectus, advertising, public announcements, underwriting commissions, brokerage, expenses for processing of share applications and allotment of shares. Preliminary expenditures also include legal fees for loan applications and land purchase agreements.

Expenditures for preparatory studies. There are three types of expenditures for preparatory studies:

- Expenditures for pre-investment studies: opportunity, pre-feasibility, feasibility and support or functional studies (for example, project design reports) undertaken for the implementation of the project;
- Consultant fees for preparing studies, engineering, and supervision of erection and construction, although consulting services may be debited to the relevant fixed investment costs, and are not included under pre-production expenditures in cases where they can be directly related to the creation of an asset;
- Other expenses for planning the project.

Other pre-production expenditures.[91] Included among other pre-production expenditures are the following:

- Salaries, fringe benefit and social security contributions of personnel engaged during the pre-production period;
- Travel expenses;
- Preparatory installations, such as workers' camps, temporary offices and stores;
- Pre-production marketing costs, promotional activities, creation of the sales network etc.;
- Training costs, including fees, travel, living expenses, salaries and stipends of the trainees and fees payable to external institutions;
- Know-how and patent fees;
- Interest on loans accrued or payable during construction;
- Insurance costs 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 X-2.

In allocating pre-production expenditures, one of two practices is generally followed:

- All pre-production expenditures may be capitalized and amortized over a period of time that is usually shorter than the period over which equipment is depreciated;
- A part of the pre-production expenditures may be initially allocated, where attributable, to the respective fixed assets and the sum of both amortized. Pre-production expenditures that are not attributable are capitalized as a total and also amortized over a certain number of years. For the phasing of pre-production expenditures on an annual basis see schedule X-2.

Plant and equipment replacement costs. Such costs include all pre-production expenditures as described above and related to investments needed for the replacement of fixed assets. Again, the estimates include the supply, transport, installation and commissioning of equipment, together with any costs associated with down time, production losses as well as allowances for physical contingencies.

End-of-life costs. The costs associated with the decommissioning of fixed assets at the end of the project life, minus any revenues from the sale of the assets, are end-of-life costs. Major items are the costs of dismantling, disposal

[91] Investment in current assets, such as stocks of spare parts, raw materials and factory supplies, as required for the start-up of plant operation, is dealt with below in the section on net working capital.

and land reclamation. It is often reasonable for a feasibility study to assume that these costs can be offset against the salvage value of the corresponding asset.

Fixed assets

As indicated above, fixed assets comprise fixed investment costs and pre-production expenditures.

Fixed investment costs

Fixed investments should include the following main cost items, which may be broken down further, if required:

- Land purchase, site preparation and improvements
- Building and civil works
- Plant machinery and equipment, including auxiliary equipment
- Certain incorporated fixed assets such as industrial property rights and lump-sum payments for know-how and patents

The estimates include supply, packing and transport, duties and installation charges. Depending on the type and accuracy of the pre-investment study, provisions should also be made for physical contingency allowances, providing a safety factor to cover miscellaneous (unforeseen or forgotten) minor cost items. To arrive at the total fixed investment costs, the final amounts derived from schedules V-1 and V-2, and schedules VI-1, VI-2 and VI-3, should be inserted in schedules X-1 and X-2,[92] respectively, and added up. Total annual fixed investment costs are projected for each year of the construction period until the planned production level is reached. Any investment required during the operational phase to maintain the operation of the plant should be inserted in schedule X-1.

Net working capital

Net working capital[93] is defined to embrace current assets (the sum of inventories, marketable securities, prepaid items, accounts receivable and cash) minus current liabilities (accounts payable). It forms an essential part of the initial capital outlays required for an investment project, because it is required to finance the operation of the plant. Any changes in current assets or liabilities, such as an increase or decrease of production volumes or inventories (raw materials, work-in-progress, finished products etc.), has an impact on the financial requirements. Any net increase of working capital corresponds to a cash outflow to be financed, and any decrease would set free financial resources

[92]These schedules are given in the appendix to this chapter.

[93]In the literature quite often the term working capital is used as a synonym for net working capital. This term should not, however, be mixed up with the net increase or net changes of working capital, which result from changes in current assets and liabilities.

(cash inflow for the project). Since the working capital is computed net of creditors, that is, net of short-term finance, it is quite logical that working capital should be financed from equity or long-term debt (short-term seasonal peaks occurring within a production year may, however, be financed by short-term or medium-term capital).

In the analysis of investment costs it should be carefully checked whether the initial working capital requirements as well as the changes during plant operation are properly considered in the cost estimates. Only thus can it be ensured that there is no unexpected shortage of finance during start-up of operations, and that working capital outlays are included for the appraisal of the investment project.

The above classification makes no mention of time, and since time is vital in the formulation of procurement policies, working capital should furthermore be classified as either permanent or temporary. Permanent working capital is that amount of funds required to produce the goods and services necessary to satisfy demand at its lowest point. The funds representing permanent working capital never leave the business process. Temporary or variable working capital is not always gainfully employed. For example, project businesses that are seasonal or cyclical in nature require relatively more temporary working capital. Therefore, capital that is temporarily invested in current assets should be obtained from sources that will allow its return when not in use.

The net concept is used in determining the amount and nature of assets that may be used to pay current liabilities. The amount that is left after these debts are paid may be used to meet future operational needs. If the analyst abstained from classifying permanent and temporary working capital, then net working capital is used as the average long-term level of working capital and has to be covered by medium or long-term financing or equity (schedules X-4 and X-7).

The amount of working capital invested should be optimal, that is, neither too large nor too small, to avoid penalties for the project. Working capital should be carefully estimated and adequately controlled and monitored.

Accounts receivable (debtors)

Accounts receivable are trade credits extended to product buyers as a condition of sale; the size of this item is therefore determined by the credit sales policy of the company. 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:

$$\text{Debtors} = \frac{\text{Credit terms (in months)}}{12} \times (\text{Value of annual gross sales})$$

In the case of accounts receivable the value of annual gross sales should be calculated as costs of the product sold (that is, production costs plus marketing and distribution costs) minus depreciation and interest, with the understanding that the latter are to be covered by the sales revenues 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 justifiable.

Production materials. In computing inventories of production materials, consideration should be given to the sources and modes of supplies of raw materials and factory supplies. If the materials are locally available and in plentiful supply and can be rapidly transported, then only limited stocks should be maintained unless there are special reasons for keeping a higher stock (such as price fluctuations). If the materials are imported and import procedures are dilatory, then 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 capital requirements for covering work-in-progress, 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 production, this can extend to several months. The valuation is based on the factory costs of work-in-progress.

Finished products. The inventory of finished products depends on a number of factors, such as the nature of the product and trade usage. The valuation is based on factory costs plus administrative overheads (schedule X-3).

Cash-in-hand and cash-in-bank

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. However, if at the end of such a six-month period the surplus of receipts over payments does not fully cover the interest payments, additional short-term finance would be required. It may also be prudent to provide for a certain amount of cash-in-hand. This could be done by including a contingency reserve on working capital, which, depending on the case, could be around 5 per cent.[94] Schedule X-5/2 provides an example of how to calculate the cash requirements in the case of seasonal fluctuations of such requirements.

[94]For the purpose of feasibility studies and in the case of a similar distribution of receipts and payments during each year, the approximate minimum cash/overdraft to be included in the computation of the net working capital may be computed on the basis of annual costs of labour, factory and administrative overheads, as well as direct marketing costs (or operating costs less the costs of raw materials, factory supplies and indirect marketing).

Accounts payable (creditors)

Accounts payable will depend on credit terms provided by suppliers. Hence raw materials, factory supplies and services 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 (unless tax advances have to be paid), and may be another source of finance similar to accounts payable. The same holds true for wages payable. Such credited payments reduce the amount of net working capital required.

It is very important to understand that creditors related to investment are to be excluded from the computation of working capital requirements, because by definition investments are long-term commitments and must therefore be financed by long-term resources (equity or debt).

Calculation of net working capital requirements

When calculating the working capital requirements, the minimum coverage of days for current assets and liabilities has to be determined first. Annual factory costs, operating costs, and costs of products sold should then 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 the above cost data for the complete start-up period until and including production at full capacity (schedule X-3). If however the project generates sufficient cash surplusses (self-financing capacity), it may not be necessary to finance any net increase in working capital from outside resources.

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 X-4). Subsequently, the cost data provided in schedule X-3 for each item of the current assets and liabilities are divided by the respective coefficients of turnover and put in schedule X-4. 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 (schedule X-5/2) and inserted at the bottom of schedule X-4.

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.

All payments are listed and compared with monthly receipts coming from sales. In schedule X-5/1 the net working capital requirements are projected for the case of seasonal fluctuations. Schedule X-5/2 provides an example of the calculation of short-term liquidity. The last column of the schedule shows the deficits aggregated over the year, NCU 90,000 being the lowest and NCU 2,710,000 the highest deficits. In case of a permanent net working capital

of approximately NCU 2 million, the credit would peak at about NCU 600,000 and the debt at about NCU 700,000.

The calculation of working capital requirements at the stage of the feasibility study is of particular importance since it forces the project promoter, investors and financing institutions to think about the funds needed to finance the operation of the project as compared with invested funds, such as pre-production expenditures and fixed investment costs.

Conceptually, the term net working capital should not be confused with the term current assets, which normally ought to be larger. Figure XXVIII shows how working capital should be financed out of permanent capital, which is composed of equity capital, reserves and long- and medium-term liabilities.

Current liabilities (mainly accounts payable) represent financial means usually considered to be put at the disposal of the project at no interest cost. However, in case a discount is offered for payment on delivery or receipt of the invoice, such a discount, if not used, is equivalent to an interest payable to creditors. It is a generally accepted practice to deduct current liabilities from current assets and to compute the return on capital employed as well as the discounted cash flows only for the permanently employed capital, that is, the finance corresponding to fixed investment plus working capital (see schedules X-6/1 and X-6/2).

Schedules for total investment costs and total assets

From the figures of fixed investments, pre-production expenditures, and net working capital estimates, the total initial investment costs of the project under consideration can be calculated. The phasing of such costs, including plant and equipment replacement costs and end-of-life costs (if any), is shown in schedules X-6 and X-9. 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 operation at full capacity is reached.

In order to establish the projected balance sheets (schedule X-11) and to obtain sufficient data for ratio analysis,[95] a schedule covering total assets should be provided at the stage of project preparation. This can easily be done by substituting current assets for net working capital in schedule X-6. When phasing current assets, the initial amounts should be inserted in the schedule first, and then all subsequent changes, until operation at full capacity is reached.

Production costs

It is essential to make realistic forecasts of 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 reinforced by low capacity utilization caused by wrong sales forecasts, may quickly push a nascent establishment out of operation. The analysis of cost structures and identification of critical cost items, as well as

[95] See sect. G below.

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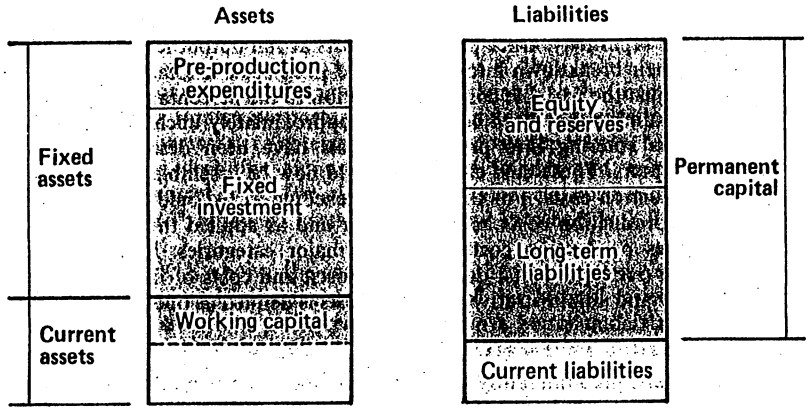
Figure XXVIII. Structure of the balance sheet



critical comparisons with similar projects, are proper means of improving the reliability and accuracy of cost projections and predictions of the financial feasibility of an investment.

Production costs should be calculated as total annual costs and preferably also as cost per unit produced (unit costs). Often pre-investment studies deal only with overall production costs, which should then be broken down at least into the main cost items (raw materials, factory supplies, personnel, overheads etc.). The computation of unit costs, which is relatively simple for single-product factories, may become rather complicated for certain technologies and the manufacture of a variety of products. For the analysis and justification of an envisaged production programme and for the break-even analysis, it is necessary to determine the main cost items directly related to each individual product. Production costs must be determined for the different levels of capacity utilization, and for an operational period corresponding to the planning horizon of the investors and financing institutions interested in the project.

Frequently overlooked in feasibility studies is the fact that fixed costs may be constant within only a limited range of production increases or decreases.

Definition of production cost items[96]

As has been indicated, this *Manual* is geared towards the use of discounting methods for financial analysis and investment appraisal. All cost

[96] In the first edition of this *Manual* sales and distribution costs were treated as a part of total production costs. With the revision and extension of chapter III, the term marketing costs has been introduced, covering direct and indirect costs of all marketing activities (including sales and distribution costs). Since marketing costs are, strictly speaking, costs relating to the marketing of products and not to the manufacturing process, it has been decided to differentiate between these two types of costs.

elements required for the calculation of total production costs therefore have to be projected and scheduled in line with the production programme and for the full planning period. It is, however, not necessary to prepare a schedule for each cost item separately. Once production costs at full output level have been defined and their breakdown into variable and fixed costs is established,[97] it is possible to adjust the variable costs in proportion to the percentage of capacity utilization, assuming that fixed costs remain approximately unchanged. All of the cost items entering into production costs have been described in the preceding chapters. These cost elements should now be assembled in order to arrive at production costs. For this purpose schedule X-3 should be used. The definition of production costs as given earlier and as applied throughout this *Manual* divides production costs into four major categories: factory costs; administrative overhead costs; depreciation costs; and costs of financing. The sum of factory and administrative overhead costs is defined as operating costs.

Factory costs. Factory costs include the following cost items:

- Materials, predominantly variable costs, such as raw materials, factory supplies and spare parts
- Labour (production personnel) (fixed or variable costs, depending on type of labour and cost elements)
- Factory overheads (in general, fixed costs)

To arrive at factory costs (schedule VI-4), the final amounts derived from schedules IV-1, V-3, V-4, VI-1 (if applicable), VII-1 and VIII-2 should be inserted in schedule VI-4 and schedule X-3.

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 VII-1 and VIII-2 to schedule X-3.

Depreciation costs. Depreciation costs are charges made in the annual net income statement (profit-loss account) for the productive use of fixed assets. While depreciation costs have to be considered in accounting for the computation of the balance sheet and net income projections, they present investment expenditure (cash outflow during the investment phase) instead of production expenditure (cash outflow during production). Depreciation charges must therefore be added back if net cash flows are calculated from the net profit after corporate tax, as obtained from the net income statements. Depreciation costs do have an impact on net cash flows, because the higher the depreciation charges, the lower the taxable income, and the lower the cash outflow corresponding to the tax payable on income.

Financial costs. Financial costs (interests) are sometimes 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. For the purposes of financial analysis and investment appraisal, however, it is necessary to determine financial costs separately. Most feasibility studies show a declining amount of external finance and, correspondingly, decreasing financial costs. The computation of financial costs is described later in this chapter.[98] Financial costs are computed in schedule X-7 and inserted into schedule X-3.

Figure XXIX 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 understanding of the cost structure and its impact on the profitability (return on investment and equity, respectively) of a project.

Unit costs of production

For the purpose of cash flow analysis it is sufficient to calculate the annual costs. At the feasibility stage, however, an attempt should also be made to calculate unit costs to facilitate the comparison with sales prices per unit. For single-product projects, unit costs are calculated simply by dividing production costs by the number of units produced (therefore unit costs usually vary with capacity utilization). In the case of a multi-product project it is recommended to apply direct costing and compute both the direct costs and the margin generated per unit produced and sold. The overall margins serve to cover the indirect costs or overheads, that is, those costs which have not been directly related to a certain product. A common accounting method for computing unit overhead costs is to allocate overhead costs to direct material and direct labour unit costs by means of different percentage surcharges. For new investment projects the determination of these surcharges may be difficult, and for projects in developing countries in particular, comparative data may be difficult to obtain or may not be available at all. Cost accounting surcharges vary from factory to factory and country to country, and are computed with the help of a specially designed cost-centre accounting scheme. For an ongoing project, surcharges are based on historical data. In the absence of such data it might perhaps be thought that for 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 generally practicable.

Direct and indirect costs

From the viewpoint of product costing (calculation of unit cost prices), production costs and marketing costs should be divided into direct and indirect costs. Direct costs are easily attributable to a product unit or service in terms of

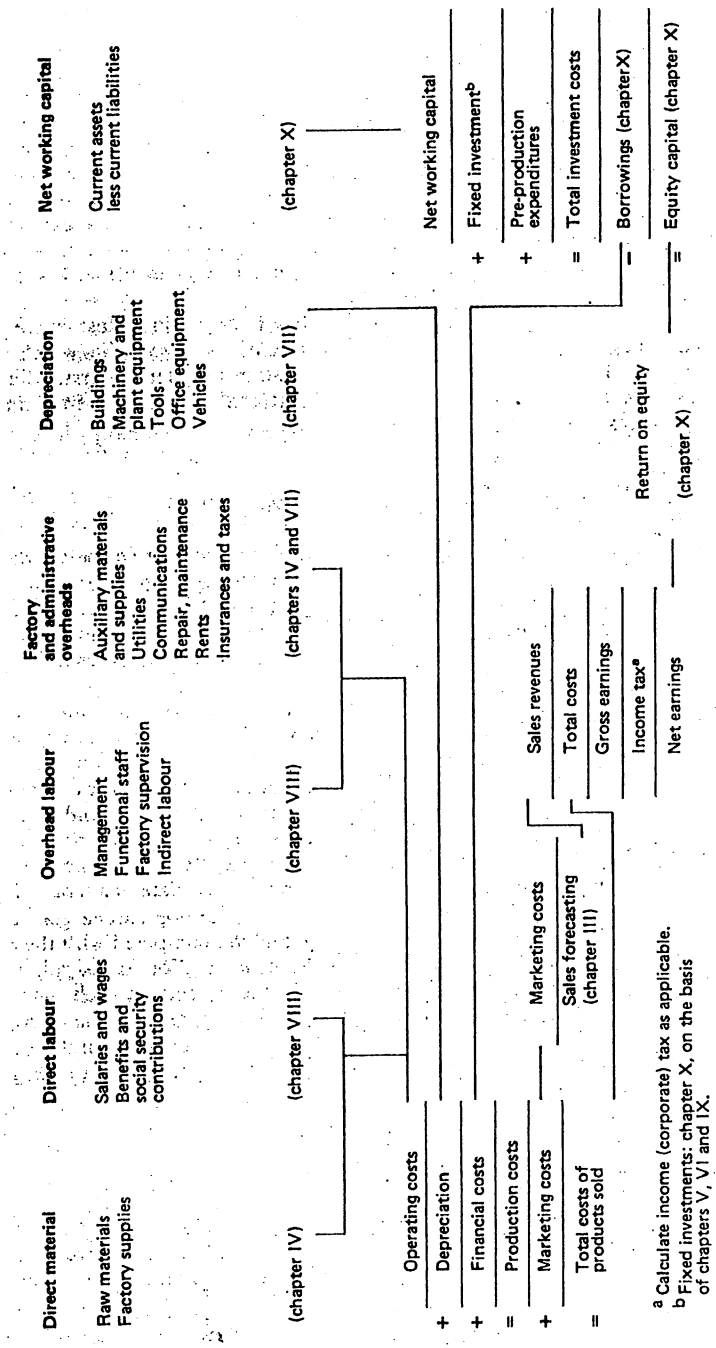
[97] Variable costs change roughly in proportion to the variations in the level of production. Typical variable costs include materials, production labour and utilities. Variable costs can be divided further into: proportional costs, which change proportionally with the volume of production (for example, raw materials); degressive costs, which change at a lower rate than the volume of production (for example, maintenance and repair); progressive costs, which change at a higher rate than the volume of production (for example, overtime); and regressive costs, which decrease with an increase in the volume of production (for example, 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. It 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.

[98] See sect. F below.

Figure XXIX. Origin of cost items for profitability calculation (return on equity)



cost of production materials and production labour. Since indirect costs (factory administrative overheads such as management and supervision, communications, depreciation and financial charges) cannot be easily allocated directly to a particular unit of output, they must first be apportioned to cost centres, and thereafter to the unit cost price by way of surcharges obtained from the cost accounting department. *Direct costing* is an accounting method that avoids the problem of determining surcharge rates. The direct variable and direct fixed costs are deducted from the revenues generated by a certain product (or product group), and the remaining surplus or margin together with the margins generated by other products is then available to cover the indirect costs. The surplus then remaining is called the *operational margin* (excluding or including costs of finance). This method may be extended for the computation of margins on different production or enterprise levels, such as a production line (first level), then a plant unit composed of more than one production line (second level), then the complete factory (third level), and finally the entire enterprise, which may operate more than one factory. Direct costs are often mixed up with variable costs and indirect costs with fixed costs, probably because most of the indirect costs are invariable or fixed. However, as described above, both direct and indirect costs may be variable or fixed. The distinction between direct and indirect costs is made to indicate the relationship between a cost item and a cost centre or profit centre, while the variability (or non-variability) describes the relationship between a cost item and the volume of production.

The solution adopted in this *Manual* is to deduct from the anticipated unit sales price the variable unit costs and then multiply the remaining margin by the units produced.[99] The annual margin must then be sufficient to cover all fixed costs arising in the period, and should also generate a sufficient surplus, as required by the investors.

Marketing costs

Marketing costs comprise the costs for all marketing activities as described in chapter III (see also schedule III-2), and may be divided into direct marketing costs for each product or product group, such as packaging and storage (if not included in the production costs), sales costs (salespersons, commissions, discounts, returned products, royalties, product advertisements etc.), transport, interim storage (if required) and distribution costs, indirect marketing costs, such as overhead costs of the marketing department (personnel, materials and communications, market research, public relations and promotional activities not directly related to a product or product group etc.). The analysis of these costs involves their assignment to various costing groups such as territories, certain classes of customers (wholesalers, retailers, governmental institutions etc.), and products or product groups.

Marketing and distribution costs fall into the category of period costs, even if variable, and as such are charged against the operations of the accounting period in which they are incurred (while production costs are frozen in inventory until the units are sold). For depreciable investments as required

[99] It is also possible to deduct the total annual variable costs from the total sales income to compute the annual margin, in this case the variable margin. The computation of the variable margin is necessary when a break-even analysis is required.

for marketing and distribution (for example, delivery trucks), depreciation charges are to be included in the computation of total marketing costs. The analysis of marketing costs together with direct costing can be a very useful instrument for evaluating a marketing mix and for determining an optimal production programme and product mix.

D. Basic accounting statements

Although the cash flow analysis has been adopted as the principal instrument of investment appraisal, it is necessary for the analyst and for those finally deciding whether to invest and finance a project to have an understanding of basic accounting principles and statements. The accounting statements are also important for the analysis of the structure of project financing and for the computation of the capital costs of a company. In the case of rehabilitation, modernization and expansion projects, the accounting records of the existing company are usually the best source of information and the basis for starting the financial analysis.

There are basically two categories of accounting statements: the net income statement or profit and loss account which is linked to the balance sheet; and the cash flow table for financial planning. In many countries the balance sheet and net income statement must be published in the case of certain types of corporations.

Net income statement

The net income statement (schedule X-10) is used to compute the net income (net earnings) or deficit of the project arising each year. The projections are required for the entire duration of the planning period chosen for the project. The net income statement differs from the cash flow statement inasmuch as it shows costs and incomes (and not expenditures and revenues)[100] by period, following the accrual concept, according to which income from operations is associated with the costs that were needed to achieve this income during the period under consideration. To keep computations simple, in feasibility studies it is usually assumed that inventories of raw materials, work-in-progress and final products are the same at the beginning and end of each accounting period (usually the calendar year).

The net income statement is linked with the projected balance sheet in so far as the annual profit (or loss) shown in the net income statement (schedule X-10) increases (or reduces) the wealth of a company as represented on the balance sheet. Annual profits, if retained, increase the reserves (schedule X-11), while losses are accumulated under the assets.[101] As dividends are usually not paid in the same year, the annual balance contains also a line for dividends payable (schedule X-11).

[100]The cash flow concept is described in the section on accounting terminology in part one of this *Manual*.

[101]In United States accounting, accumulated losses are not shown on the asset side, but are deducted from accumulated profits, making the account negative if the losses exceed the profits.

For the purpose of a feasibility study the net income statement should show at least how the net earnings are divided between different classes of equity shareholders, the different suppliers of loan capital and the tax authorities. For the break-even analysis the variable costs, the variable margin, fixed costs (including depreciation and financial charges) and the operational margin should be shown (schedule X-10). No explanatory notes on the concept of net income statements are provided here, since this has been sufficiently covered in the literature.

Balance sheet

A balance sheet is a statement showing the accumulated assets—the wealth—of a company and how this wealth is financed. The sources of finance are treated as the aggregate liabilities of the company *vis-à-vis* those providing it with funds, namely the investors (equity shareholders) and the group of creditors, banks and debenture holders. By definition both sides of a balance sheet, representing assets and liabilities,[102] are equal. For the purpose of a feasibility study the balance sheet should be broken down at least as shown in schedule X-11.

The projected balance sheet in the feasibility study should consist of estimates of key items, such as cash and other current assets (in particular, raw materials, accounts receivable, work-in-progress, and finished products), fixed assets, as well as equity and loan capital and current liabilities that are required for the smooth performance of the enterprise. The series of projected balance sheets shows then the projected development of the accumulated assets and how these are financed.[103]

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 in schedule X-4,[104] and fixed assets may be computed from the data contained in schedule X-6 (it should be noted that annual depreciation allowances are required in order to arrive at the book value). Short- and medium-term loans and equity capital are derived from schedule X-7/3, whereas current liabilities are inserted from schedule X-4. The balance between total assets and long-term liabilities, however, may show the need for additional, usually short-term, finance. On the other hand, a cash surplus (unemployed liquidity) may be shown on the asset side, resulting from retained profits (build-up of reserves, as shown in schedule X-10).

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. Often business laws demand that a minimum amount of reserves (related, for example, to dividend payments) is maintained. Retained profits are available for financing new investments, and under some taxation laws these funds may be cheaper for the firm than new equity paid in by shareholders.

[102]In the United States, the term "liabilities" does not include equity and reserves.

[103]The discussion of the rate of turnover presented at this point in the first edition has been transferred to the later section on financial and efficiency ratios.

[104]Changes in inventories of raw materials, work-in-progress and finished products have been taken into account when calculating the working capital (see schedule X-4 for the growth of current assets).

Source and application of funds (cash flow table for financial planning)

It is not sufficient to determine the total amount of financial means required and to identify sources of available finance. The timing of the inflow of funds (paid-in equity, loan disbursements, sales revenues, short-term loans, bank overdrafts or creditors) must be synchronized with the various expenditures (cash outflow) for investments as well as the plant operation. If this timing of financial flows is not properly done, the project may experience periods with accumulated financial surpluses not employed but costing interest, or face sudden shortages of funds and liquidity problems. The latter case may have a serious financial impact, for example, forcing the project to borrow short-term finance at usually higher costs, or there may be delays in project implementation if a financial bottleneck cannot be covered during the construction phase. During the operational phase liquidity problems would lead to reduced supplies and under-utilization of the installed production capacities.

The net income statement and the balance sheet, designed to show the wealth of a firm, are not directly suitable for financial planning, that is, the assurance of the liquidity of the firm. It is therefore necessary to prepare a cash flow schedule showing the sources and application of funds, in particular, the overall cash inflows and outflows. During the project implementation and operational phases detailed financial planning is required at least on a monthly basis. For the purpose of the feasibility study, however, an annual cash flow schedule is generally sufficient.

Just as financial planning for the investment phase should ensure that capital is available to finance investment expenditures, and that financial inflows and expenditures (cash outflows) are synchronized, financial planning for the operational phase must ensure that cash inflows, or sales revenues, from operations will be adequate to cover all production expenses and all financial commitments, such as debt service (both interest and principal), taxes and payment of projected dividends. This aspect is particularly significant in the early years of operation, when output is usually considerably below the installed capacity, while the burden of debt service is often the highest. This is the case, for example, with supplier credits, which usually have to be repaid over a period from 5 to 8 years in equal instalments.

In schedule X-8, an example of integrated cash flow (comprising operational (real) and financial cash flows) is given, covering the periods of construction, start-up and operation at full capacity. The preparation of a separate cash flow schedule showing also the foreign exchange requirements and foreign cash inflows is recommended. Data for the financial planning schedule are obtained from schedules X-1, X-2 and X-4 (fixed investment, current assets and current liabilities), X-7 (sources of finance and corresponding debt service) and X-10 (sales revenues). The cash flow tables are closely linked to the projected balance sheet, since the cumulative cash balance obtained in the cash flow schedule for financial planning—which should never be negative—corresponds to the figure in the balance sheet. The cash outflow for tax payments is obtained from the net income statements, assuming that the tax is paid at the end of the same year, in other words, that no tax credits are granted.

Since capital is frequently scarce, it is the general tendency of inexperienced promoters to keep the projected financial requirements as low as possible. A project analyst should resist the temptation to please the sponsors of the study by such unreasonably low figures. Bad financial planning in the pre-investment

study will hamper 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 on the financial structure of investment proposals and to facilitate the final choice of financing, alternative modes of financing must be considered and provided for in every pre-investment study. For each financing alternative the cash flow tables, net income and balance sheet projections have to be computed, as well as those ratios and indicators of the efficiency of investment projects which vary with the structure and costs of finance.

The following two approaches are generally taken in projecting cash needs:

- A cash flow forecast based on the income statement, in which the statement is adjusted for non-cash items. The resulting figure refers to funds provided by operations. Considering cash flows not recognized in the income statement leads to the final funds position of the project;
- A cash receipts and disbursement statement, or the cash budget, reflecting the initial cash balance, the receipts for the period, the expected disbursements and the ending cash balance. This statement is typically divided into subperiods, possibly in terms of weekly or monthly time intervals.

E. Methods of investment appraisal

As far as the investor is concerned, the investment criterion overruling all other project-related business objectives is the financial feasibility of an investment project. This means that the financial return on both the total capital invested and on the paid-in equity capital is sufficiently high. However, the interest of the parties involves a wider field of decision criteria than that represented by net returns on capital invested.[105] Although sufficient returns are essential for a project to be approved, investments must be justified usually within a wider context, which for investors and financiers includes any gains, whether net profits or non-cash benefits, resulting directly or indirectly from an investment. For investment appraisal such external or indirect benefits should be expressed in monetary terms whenever possible, if the decision makers want to include such criteria for the approval of a project.

As mentioned in discussing financial statements, different sources of finance are usually involved in financing a project. Each of the parties interested in co-financing would logically have their own appraisal criteria, including the acceptable minimum return on the corresponding capital share. The feasibility study should therefore consider the various decision criteria. The financial evaluation should be carried out and presented in such a way that all parties concerned with the investment and financing decision obtain the information needed to ascertain their share of the projected return in relation to other parties as well as in relation to their inputs and the expected financial risks of the project.

An entrepreneur, as a rule, finances a project partly through equity capital and partly through borrowed funds. The prime interest of the entrepreneur is

[105] See sect. B above.

usually to know the profitability of the equity capital, that is, the net profit after tax over the paid-in equity (or share) capital. When preparing a feasibility study, however, it is generally not known how the project will be finally financed. Apart from the impact of loan financing on income tax computations (cost of finance is deductible from the operational margin),[106] the profitability rate for equity capital depends entirely on the overall profitability of total capital invested and the interest paid on the debt balance (leverage effect). It is therefore necessary first to determine the financial feasibility of the investment project as a whole, and only then assess the individual feasibility for each participating source of finance (equity holders including joint venture partners, commercial banks and development finance institutions).[107]

Cash-flow concept

Investment has been defined[108] as a long-term commitment of economic resources made with the objective of producing and obtaining net gains in the future. The conventional methods of investment appraisal, which will be discussed later, basically evaluate the expected net profit (sales income less costs and income taxes) against the capital invested. For the purpose of investment appraisal it is, however, necessary to assess and evaluate over a certain period (in this *Manual* defined as the planning horizon of the decision makers) all inputs required and all outputs produced by the project. The information contained in the net income statements and projected balance sheets is, however, not sufficient for this purpose, and therefore the discounted cash-flow concept has become the generally accepted method for investment appraisal.

Similarly, the cash-flow concept is needed for planning of the flow of financial means, in other words, of the sources and application of funds.

Definition and computation of cash flows

Cash flows are basically either receipts of cash (cash inflows) or payments (cash outflows). For the purpose of financial planning and the determination of the net cash returns of an investment, it is necessary to distinguish between financial flows, which are related to the financing of an investment, and cash flows (expenditures and revenues) representing the performance or operation of the project (operational cash flows).

Financial cash flows are shown in schedules X-7/2 (financial resources, inflow), X-7/4 (debt service, outflow) and X-8, and include, for example:

Financial inflows	*Financial outflows*
Paid-in equity capital	Dividends paid Buying back of shares

[106]See schedule X-10.

[107]Profitability ratios for capital invested are computed from the figures contained in the balance sheet and net income statement of the project. Since the net profit is usually not identical with the profit distributed (dividends paid), two different values can be computed for the profitability of equity capital. As compared with the cash-flow concept, there is also a difference between the net cash return on equity capital and the profitability computed for the same source of funds. The differences are explained in detail below in the analysis of cash-flow discounting methods.

[108]See sect. B. above.

Financial inflows	*Financial outflows*
Subsidies, grants	Repayments (if required)
Long- and medium-term loans	Interests paid on loans and other costs of finance Amortization (repayment) of loans
Short-term loans, bank overdraft	Interest paid on short-term loans and overdraft, repayments on short-term loans and overdraft
Increase in accounts payable	Decrease in accounts payable

Operational cash flows are shown in schedules X-9 (discounted cash flow):

Operational cash outflows	*Operational cash inflows*
Increase in fixed assets investment)	Revenues from selling of fixed assets Recovery of salvage values (end of project)
Increase in net working capital	Revenues from decrease of net working capital
Operating costs[109]	Sales revenues
Marketing expenses	
Production and distribution losses	Other income due to plant operations
Corporate (income) taxes	

Basic assumptions underlying cash-flow discounting

This *Manual* does not undertake to justify and explain the methods and basic assumptions of cash-flow discounting and compounding, because the subject is extensively dealt with in the literature. The basic assumption underlying the discounted cash-flow concept is that money has a time value in so far as a given sum of money available now is worth more than an equal sum available in the future. This difference can be expressed as a percentage rate indicating the relative change for a given period which, for practical reasons, is usually a year. Considering that a project may obtain a certain amount of funds F, if this sum is repaid after one year including an agreed interest I, the total sum to be paid after one year would be $(F + I)$, where

$$F + I = F(1 + r)$$

and r is defined as the interest rate (in percentage per year) divided by 100 (if the interest rate is, for example, 12.0 per cent, then r equals 0.12).

[109]It should be noted that depreciation charges (costs) and interest payments are not classified among the operational cash outflows, because inclusion of depreciation of assets would provoke a double-counting of the costs to the project, since they are already accounted for as investment costs when capitalized in the balance. However, for accounting purposes (including taxation) assets are to be depreciated over the project lifetime. This is why the depreciation of assets is a cost item in the net income statement only, and must be deducted from the annual total costs of products sold (production and marketing costs) when determining the annual cash outflows. Interest and any other cost of finance are also included for the computation of the yield or return on the total capital investment, because they are part of this total yield. However, interest on loans (but not net profits distributed) is a cost item in the net income statement.

Supposing that CF_n is the nominal value of a future cash flow in the year n, and CF_p the value at the present time (present value) of this expected inflow or outflow, then (assuming that r is constant):

$$CF_p = CF_n/(1+r)^n$$

$$\text{or } CF_p = CF_n(1+r)^{-n}$$

Main discounting methods

There are two main discounting methods used in practice for the appraisal of investment projects, as far as the evaluation of financial feasibility is concerned: the net-present-value method (often referred to as NPV method), and the internal-rate-of-return (IRR) method, sometimes also referred to as the discounted-cash-flow method.

Net present value

The net present value of a project is defined as the value obtained by discounting, at a constant interest rate and separately for each year, the differences of all annual cash outflows and inflows accruing throughout the life of a project. 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 project life are added to obtain the project NPV as follows:

$$\text{NPV} = \text{NCF}_0 + (\text{NCF}_1 \times a_1) + (\text{NCF}_2 \times a_2) + \ldots + (\text{NCF}_n \times a_n)$$

$$\text{or NPV} = \sum_{n=0}^{n=j} \frac{\text{NCF}_n}{(1+r)^n}$$

where NCF_n is the annual net cash flow of a project in the years $n = 1, 2, .., j$, and a_n is the discount factor in the corresponding years, relating to the discount rate applied through the equation

$$a_n = (1+r)^{-n}$$

Discount factors (a_n) may be 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 (cost of capital) paid by the borrower.[110] The discount rate should basically reflect the *opportunity cost of capital,* which corresponds to the possible returns an investor (financier) would obtain on the same amount of capital if invested elsewhere, assuming that the financial risks are similar for both investment alternatives. In other words, the discount rate should be the *minimum rate of return,* below which an entrepreneur would consider that it does not pay for him to invest.

[110]The market rate for long-term loans is usually valid for borrowers with the best credit rating. In case additional risks, exceeding the normal investment risks, are expected, financing institutions as well as private investors would increase the costs of finance for the project by adding a safety margin to the base rate to cover the various country risks etc.

If the computed 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 NPV can thus be considered acceptable, provided a sufficient margin of error above zero NPV to account for uncertainty has been included. If the NPV is negative, the profitability is below the cut-off rate (usually the opportunity cost of capital for this type of project), and the project should be dropped.

An important decision criterion of the investor is often not only the profitability of his investment, but also the answer to the question: how long does it take to get the money back including a certain minimum interest rate? He may decide, for instance, to invest only if the investment is repaid in five years at an interest rate of 15 per cent per year, which would mean that the NPV must not be negative for a discounting rate of 15 per cent and a planning horizon of five years. The net cash return on equity would have to be used for discounting.

Using the data of the example, the NPV of the total investment outlay (schedule X-9/1) and the NPV of the equity capital (schedule X-9/2) can be determined. The relevant schedules are given at the end of this chapter.

Schedules X-9/1 and X-9/2 show that the working capital and the salvage value of fixed assets will be recovered by the end of the project life. For the computation of the discounted return on equity capital invested, any outstanding debt balances would have to be deducted from these salvage values in order to obtain the real end-of-life net worth for the shareholders.

The NPV and the IRR for the total investment (schedule X-9/1) shows the yield of the project as a whole. In case there is no loan (outside) financing, the NPV and IRR are the same as in schedule X-9/2.[111] However, if part of the investment is financed from loan capital (outside financing), the NPV and IRR are different because of the tax effect of the debt service (interest is a cost item, and therefore the taxable profit is lower in the case of interest payments). The cash flow corresponding to payment of the income (corporate) tax is taken from the net income statement (schedule X-10).

Net-present-value ratio

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),[112] and yields a discounted rate of return. This should be used for comparing alternative projects. The formula is as follows:

$$\text{NPVR} = \frac{\text{NPV}}{\text{PVI}}$$

[111]It should be borne in mind that if a project is financed without loan capital, the production costs will not contain any financial costs.

[112]In some textbooks this is called the profitability index.

If the construction period does not exceed one year, the value of investment will not have to be discounted. A comparison of the two alternative ways of financing the project in the example yields the NPVRs shown in table 1.

Table 1. Computation of net-present-value ratios

Schedule	NPV[a] at 12 per cent	PVI	NPVR
X-9/1	3 798	3 291 + 4 578 + 761 = 8 630	0.44
X-9/2	4 106	2 600 + 804 + 8 = 3 412	1.20

[a] Accumulated for 18 years (schedules X-9/1 and X-9/2).

In summary, the NPV has great advantages as a discriminatory method compared with the payback period or the annual rate of return, discussed later, since it takes account of the entire project life[113] and of the timing of the cash flows. The NPVR 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 the fact that the NPV does not show the exact profitability of the project. For this reason the NPV is not always understood by business people used to thinking in terms of a rate of return on capital. It is therefore advisable to use the internal rate of return.

Internal rate of return

The internal rate of return is the discount rate at which the present value of cash inflows is equal to the present value of cash outflows. In other words, it is the discount rate for which the present value of the net receipts from the project is equal to the present value of the investment, and the NPV is zero. Mathematically, it means that in the NPV equation discussed earlier, the value for r has to be found for which—at defined values for CF_n— the NPV equals zero. The solution is found by an iterative process, using either discounting tables or a suitable computer programme.

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.[114]

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

[113] An investor may be willing to invest if the NPV on his paid-in equity is above zero for a shorter period—his planning horizon adopted for the investment decision—than the project lifetime. In this case the net cash return on equity is estimated for this shorter period and discounted using the cut-off rate of the investor. If the value of the plant at the end of the planning horizon (assuming, for example, that the investor could sell his equity share at that time) is taken into account in the decision, then the net value, that is, the total value net of all obligations towards others, is taken as a net cash inflow occurring at the end of the discounting period.

[114] The IRR is known also as marginal efficiency of capital, interest rate of return, discounted cash flow, or financial rate of return (as opposed to the economic rate of return used in economic analysis).

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 good approximation of the IRR value can be obtained, using the following linear interpolation formula:

$$i_r = i_1 + \frac{\mathrm{PV}\,(i_2 - i_1)}{\mathrm{PV} + \mathrm{NV}}$$

where i_r is the IRR, PV is the positive NPV (at the lower discount rate i_1), and NV is the negative NPV (at the higher discount rate i_2).

The absolute values of both PV and NV are used in the above formula. It should be noted that i_1 and i_2 should not differ by more than one or two percentage points (absolute). 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.

For the total capital invested the NPV equals $3,801,000 at a 12 per cent discount rate (for the example shown in schedule X-9/1). In order to find the IRR, several discount rates greater than 12 per cent are tried until the NPV is approximately zero. The NPVs at discount rates of 18 per cent and 20 per cent are shown in table 2.[115]

Table 2. Example of cash flow discounting

Year	Annual net cash flow (thousand dollars)	Discount factor at 18 per cent	NPV (thousand dollars)	Discount factor at 20 per cent	NPV (thousand dollars)
1	(3 291)	1.000	(3 291)	1.000	(3 291)
2	(5 127)	0.847	(4 343)	0.833	(4 271)
3	(88)	0.718	(63)	0.694	(61)
4	1 722	0.609	1 049	0.579	997
5	2 700	0.516	1 393	0.482	1 301
6	3 343	0.437	1 461	0.402	1 344
7	2 259	0.370	836	0.335	757
8	1 208	0.314	339	0.279	337
9	2 192	0.266	583	0.233	511
10	2 170	0.225	488	0.194	421
11	2 170	0.191	414	0.162	352
12	1 995	0.162	323	0.135	269
13	1 805	0.137	247	0.112	202
14	1 805	0.116	209	0.093	168
15	1 805	0.099	177	0.078	141
16	1 805	0.084	152	0.065	117
17	1 805	0.071	128	0.054	97
18	2 723	0.060	163	0.045	123
Accumulated total	—	—	265	—	(486)

Note: Figures in parantheses are negative.

[115] The IRR is sensitive to the length of the cash flow array (planning horizon). For example, if the cash flow is discounted for 16 years only, the IRR would be approximately 18 per cent, and less if a shorter planning horizon is chosen.

Table 2 shows that, discounted at 18 per cent, the net cash flow is still positive, but it becomes negative at 20 per cent. Consequently, the IRR must lie between 18 and 20 per cent. For practical purposes this would be sufficiently close to be able to calculate the exact IRR using the formula or a graphical interpolation.

Interpretation of the internal rate of return

The IRR may be interpreted as the annual net cash return (gain or yield in financial terms) produced on capital outstanding per period, or understood, in other words, as the highest net-of-tax annuity rate (annual debt service rate) at which the project could raise funds, provided the annual net cash flows are rather constant.[116]

When analysing the equations for the computation of the NPV of a series of annual cash flows CF_n, it can easily be shown that the same NPV may be obtained for different cash flow arrays, and similarly, for investment projects with completely different cash flow structures, the same IRR may be computed (see table 3). In addition, the value computed for the NPV depends also on the lengths of the cash flow array (that is, the planning horizon adopted as a criterion for the investment decision). The IRR or NPV should therefore never be used as the only decision criterion, and the financial evaluation of investment projects should always include a critical analysis of the structure and timing of discounted cash flows.

Table 3. Comparison of project alternatives

(Thousands of dollars)

	Discounted annual net cash flow									
Invested capital	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*NPV*	*Rate of discount or IRR (per cent)*
					Project A					
(950)	150	170	190	210	230	250	270	375	895	—
(950)	130	129	125	120	114	108	102	122	—	15
(950)	134	136	135	134	130	127	152	152	120	12
(190)[a]	34	34	34	33	32	—	—	—	(17)	12[b]
					Project B					
(780)	166	180	190	200	200	200	200	—	556	—
(780)	144	136	125	115	99	86	75	—	—	15
(780)	148	144	135	127	113	101	91	—	79	12
(156)[a]	37	36	34	32	28	—	—	—	9	12[b]

Note: Figures in parentheses are negative.

[a] Assuming 20 per cent equity participation and a 25 per cent share in net cash flows.

[b] Assuming investor's opportunity costs of capital at same rate as for total project.

[116] When the assets of a project sufficiently cover all liabilities at the end of the discounting period, the IRR would only then correspond to the highest net-of-tax interest rate, provided that the firm has the option to repay its obligations at will.

The investment proposal may be accepted if the IRR is greater than the cut-off rate (the cost of capital plus any margin for risk), which is the lowest acceptable interest rate for the invested capital.[117]

If several projects or alternatives are being compared, it is not necessarily the project with the highest IRR which should be selected, provided the IRR is greater than the cut-off rate for at least two of the projects or alternatives. In this case, known as the ranking problem and the problem of mutually exclusive investment projects, the two discussed discounting methods may lead to contradictory results.[117]

The ranking problem

It has been shown above that different cash flow arrays can produce an identical IRR, and it is also possible that a project with a lower IRR (still above the cut-off rate, however) should be given preference to a project with a higher IRR but showing an undesirable cash flow structure. Furthermore, projects may be ranked differently if the NPV method is applied. Figure XXX below illustrates the problem.

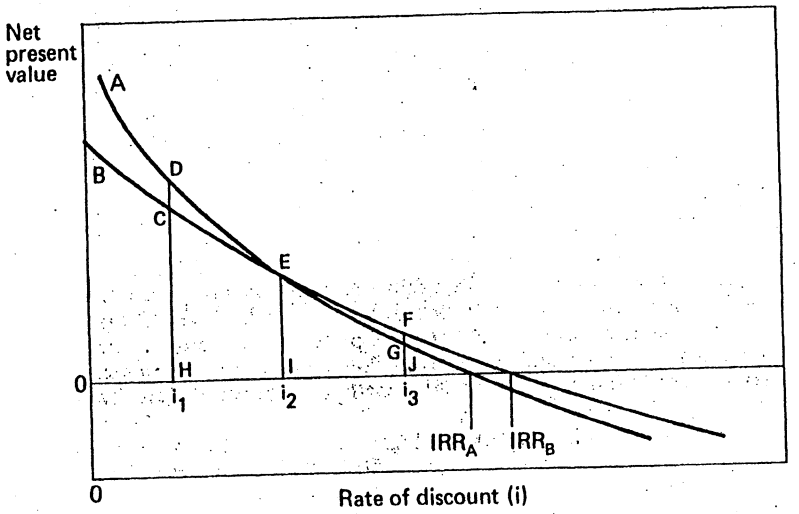
The IRR of project B (IRR_B) is higher than for project A (IRR_A), and for any rate of discount between i_2 and the IRR, the NPV is higher for project B than for project A. If the cut-off rate is below i_2, then both projects would be still acceptable from the profitability point of view. In this case, however, project A would be given priority if the NPV dominates project selection. The rate of discount for which the NPVs of both projects are identical is called the crossover rate (i_2). Under the rather theoretical conditions of completely identical project risks, identical project life and a comparable amount of investment, the project earning the higher yield would normally be ranked first. Since these assumptions would rarely apply in real life, the investors' evaluation of the different project risks and of possible risk minimization strategies would finally determine the investment decision.

Mutually exclusive projects

For the reasons explained above the IRR method should also be applied with care in the case of two or more mutually exclusive projects. Projects are mutually exclusive if the acceptance of one project means the rejection of the other. This situation is typical, for example, if only one site is available to the

[117] The IRR should be applied with care 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 rates of discount. In this case, there would be more than one solution for the IRR (a polynomial equation has as many solutions as there are changes in the sign of the cash flows series, although most likely not all solutions would be real), and the IRR method may produce meaningless results. To overcome this deficiency, the adjustment of the cash flows in accordance with the yield method and the following procedure has been recommended. The point is determined from which the future cash flows—discounted at the yield rate—are negative. These cash flows are then discounted at the normal cost of capital to bring them back in time to the point at which they are largely absorbed by the preceding positive cash flows. A revised yield calculation is then performed on the cash flows modified in this way. This method is explained and justified in detail in A. J. Merrett and A. Sykes, *The Finance and Analysis of Capital Projects* (London, Longman, 1974).

Figure XXX. NPV method and ranking problem



investors, or if they have a choice between extending an existing plant or establishing additional but smaller production facilities at a distant location (total capacity being limited by total demand). This problem is not a question of accepting or rejecting a project, but of determining which of two feasible alternatives should be chosen. Figure XXX can again be used to illustrate the problem.

When applying the IRR criterion project B would be chosen because the value of the IRR is greater for project B than for project A. Using the NPV as a selection criterion, the solution depends on the rate of discount applied. In figure XXX, for example, if the opportunity cost of capital corresponds to an interest rate i_2, both projects would show an identical NPV ($\overline{IE}$) for this rate of discount. In case the opportunity cost of capital is lower, project A may be chosen because of the higher NPV ($\overline{HD}$). If the discounting rate is higher than i_2 (as is the case with i_3) the choice would probably be in favour of project B, owing to its higher NPV ($\overline{JF}$). The application of the IRR method would also lead to the selection of project B.

Of the three appraisal methods discussed above, the NPV allows the evaluation of the expected accumulated net gains of an investment discounted to the present time. The NPVR shows the accumulated net gain as generated by one unit of capital invested, while the IRR indicates the net return (gain) expressed as a profitabilty rate per year, but does not allow any direct conclusion to be drawn with regard to the accumulated gains. Furthermore, all three methods have in common that there is no direct assessment of the distribution of cash inflows and outflows over the planning horizon (increasing, decreasing, constant or fluctuating net cash flows). Therefore, when applying these methods, the financial objectives and decision criteria of the investors

(and financing institutions) with regard to amortization periods, risk acceptance etc. must be observed. This may be especially important in cases where one method would not produce a clear indication of which project alternative to choose. For example (see table 3), suppose there are two projects A and B with the same IRR, as follows:

Project	*IRR (per cent)*	*NPV at 12 per cent*
A	15	120
B	15	79

Since both projects have the same IRR of 15 per cent, an investor would be indifferent to the choice of either if the IRR method alone is applied. However, project A would produce a higher NPV at 12 per cent, and is also better if the NPVR is taken as an efficiency measure (0.126 for A and 0.101 for B). Project A should therefore be recommended for implementation, provided the projects are similar with regard to other investment criteria (risk, markets, total funds available etc.). On the other hand, an investor sharing, for example, 20 per cent of the initial investment and—as a simplification—25 per cent of the annual net cash flows would prefer project B, if the aim is to recover the investment at 12 per cent within five years.

The discounted net cash return on equity (NPV and IRR on equity) is computed by deducting from the net cash flows of the entire project the financial cash flows related to loans (outside financing), that is, the debt service (interest and amortization of the loan) as well as the repayment of any debt balance outstanding at the end of the planning period (see schedule X-9/2).

Discounted return on equity capital

The concept of cash flow discounting can also be applied to determine the NPV of an investment from the point of view of the shareholders. Two positions may be distinguished:

- The cash returns on equity as represented by annual payments of dividends are discounted at the opportunity cost of capital of the shareholders. The NPV for shareholders is obtained by deducting the total of discounted paid-in equity from the accumulated discounted dividend payments. If this NPV is positive for the planning period of shareholders, the investment would be able to pay the required returns. The IRR for this cash flow shows the profitability of equity capital, as represented by dividends paid.
- The cash surpluses generated annually, that is, after debt service and corporate tax, but before payment of dividends, is discounted. The discounted net cash flow from the point of view of the shareholders is obtained by deducting the total discounted equity payments from the accumulated discounted cash surpluses (that is, the accumulated discounted return on equity capital). The computation of this discounted return on equity[118] is demonstrated in schedule X-9/2.

[118]The discounted return on equity corresponds to the "present value for a project with outside financing", as described in schedule X-14 in the first edition of this *Manual*.

Payback period

The payback, also called pay-off period, is defined as the period required to recover the original investment outlay through the accumulated net cash flows earned by the project. It is important to note that the cash flows of a project are used to calculate the payback. It would be entirely wrong to compute the payback on the basis of the accumulated net profit after tax. Even when accumulated interest and depreciation are added back, there is the danger that investments for replacement, as usually necessary for continuing the operation of the plant, will not be included in the calculations.

The payback method[119] is mainly criticized for its concentration on the initial phase of the production period, without taking into account, for the investment decision, the performance of the plant after the payback period. This critical argument would be justified if an investment decision is entirely based on the payback method. However, if applied for assessing risk and liquidity, and if used in combination with profitability measures as discussed in this *Manual*, the payback can be a very practical and useful instrument.

Interpretation of the payback

Risk. The payback is useful if a new project would have to expect rapid technological change in the industrial sector, in particular when the technological life cycle is much shorter than the technical life cycle of the project or its main components. Another typical situation would be that the entry barriers (see chapter III) are relatively low in a highly competitive market. In such business environments the investors may choose a project strategy to recover the investment outlay, including a certain minimum interest within a period related to the phase of the life cycle of the industrial sector as well as to the expected technology and product life. The decision makers would then be able to determine the payback points first for the recovery of all investment outlays (conventional payback), and secondly for the recovery of all investment outlays including a minimum profitability (the NPV at the required discounting rate would be equal to zero for a payback period of n years, thus breaking even at this point, and then earning additional interest in the following years).

The experienced financial analyst can use this information to determine the sensitivity to cost and sales price variations in each of these periods. After allowing for debt service, the net cash generation capacity (self-financing capacity) may be computed for the payback period—indicating the capacity of the project to finance the new investments probably needed to cope with the development of the industrial sector (innovation and modernization investments, rationalization etc.).

Approximate measure of profitability. A short payback period corresponds on average to a high annual net cash flow. The reciprocal of the payback period can therefore be used as an appropriate measure of the profitability of an investment.[120] A long payback period would also imply that the ratio between the annual net cash flows and the initial investment is relatively poor. If at the same time the output-capital ratio (expressing the value of the annual output produced by investing one unit of capital) is also low, the project is likely to be unattractive to investors and financiers.

[119]While the payback is usually interpreted as a break-even point at which accumulated net cash flows become positive, the method is sometimes adapted, in so far as those assets which could be converted into cash easily, such as working capital, are added to the accumulated net cash flows, thus shortening the payback period. This method is not recommended, because it would mean assuming that the plant would cease operations at the moment the initial investment outlay is paid back, no longer being able to earn the necessary return (interest) on capital.

Simple or annual rate of return

The simple rate of return method relies on the operational accounts.[121] It is defined as the ratio of the annual net profit on capital. This ratio is often computed only for one year, generally a year of full production. However, it may also be calculated for various degrees of capacity utilization (sensitivity analysis) or for different years during the start-up phase. For investment appraisal two rates of return—on total capital employed (total investment) and on equity capital—are usually of interest.

The (annual) rate of return on total capital invested R_j is

$$R_j \text{ (per cent)} = \frac{NP + I}{K} \times 100$$

and the (annual) rate of return on equity capital paid RE is

$$RE_j \text{ (per cent)} = \frac{NP}{Q} \times 100$$

where NP is the net profit (after depreciation, interest charges and taxes), I the interest, K the total investment costs (fixed assets and working capital, [122] and Q the equity capital.

The retained profits (reserves accumulated in a firm) should, however, be included when calculating the efficiency of the investor's financial share. The sum of equity capital and retained profits (PR) is also known as the net worth of a company. For the computation of the return on net worth, Q in the above formula would have to be replaced by $Q + PR$. A shareholder, if mainly interested in the dividends paid, would evaluate the profitability of involvement by comparing the annual (average) dividend received net of tax with capital investment.

In conclusion, the value of the simple rate of return depends on how the terms profit and capital are defined. The ratios used should therefore be

[120]The approximation is relatively good if the investment phase is short, the annual net cash flows are fairly constant and the project life exceeds 10 to 15 years. In case of a perpetual net cash flow, the reciprocal of the payback exactly equals the IRR.

[121]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 in terms of profitability, so as to be able to assess the project under prevailing conditions. The net income statement (schedule X-10) 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 the gross profit to obtain the taxable income.

[122]Sometimes the value of total long-term liabilities as shown in the balance sheet is used for the computation. For example, in the case of the rehabilitation of existing firms, the balance sheet (after revaluation) may be the only source of information available.

explained before a final judgement is made. Using the figures of the example presented in annex A, the rates of return shown in table 4 could also be considered for year 6, the first year of full capacity, and for year 8, after the expiry of tax holidays:

Table 4. Example of different rates of return

	Year 6	*Year 8*
	(thousand national currency units)	
Net profit plus interest	2 720	1 428
Total investment outlay	8 720	8 720
Rate of return (per cent)	31.2	16.4
Net profit plus interest and depreciation	3 500	2 208
Total investment outlay	8 720	8 720
Rate of return (per cent)	40.1	25.3
Net profit	2 381	1 292
Total equity paid	3 500	3 500
Return on equity (per cent)	68.0	36.9
Net profit	2 381	1 292
Total net worth	4 830	7 192
Return on total net worth (per cent)	49.3	18.0

The simple rate of return method has a few serious disadvantages. For example, which year is the normal (representative) year to be taken as a 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 (tax holidays, for instance).

In years in which a tax concession is to be applied, the net profit will obviously 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 X-10. The difficulty of choosing the "normal" year is revealed by the varying annual rates of return shown in table 5.[123]

Even after this calculation, however, the main shortcoming of the simple rate of return remains: it does not take into account the time value of the equity payments and of the annual returns on equity. Furthermore, the annual return on equity is lower than the net cash flow remaining after debt service. Thus, unless the annual depreciation is reinvested without delay, the rate-of-return method always underestimates the financial gains (yield) of an investment as expressed by means of the IRR. Income obtained in an early period is

[123]The computation of an average rate of return (accumulated net profits divided by the number of years) would solve the problem of selecting a representative year. However, the problem of the time value of money would still remain unsolved. The rate of return method is often used when alternative technologies are compared by determining the total annual production costs assuming full capacity utilization. The margin between sales prices and costs of products sold (production costs plus marketing costs) is then related to the respective investment costs and the alternative with the higher rate of return is given priority, ignoring all other factors relevant for investment appraisal, as discussed in this *Manual*.

Table 5. Annual rate of return on equity capital

	Year of project								
	Construction			*Start-up and full capacity*					
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Item	*(thousand national currency units)*								
Net profit after tax	—	—	(434)	712	1 682	2 381	1 241	1 292	1 308
Equity capital	—	—	3 500	3 500	3 500	3 500	3 500	3 500	3 500
Rate of return (per cent)	—	—	—	20.3	48.1	68.0	35.5	36.9	37.4
Net worth	—	—	3 500	3 066	3 778	4 830	6 581	7 192	7 869
Return on net worth (per cent)	—	—	—	23.2	44.5	49.3	18.9	18.0	16.6

Note: Figure in parentheses is negative.

obviously 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 two alternatives shown in table 6 be selected, assuming both had the same total investment costs?

Table 6. Net profit of project alternatives

	Net profit per year after taxes					
	1	*2*	*3*	*4*	*5*	
Item	*(thousand national currency units)*					*Total*
Net profit, project A	50	60	120	160	200	590
Net profit, project B	170	120	90	80	70	530

In such a case it is not sufficient to rely on an annual calculation of the profitability. It is necessary instead 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 total investment costs when more or less equal gross profits are expected throughout the lifetime 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, and that such rules make it difficult to evaluate the real benefits of the projects.

F. Project financing

The allocation of financial resources to a project constitutes an obvious and basic prerequisite for investment decisions, for project formulation and pre-investment analysis, and for determining the cost of capital (without which the decision to accept or reject a project on the basis of the NPV and IRR cannot be made). 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 the required capital outlay. 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 iron ore deposits but with very limited financial resources. Such resource constraints may limit the consideration of certain projects or restrict project capacity to the minimum economic levels. Financial constraints could exist at all levels of project sponsorship and 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 estimates of the costs of a developed site, buildings and civil works, technology and equipment.

Defining the financial requirements of a project at the operational stage in terms of working capital is equally necessary, although too often neglected. 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 cover a period of time and be reflected in a cash flow analysis. Unless both estimates are available and unless the available resources are sufficient to meet the fund requirements, 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 financing decision and 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, production costs and marketing costs were underestimated, or sales and income were overestimated.

Sources of finance

Equity

A generally applied 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. However, as explained before, the minimum net working capital requirements should be financed from long-term capital. Within this framework various permutations are possible and need to be assessed.

In certain projects, equity 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 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- 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 debt service obligations and the higher the gross profit before taxation. The higher the proportion of loan finance, the higher the interest payable on 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: ordinary shares (common shares in United States terminology); and preference shares. Preference shares usually carry a dividend at least partly independent from profit, without, or with only limited, voting rights. Preference shares can be convertible to common shares, they can be cumulative or non-cumulative in terms of dividends, or they 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. There is currently a trend towards more than one class of common shares, involving greater voting rights combined with lower dividends and receipts and fewer privileges, or vice versa.

Loan financing

Since it is relatively easy for a sound project 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 following forms: short- and medium-term borrowings from commercial banks for working capital purposes, or supplier credits of various forms; and long-term borrowings preferably from national or international development finance 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 to be financed from other sources, preferably 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 case presented in annex A to this *Manual*, 20 per cent of the total liabilities are financed from equity funds. As shown in schedule X-7/2, the loan capital is repaid during five years starting in the second year of operation. The change in the ratio of net worth to debt is possible because the project generates a sufficient cash surplus (over interest payments) to repay the debt. Other short-term funds are trade credits (creditors or accounts payable), bills of exchange, deferred tax payments and wages payable.

Long-term loans. Loan financing is usually subject to 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 for 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 accumulated reserves (retained profits and depreciation).

Supplier credits. 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 to 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.

Example

Cost of the project and means of finance. In table 7, part A, the total initial investment outlay (schedule X-6/1) amounts to NCU 8.72 million (including interest accrued during construction). Financing of the total initial investment outlay is shown in part B.

Leasing

Instead of borrowing financial means it is sometimes possible to lease plant equipment or even complete production units, in other words, productive assets are borrowed. Leasing, as the borrowing of productive assets is called, requires usually a down payment and the payment of an annual rent, the leasing fee. These assets are, however, contained in the balance sheet of the lessor and not in the balance sheet of the borrowing firm, the lessee.[124] Therefore, leasing essentially represents a form of off-balance sheet financing. This aspect may be important in situations in which a firm prefers to maintain

[124] In United States accounting, financial leases are included directly in the balance sheet.

Table 7. Example of investment outlay and structure of finance

Item	*Funds (thousand national currency units)*
A. Investment outlay	
Fixed-investment costs	
Land	80
Buildings	2 900
Equipment	4 000
Other	730
Total initial fixed investment	7 710
Working capital (including bank borrowing)	400
Pre-production capital expenditures[a]	610
Total initial investment costs	8 720
B. Structure of investment	
Source	
Equity capital	3 500
Supplier credit	2 600
Commercial credit (including NCU 200 for start-up year)	3 000
Total long-term capital	9 100
Surplus (long-term capital) during construction phase	380
Start-up year	
Short-term finance (bank overdraft)	400
Cash deficit (start-up year)	(10)
Financing of net increase in assets (start-up year)	(600)
Finance available	170

Note: Figures in parentheses are negative.

[a] Including interest of NCU 302,000 accrued during construction.

a certain debt-equity ratio or is not in a position to further increase its debentures.

Provided that both the lessor and lessee fall under the same tax regulations, purchase equipment under the same conditions and enjoy identical financing conditions, the accumulated leasing costs should not differ significantly from the costs of purchasing and financing of the purchase of the same assets. Only when lessors enjoy certain advantages, owing, for example, to their position in the capital-goods or financial markets (credit rating), may the leasing costs be lower for the lessee than total costs in case the items are purchased.

In the case of investment projects the problem is basically to decide which alternative should be preferred, leasing or purchasing of capital assets. For the evaluation of the two financing alternatives the discounted cash flow method should be applied. The initial down payment, the current leasing fees and any additional payments[125] under the leasing agreement are then part of the cash outflows, replacing all initial investment costs computed for the purchasing alternative. Since the duration of leasing contracts is in general much shorter

[125] If the lessor is responsible for maintenance and insurance, as is usually the case with an operating leasing contract, the leasing payments include these costs. In the case of financial leasing, maintenance and insurance are usually the responsibility of the lessee, and the corresponding costs must be included in the production cost estimates.

than the technical and economic life of an asset, it is necessary to include the residual value (cash inflow) of the leased asset when comparing leasing with loan financing. The inflow for the lessee would usually not be the book value but either the book value or the market value (minus the lessor's cost of selling the used items), whichever is lower.[126]

If the investor has a choice between loan and leasing financing,[127] he would compare the discounted cash flow for both cash flow arrays to determine which alternative would bring the higher yield (IRR, NPV), bearing in mind, however, the liquidity aspect and risks involved. If tax regulations have different effects on leasing financing, these tax impacts need to be included in the cash flow discounting.

Funds to finance leases may be obtained from independent leasing companies (service or financing leasing companies, lease brokers), banks, insurance companies, pension funds and industrial development agencies. Leasing financing of investment projects in developing countries has been introduced by international financing institutions such as the International Finance Corporation, and may become an interesting financing alternative, especially in cases where leasing has certain advantages over loan financing.

Cost of capital

Capital for financing of investments may be obtained from private and institutional resources (banks, insurance companies, funds etc.). However, behind these institutions stand again private investors. In all cases private savings are therefore the ultimate source of capital.[128] Basically, all savings are made to provide for future needs, but this alone would not be an incentive to invest or lend money to an investor, because lending would mean a long-, medium- or short-term commitment reducing the liquidity of the lender, and would also imply uncertainty concerning the full return of the funds lent. To obtain finance, an investor must therefore pay a charge—the cost of capital or of finance—for the funds lent. This charge comprises an interest rate, usually expressed as a percentage per annum, as well as certain fixed charges (commitment fee, charge on capital not drawn, commissions etc.). Interest is usually computed for the outstanding balance of the corresponding liabilities of a firm, for example, interest payable on a bank loan, dividends payable on equity capital (such as preference shares) and interest payable on a current account.

For the investor the cost of capital is determined by the conditions that can be obtained for the project on the capital market. For the amount stemming from own funds (savings) investors should charge their opportunity cost of capital, that is, the interest they would obtain if they invested in another feasible venture (provided such alternatives exist).

[126]If the market value is greater than the book value, usually the margin is split between the lessor and the lessee, at a rate determined in the contract. The lessee may also have the option to purchase the equipment from the lessor at the market price or book value.

[127]Apart from the above described situations, when the financing policy of a firm requires leasing financing, or when the investor cannot raise the necessary funds on the capital market, or when the firm has exceptionally high marginal capital costs, there is little justification for a company to undertake lease commitments on plant and machinery or any assets.

[128]Similarly, most public sources of finance stem from individual savings (individual income which is not or cannot be consumed).

Impact of financing cost on financing policies

The cost of equity capital for the project or firm is basically determined by the minimum accumulated return,[129] expressed as the NPV of the future income of the shareholders, and the minimum annual rate of return, expressed as the rate of return on equity capital. The acceptable minimum rates depend on the opportunity cost of capital, the expected business risks, and the valuation of any gains or benefits obtained in addition to the payment of dividends. The purpose of the concept of equity is to give the management of the firm more flexibility with regard to the best use of the annual net profits in the interest of the shareholders or owners and the firm.

The debt service (interest and amortization) is fixed and legally binding for the firm, and has to be paid even when the generation of cash is insufficient in certain years, whereas payment of dividends is in general linked to a sufficiently high profit and cash generation. The determination of the right (optimal) capital mix is therefore essential when a financing strategy is designed for an investment project.[130]

Different financing institutions impose different financing conditions. A government guarantee is even sometimes required for multilateral financing. It is important that the enterprise is not obliged to start with loan amortization before the start-up of operations. Very often financial costs are capitalized during the implementation period, and debt service starts when sufficient cash is generated through the operation of the new production facilities.

It may be possible to combine relatively short-term supplier credits (for instance, a three-year grace period and a four-year amortization period) with longer-term financing from multilateral banks. In this case, supplier credits could be disbursed last and amortized first, while leaving multilateral financing for early disbursement and late amortization. Thus, generally suitable loan terms can be obtained.

In new as well as expansion projects, the kind of debt service will also have to be decided on. The following two systems are possible: periodical debt service with equal amortization instalments (constant principal) plus gradually decreasing interest; and periodical debt service with constant payments (annuities), in which case the sum of the declining amortization and increasing interest payments is constant over the amortization period of the loan. The first system requires less total financing cost but a fairly substantial initial debt service during the start-up of the project. The second system, although it has a higher total financing cost, is preferable 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

[129]For an investor, the return net of all taxes will of course be taken into account when deciding whether to finance or co-finance an investment project.

[130]A rule applied by consultants suggests that the total equity capital should be able to cover possible losses over a five-year period (assuming the worst case).

full implications are adequately highlighted. In some cases, they insist that the feasibility study should be prepared by recognized independent consultants or that management responsibilities for certain major projects be 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 sale 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 the anticipated profitability and on availability of funds for this purpose and of alternative sources of capital participation, all under the prevailing regulations on financing and taxation of income from capital investment.

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 share-holding. 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.

Technical management may sometimes have to be entrusted to a foreign company, usually a licensor, in which case foreign capital participation may be desirable. The extent of foreign participation would, however, have to be considered on a case-by-case basis and be determined within the framework of national policies by such factors as the nature and magnitude of investment outlay, and the 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 the policy and general implications of foreign capital participation can be elaborated.

Financing institutions

Most developing countries have established development 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.

Various international institutions and funding facilities exist for the financing of industries in developing countries. Some of these, such as the World Bank, including the International Development Association as well as the International Finance Corporation, the Special Fund of the Organization of Petroleum Exporting Countries, the Kuwait Fund for Arab Economic and Social Development, and the International Investment Bank of the Council for Mutual Economic Assistance, operate on a world-wide scale. Even though many of these funds will be used primarily for infrastructure and agricultural development 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. 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 Cooperation and Development and, in some oil-exporting countries, including Kuwait, the United Arab Emirates and Venezuela.

In this context, the role of the export financing and guaranteeing agencies must be mentioned.[131] The primary task of such agencies is to provide financial support of exports from industrialized countries; only as a secondary task are they designed to help developing countries. Commercial banks, including those in the Eurocurrency market and the currency markets of the Association of South-East Asian Nations, are becoming increasingly active in industrial development financing. However, they lend to only a few 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.

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

[131] Supplier credit guarantees are given, for example, by *Compagnie française d'assurance pour le commerce extérieur* (France), *Compañia española de Seguros de Crédito a la Exportación* (Spain), Export Credits Guarantee Department (United Kingdom), Export Development Corporation (Canada), *Exportkreditnamnden* (Sweden), Export-Import Bank (Japan), Export-Import Bank (United States), Ministry of International Trade and Industry (Japan), Nederland se Crediet Maatschappij (Netherlands), *Office national du ducroire* (Belgium) and *Sezione Speciale per l'Assicurazione Crediti Esportazioni* (Italy).

relatively small share of the total equity required. The situation varies widely, but in some countries, the initial portion of equity to be raised by sponsors of industrial projects can be as low as 10-25 per cent of the total finance 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 the 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 X-7/1. Schedule X-7/2 shows the flow of financial resources and schedule X-8/2 the utilization of these funds during construction, start-up and full capacity operation.

G. Financial and efficiency ratios

The figures appearing in the balance sheet, the net income statement and the cash flow tables convey a considerable amount of information in terms of their absolute values. In financial analysis it is usual to refer to several well-known ratios that facilitate the analysis and specially the comparison of projects and alternatives.[132]

The ratios discussed below are those most frequently used. Other ratios may be applied as well. Whichever choice is made by the project evaluator, the ratios should not be applied automatically. The computation of such ratios alone would little serve the purpose of project appraisal, if not accompanied by an interpretation of their meaning. Analysts and decision makers should also bear in mind that ratios may not automatically be regarded as good or bad, but have to be evaluated in the light of the characteristics of the corresponding industry, the type and scope of the project and the country of investment.

Financial ratios

Long-term debt-equity ratio and long-term debt-net-worth ratio

The long-term debt-equity ratio is an indicator of the financial project risk for both the equity and the loan capital. Considering that the debt service represents a legally binding commitment of a firm, the financial risk is higher for the firm as well as the bank or financing institution, the higher the debt in relation to equity capital. The ratio also indicates the extent to which the outstanding debt balance is covered by the total assets of a firm in the event of liquidation of the project before it goes into operation. In case of an existing firm the earned surplus and reserves (retained profits) must be added to the equity capital to reflect the true ratio between the shareholders' interest in the firm and the long-term debt. This sum of equity and reserves is known as the net worth of the firm or the shareholders' interest. Financial prudence sets certain norms for this ratio.

Usually, the ratio is expressed as a fraction, for example, debt to net worth is 4:1 or 80:20, meaning that for this example the total long-term debt is four

[132]The financial and efficiency ratios, if properly interpreted, are valuable analytical tools, especially for the comparison of projects and in rehabilitation studies.

times the net worth or one fifth or 20 per cent of the total liabilities. In a number of projects of large or medium size, an ideal debt-equity 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 is also a measure of *investor leverage.* The smaller the equity capital, the higher the income per unit share. From the profitability point of view, 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. However, since the financial risk is growing with an increasing debt balance, it is also in the interest of the shareholders to establish a sound balance between risk and loan 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.

Current ratio or current-assets-to-current-liabilities ratio

The current ratio is a liquidity measure computed by dividing current assets by current liabilities. This ratio measures the short-term solvency and is a very rough indicator of the ability of a company 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 possibility, 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 caution.

Current ratio	2.0-1.2
Quick ratio	1.2-1.0

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[133] to debt service

[133]The annual cash generation may be obtained from the cash flow schedule for financial planning (schedule X-8), or may be derived from the figures contained in the balance sheet and net income statement (net profit after tax plus interest and depreciation plus net increase of liabilities (equity or debt), minus new investments.

(interest plus repayment of principal). Ratios of 1.5-3.0 range between acceptable and satisfactory. This ratio often increases considerably if the long-term debt service gradually decreases and no new borrowing is projected.

Debtors—creditors ratio

The ratio between debtors (accounts receivable) and creditors (accounts payable), if determined for a number of consecutive periods, helps to identify overtrading, as in the case of rehabilitation projects. Overtrading, which is often found in developing countries, is a situation where too high a level of production is maintained with insufficient cash resources. The effects of overtrading can be disastrous for a company, and usually lead to a complete failure of a business. Overtrading is in most cases the result of rising prices (inflation), increasing stocks, heavy taxation, depletion of working capital or overexpansion of production in relation to the market. The cure for overtrading is the provision of additional (long-term) funds, increasing marketing efforts to reduce stocks, and the reduction of operations.

The following indicators help to detect overtrading in the balance sheet:

- A progressive fall of the debtors—creditors ratio;
- There is an increase in the creditor accounts, or in the stocks and work-in-progress, or in the total debt (loan), without a corresponding increase of sales (turnover);
- 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 the other is mortgaged.

Efficiency ratios

The operational performance and profitability of an investment is measured by relating the financial net benefits—expressed as net cash flows, profits before and after corporate tax or profits plus interest payable on debt—to the corresponding capital investments. For the comparison of projects the *profitability of sales* is sometimes computed, where gross or net profits are expressed as a percentage of annual sales. The profitability figures of both investment and sales are mathematically related to each other through the output-capital ratio (annual sales divided by total capital investment).

Output-capital ratio

The efficiency of an investment may also be expressed in terms of the annual output produced by investing one unit of capital. Although this ratio is used more in economic analysis, it can be a very useful yardstick when assessing investment ideas at an early stage (opportunity study and pre-feasibility study phase of a project).

Net present value ratio

When the present value of the accumulated net benefits of a project (that is the annual output of the project net of annual operating expenditures and income taxes, discounted and accumulated over the planning horizon) is related to the present value of the total capital invested, the NPVR, which has already been described in this chapter, is obtained.

Relation between personnel employed and investment

The relation between total initial investment and the number of workers and staff employed is used when comparing alternative technologies. However, when the problem is to choose between alternatives with different labour intensities, it may be advisable to compute the ratio between investment and total costs of personnel. Similarly, the efficiency of personnel employed may be computed by determining the value of output produced by one unit of personnel costs. These ratios, including the capital-output ratio, complement the cash flow and financial analysis in so far as additional information may be obtained with regard to possible risks, suitable investment strategies and positioning of a project in a competitive environment.[134]

Turnover of inventories

The rate of turnover of products in stock is a measure of the marketing capabilities of management. It is specific to particular industries, but differs from country to country, as it depends also on the overall business environment. However, provided that comparable project data are available from a data bank, these ratios may serve for financial planning as well as for the final project appraisal. In general, the faster the turnover, the better for the finance of the company.

H. Financial evaluation under conditions of uncertainty

Forecasts of the future business environment and of demand, production and sales can be only an approximation, because it is not possible, on the basis of past data, to determine more than a past trend, which may be extrapolated into an uncertain future. Of primary importance in the appraisal of an investment project is the reliability of the data assessed and of the project design[135] (marketing concept and sales programme, selection of project inputs and location, choice of technology, engineering design, management, personnel

[134]The estimate of the IRR and NPV obtained by competitors is usually not possible on the basis of published data (balance and net income statement). The various ratios may however be estimated with sufficient approximation. Ratios may also be obtained from research institutions and industrial associations for various industries.

[135]Risks may be categorized as follows: risk from undertaking insufficient numbers of similar projects; risk from misinterpretation of data; risk from bias in the data and in its assessment; risk from a changing external economic environment invalidating much of the usefulness of past experience; and risk from errors of analysis (see A. J. Merrett and A. Sykes, op. cit., p. 143).

and organization, as well as the implementation of the project). To minimize uncertainty with regard to the reliability of project data and design, the financial analyst should check whether the feasibility study covers all aspects relevant to the investment and financing decisions. Then the study must indicate all sources of data, and any assumptions made should be explained and justified.[136] Only when the feasibility study fulfils these basic requirements should the analysis of the business risks begin. The most common reasons for uncertainty, however, are inflation, changes in technology, false estimates of the rated capacity, and the length of the construction and running-in periods. The problem of uncertainty is aggravated by the phasing of a project over time. Investments also underlie many developments and changes in the political, social, commercial and business environment, as well as changes in technology, productivity and prices.

To cope with the risks involved in any significant investment, management has basically the following two options with regard to a policy on risks: to seek insurance against various risks identified for an investment project; to identify the possibilities for active risk control or *risk management.* The main instrument of the insurance strategy is to invest (finance) only when the expected returns are higher than the cost of capital plus the risk margin. This concept, however, can be successful only when the investor has an *investment portfolio,* in other words, when his risks are spread over a number of carefully selected investments. Practically, only large business groups and financing institutions have this possibility, while most of the owners of firms do not dispose of enough funds to invest in different projects.

The insurance strategy, which is based on an assessment of the probability of risks,[137] is a basic strategy for financing institutions. However, in a very dynamic business environment this concept cannot be satisfactory, and the debt burden accumulated by many developing countries may, to a large extent, be the result of focusing on the projected investment yields (expressed as the internal rate of return). The feasibility study should therefore identify possible strategies for risk control and design the project following the strategic orientation, as described in part one and elaborated further in chapter III of this *Manual.*

When deciding about the desirability of a project, all the elements of uncertainty have to be taken into account by evaluating, on the one hand, any foreseeable risks that could have significant impacts on its feasibility, and, on the other, the possible means of risk control. The allowance to be provided for such risks may have a decisive impact on the profitability of the project, and may, in the case of a marginal proposal, tip the balance against project implementation.

When the aspects of uncertainty are to be included in the financial evaluation, three variables in particular should be examined, namely sale revenues, costs of products sold 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

[136]For example, assumptions concerning estimates of production and investment costs, prices or the lifetime of the project may not always be correct, or the decision makers may evaluate a scenario differently.

[137]For example, the country risk is evaluated on the basis of the economic and political situation in the country, the total outstanding foreign debt in relation to the domestic product etc. A country risk may be insured through a government guaranty, possibly from an exporting country.

have a decisive influence on the profitability of a project, and that should be subjected to risk analysis. Sensitivity analysis is a proper instrument for identifying these critical variables and the extent to which they could affect the financial feasibility of a project.

Sensitivity analysis

With the help of sensitivity analysis it is possible to show how the net cash returns or the profitability of an investment alter with different values assigned to the variables needed for the computation (unit sales price, unit costs, sales volume etc.). 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 reduced at this stage by finding the optimistic and pessimistic alternatives, and thus determining the commercially most realistic combination of project inputs for the business environment (or scenario) favoured by the decision makers.

To determine the critical variables the structure of cash flows should be analysed first. The variables having the greatest share of cash inflows and outflows are then subject to variations of quantities or prices or both parameters at the same time. For example, usually a few products out of a product range generate most of the sales revenues, but this does not necessarily mean that these products also make the greatest contribution to the return or gross profits. The direct costing method should therefore be applied to identifying the variable margin generated by one unit of each product having a significant share of sales revenues. Similarly, those cost items need to be identified which, in case of prices or quantities deviating from the forecasts, would have a significant impact on the variable margin and the operating profit as well.[138]

This exercise can be performed by assigning values to the critical variables corresponding to reasonably pessimistic, normal and optimistic scenarios, and by the computation of the discounted cash flows (IRR or NPV) and any ratios etc. chosen as a yardstick for investment appraisal. With the help of sensitivity analysis it is possible to identify the most important project inputs, such as raw materials, labour and energy, and to determine any possibilities of input substitution, as well as the critical elements of the marketing concept.[139]

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 is dealt with below.

Break-even analysis

The purpose of break-even analysis is to determine the equilibrium point at which sales revenues equal the costs of products sold. When sales (and the

[138]Cost structure analysis, direct costing, and the computation of variable and operational margins is described above in sect. C of this chapter.

[139]When analysing the critical variables, it is important not only to estimate confidence levels, but also to determine the possible reasons for deviations from the projections. This analysis should include the determination of critical factors possibly affecting the defined critical variables, such as possible transport and supply problems for critical materials, possible price fluctuations for critical products and supplies caused by highly speculative, competitive or volatile markets etc.

corresponding production) are below this point, the firm is making a loss, and at the point where revenues equal costs, the firm is breaking even. Break-even analysis serves to compare the planned capacity utilization with the production volume below which a firm would make losses. 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 are equal. The sales revenues at the break-even point represent the break-even sales value, and the unit price of a product in this situation is the break-even sales price. If the production programme includes a variety of products, for any given break-even sales volume there would exist a variety of combinations of product prices, but no single break-even price.

Before calculating the break-even values, the following conditions and assumptions should be satisfied:

- Production and marketing costs are a function of the production or sales volume (for example, 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 costs vary in proportion to the volume of production, and consequently total production costs also change in proportion to the volume of production;
- The 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 sales prices and the quantity sold;
- The level of unit sales prices and variable and fixed operating costs remain constant, that is, the price elasticity of demand for inputs and outputs is zero;
- The break-even values are computed for one product; in case of a variety of products, the product mix, that is, the ratio between the quantities produced, should remain constant.

Since the above assumptions will not always hold in practice, the break-even point (capacity utilization) should also be subject to sensitivity analysis, assigning different fixed and variable costs as well as sales prices. For the interpretation of the results of break-even analysis, a graphical presentation (see figure XXXI) is very useful, because from the angle of the cost and sales curves, and the position of the equilibrium point in relation to total capacity, analysts can often identify potential weaknesses.

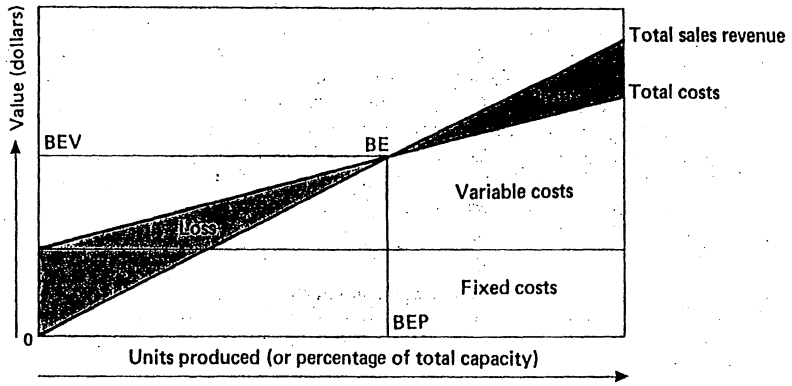
Algebraic determination of the break-even point

Break-even production is the number of units U necessary to produce and sell in order fully to cover the annual fixed costs C_f for a given unit sales price p_s and the variable unit costs c_v, or

$$(p_s - c_v)\,U = C_f$$

$$\text{or } U = \frac{C_f}{(p_s - c_v)}$$

Figure XXXI. Determination of the break-even conditions



Notes: All costs an sales are annual values.
BEV = Break-even value
BEP = Break-even production

In the above equation, the number of units U (or the rate of capacity utilization) is computed for given values of p_s, c_v and C_f. It is also possible to compute p_s, the break-even sales price for a given production volume and defined costs. In case of more than one product, for example, products A and B, the break-even sales value would be computed as follows:

$$(p_{sA} - c_{vA})U_A + (p_{sB} - c_{vB})U_B = C_{f(A+B)}$$

The break-even analysis may be carried out excluding and including costs of finance. In the latter case, the annual costs of finance need to be included in the fixed costs. Since the interest payable depends on the outstanding debt balance, the total annual fixed costs are usually not constant over the start-up and initial operating period. The break-even analysis should therefore be carried out for each year during this phase of the project.[140]

Probability analysis

The sensitivity analysis already described allows the identification of the most critical variables, in particular those which, if they deviate from the forecast, could affect the feasibility of the investment significantly. In real life not all variables are likely to deviate to the same extent and in the same direction, and deviations may occur at any time during the construction and operating phase of the investment. The methods offered by the probability analysis allow the inclusion of possible deviations in the financial evaluation and appraisal of an investment project.

[140]The same is true for the production and marketing costs, because various cost items may change as a result of extra costs arising during initial operation.

First of all, the investor would have to estimate the probability of a certain scenario materializing. For example, the possible reaction of competitors[141] could be to do nothing, to reduce sales prices, or to increase sales promotion activities. Each of these alternatives would require counter-strategies and affect sales revenues (quantities, prices) and costs. Each possible reaction of the competitors may be expected with a certain probability, as reflected by the following values assigned for different reactions: no reaction—0.1; price reduction—0.4; sales promotion measures—0.3; and price reduction and promotional measures—0.2. The simplest method is to assign to each possible alternative one profitability or yield measure (annual rate of return, IRR, NPV), and to multiply each measure by the corresponding probability factor, as in table 8.

Table 8. Calculation of weighted IRR

Alternative	*Probability*	*IRR*	*Weighted IRR*
No reaction	0.1	20.0	2.0
Price reduced	0.4	18.5	7.4
Promotion	0.3	19.0	5.7
Price reduction and promotional measures	0.2	17.5	3.5
Total	1.0	—	18.6

The weighted IRR, 18.6, given in table 8 in the example has a limited value for investment appraisal, because it does not imply that the investment would yield 18.6 on an average. However, it may be useful for ranking projects. What analysts can deduce from the above table is that there is a 4 out of 10 chance that the investment would yield 19 per cent or more, and a 60 per cent chance of earning between 17.5 and 18.5 per cent as a result of the reactions of competitors. Supposing an 18 per cent cut-off rate applied by the investors, the project could be rejected on the assumption of a ±0.5 per cent confidence level of the IRR (that is the IRR is expected to be between 17.5 and 18.5, with the probability of 0.6).

For the appraisal of a project, however, it is important to determine not only the critical variables and their probable values and impacts, but also when deviations from the forecast may happen. For example, it makes a great difference whether a drop in sales prices occurs during start-up or during or after the payback period. In case there are a number of critical variables, stochastic models may be applied, where for each critical variable a confidence level is determined, and within these limits each variable is assigned a random value. For such a random combination of cash flows, the financial ratios etc. are computed, sometimes repeatedly in order to obtain a data series for project appraisal. While the introduction of stochastic models may be an interesting complementary method, it can also give analysts and decision makers an impression of accuracy that does not really exist.[142]

[141] See the analysis of competition in chap. III, sect. B.

[142] One of the problems is that various variables are not independent; e.g. nitrogen fertilizer production costs depend to a considerable extent on energy costs, while their market prices depend on supply and demand, and production costs as well. To identify such interrelations is a precondition for the application of stochastic models and for the development of investment, production and marketing strategies.

The value of probability analysis, however, lies in the identification and analysis of what could affect and seriously endanger a project, if implemented, and the determination of possible strategies to manage such situations.

With the introduction of sensitivity and 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. Access to suitable and reliable (well-tested) computer models is therefore a condition for the application of such methods.

Evaluation of inflation risks

The question as to whether and when to use constant or current (inflated) prices in financial analysis has already been discussed in section B of this chapter. It has been shown that for the evaluation of net cash flows and the profitability of the project, inflation effects may be ignored, provided the relative prices of the major project inputs and outputs are likely to remain constant for the project lifetime. However, if relative prices are likely to change (for example, in the costs of labour, imported goods and services, replacement of fixed assets, and of local or international market prices of the goods produced), the sensitivity of the projected cash flows to such inflation effects should be analysed in the feasibility study. The analysis should not be limited to the determination of the sensitivity to changes in relative prices of project inputs and outputs, but should also identify possible strategies to cope with inflation risks (for example, any contractual obligations should include proper price escalation clauses).

In the case of hyperinflation, the yield or profitability of an investment project may best be computed assuming constant prices. If significant relative price changes are to be anticipated, the relative increase or decrease should be introduced. For example, assuming that the annual inflation rate is x per cent and the average increase in labour costs is (x + 1.5 per cent), the cash flows should be computed at constant prices, with the exception of labour costs, which would be inflated by 1.5 per cent per annum. In case the annual average price increase is lower than the general inflation, a negative inflation rate should be introduced for the corresponding item.

Financial planning in the case of significant inflation rates, especially hyperinflation, requires the application of special accounting methods, which must comply with the rules and regulations valid in the country where the project is located.[143] These methods include the frequent revaluation of the book values of fixed and current assets (including the adaptation of the corresponding annual depreciation charges), as well as of the liabilities of the firm.

Leasing. The inflation risk may have an impact on the decision whether to lease or buy a plant. If future payments on leases are fixed in money terms, as is usually the case, inflation tends to increase the attractiveness of leasing, because the inflation risk would then be partly transferred to the lessor.

I. Economic evaluation

As pointed out earlier, the financial evaluation aims at assessing the financial and commercial feasibility of a project from the point of view of the

[143] See the bibliography at the end of this chapter.

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investors and financiers. The enterprise performance within a business environment is analysed, taking all expenses for project inputs as cash outflows, and the income from operations (sales revenues) as cash inflows. Financial resources required to implement and utilize the investment are inflows from the point of view of the firm (outflows for the banks, shareholders etc.), and the costs of finance as well as repayment of liabilities are financial outflows for the firm. All inputs and outputs are valued at market conditions. This means that the analyst and decision makers measure the net gains or benefits generated by the investment in financial terms, including the net benefits from the overall investment as well as the surplus left to investors (equity or share capital), taking into consideration the individual time preferences of the investors and financing institutions.

An investment project should also be justified within the wider context of the national economic and social environment. This is important because the corporate objectives and investment policies as determined by the investors may not always be in harmony with the national socio-economic policies of the country or area of investment. For that reason, and in order to allow the determination of public investment policies,[144] the net benefits generated from the national and socio-economic point of view should be determined. Although the investors generally have little interest in such an evaluation, there are two reasons why it may be useful to include the assessment and analysis of matters of public interest in the feasibility study. First, the economic environment and its future development could have significant impacts on the financial feasibility of the project, involving policies on income distribution, environmental protection, international trade etc. Secondly, the economic benefits generated by an investment may be used as an argument in favour of required public policy measures (such as protection from imports at dumping prices, granting permission or licences for the acquisition of foreign technology, approval of foreign equity participation and governmental guaranties).

There are various reasons for definite public interest in the economic evaluation of investment projects. For example, in the absence of "perfect" markets, the market mechanism cannot ensure the optimal allocation of resources from the national point of view under any circumstances. The maximization of financial surplus at the level of the firm does not fully reflect all other national development objectives. Sometimes there is inadequate competition, which enables some firms to develop a monopolistic position in the market. On the other hand, government intervention (through taxes, subsidies, customs duties, interest rates, price controls, import quotas etc.) often distorts the market prices of traded goods and services, resulting in the failure of those prices to reflect the true economic value of such goods and services.

The economic evaluation of investment projects may be characterized as follows:

- The national development impact of a project is assessed and evaluated;

[144]For example, incentives in case the investment is beneficial for the economy but not sufficiently attractive from the point of view of the investors, or prohibitive measures such as higher taxes and duties in certain areas or for certain technologies in case the investment has negative impacts in the form of social costs to the economy etc.

- Project inputs and outputs are valued at shadow prices[145] that reflect their true value to the national economy;
- Direct effects on the economy (involving imports, exports, employment, foreign exchange, supply and demand, ecological conditions etc.), as well as indirect effects (affecting performances in other sectors, through reduced under-utilization of installed capacities, new investment initiatives etc.), are included in the analysis where significant (these effects may be economic benefits or costs, both tangible and intangible);
- Social time preferences[146] are accounted for.

The economic evaluation of investment projects is beyond the scope of this *Manual*. When an evaluation of the contribution of industrial projects to the national economy is required, one of the methods developed for this purpose should be used. The principal methods are described in detail in various publications recommended in the bibliography to this chapter.

[145]Shadow prices indicate the value of goods and services assuming no market distortions. While market prices are to be used for the financial evaluation, shadow prices reflect the value of project inputs and outputs better than market prices, and may be considered as their necessary correction for the economic evaluation. Shadow prices are usually determined only for major production factors and project inputs and outputs, as well as when market distortions are significant.

[146]Social time preferences reflect the weight that society attaches to future as opposed to present consumption. For the economic evaluation, time preferences are expressed by the social discount rate, which differs from the individual discount rate applied in the financial evaluation.

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