# ENGINEERING STANDARD

# FOR

# RECOMMENDED PRACTICE FOR FEASIBILITY STUDY

# AND

# CONCEPTUAL DESIGN

**FIRST EDITION**

**MARCH 2016**

## FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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**GENERAL DEFINITIONS**

Throughout this Standard the following definitions shall apply.

**COMPANY :**

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

**PURCHASER :**

Means the “Company" where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract document.

**VENDOR AND SUPPLIER:**

Refers to firm or person who will supply and/or fabricate the equipment or material.

**CONTRACTOR:**

Refers to the persons, firm or company whose tender has been accepted by the company.

**EXECUTOR :**

Executor is the party which carries out all or part of construction and/or commissioning for the project.

**INSPECTOR :**

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

**SHALL:**

Is used where a provision is mandatory.

**SHOULD:**

Is used where a provision is advisory only.

**WILL:**

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

**MAY:**

Is used where a provision is completely discretionary.

**PART ONE**

# RECOMMENDED PRACTICE FOR FEASIBILITY STUDIES

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## 0. INTRODUCTION

The Standard Practice Manuals titled as "Fundamental Requirements for the Feasibility Study and Conceptual Design" is intended for convenience of use and pattern of follow-up and also guidance. These Standard Engineering Practice Manuals also indicate the check points to be considered by the process engineers for assurance of fulfillment of pre-requisitions at any stage in the implementation of process plant projects.

It should be noted that these Iranian Petroleum Standards (IPS), as Practice Manuals do not profess to cover all stages involved in every process project, but they reflect the stages that exist in general in process projects of oil, gas and petrochemical industries of Iran.

These preparation stages describe the Recommended Practice for the project stages which can be distinguished in every Project.

| | |
|---|---|
| **Stage I:** | **Feasibility Study** |
| **Stage II:** | **Conceptual Design** |
| **Stage III:** | **Basic Design** |
| **Stage IV:** | **front end engineering design (FEED)** |
| **Stage V:** | **Detailed Design** |
| **Stage VI:** | **Procurement** |
| **Stage VII:** | **Construction and Installation** |
| **Stage IIX:** | **Pre Commissioning and Commissioning** |
| **Stage IX:** | **Operating and Maintenance** |

## COMMON STAGES OF THE ENGINEERING DESIGN PROCESS

The engineering design process is a methodical series of steps that engineers use in creating functional products and processes. The process is highly iterative - parts of the process often need to be repeated many times before can be entered - though the part(s) that get iterated and the number of such cycles in any given project can be highly variable.

It is a Decision Making Process (DMP or often iterative) in which the basic sciences, mathematics, and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing and evaluation.

One framing of the engineering design process delineates the following stages: Research, Conceptualization, Feasibility Assessment, Establishing Design Requirements, Preliminary Design, Detailed Design, and Production Planning. The steps tend to get articulated, subdivided, and/or illustrated in a variety of different ways, but they generally reflect certain core principles regarding the underlying concepts and their respective sequence and interrelationship.

Common Stages of the Engineering Design Process is defined as per below:

### a) Research

A significant amount of time is spent on locating information and research. Consideration should be given to the existing applicable literature, problems and successes associated with existing solutions, costs, and marketplace needs. The source of information should be relevant, including existing solutions. Reverse engineering can be an effective technique if other solutions are available on the market. Other sources of information include the Internet, local libraries, available government documents, personal organizations, trade journals, vendor catalogs and individual experts available.

In this standard, some of the subjects are adapted from the following handbook:

CHEMICAL ENGINEERING DESIGN Principles, Practice and Economics of Plant and Process Design (GAVIN TOWLER RAY SINNOTT) 2008

### b) Feasibility

At first, a feasibility study is carried out after which schedules, resource plans and estimates for the

next phase are developed. The feasibility study is an evaluation and analysis of the potential of a proposed project to support the process of decision making. It outlines and analyses alternatives or methods of achieving the desired outcome. The feasibility study helps to narrow the scope of the project to identify the best scenario. A feasibility report is generated following which Post Feasibility Review is performed.

The purpose of a feasibility assessment is to determine whether the engineer's project can proceed into the design phase. This is based on two criteria:

- **The project needs to be based on an achievable idea**
- **It needs to be within cost constraints.**

It is important to have engineers with experience and good judgment to be involved in this portion of the feasibility study.

### c) Conceptualization

Following Feasibility, a concept study (Conceptualization, Conceptual Engineering) is performed. A concept study is the phase of project planning that includes producing ideas and taking into account the pros and cons of implementing those ideas. This stage of a project is done to minimize the **Likelihood of Error**, **Manage Costs**, **Assess Risks**, and **Evaluate the Potential Success** of the intended project.

Once an engineering issue is defined, solutions must be identified.

These solutions can be found by using ideation, the mental process by which ideas are generated. The following are the most widely used techniques.

### d) Design Requirements

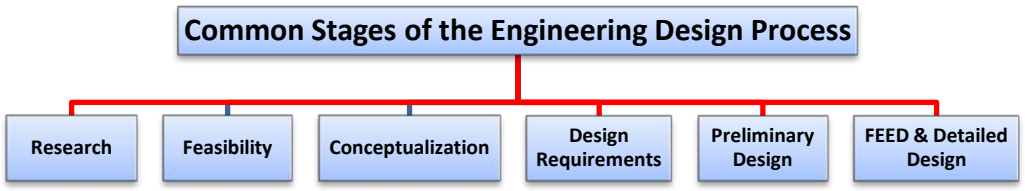
Establishing design Requirements is one of the most important elements in the design process, and this task is normally performed at the same time as the feasibility analysis. The design requirements control the design of the project throughout the engineering design process. Some design requirements include Hardware and Software Parameters, Maintainability, Availability, and Testability.

### e) Preliminary Design

The preliminary design, or high-level design (also called FEED), bridges the gap between the design concept and the detailed design phase. In this task, the overall system configuration is defined, and schematics, diagrams, and layouts of the project will provide early project configuration. During detailed design and optimization, the parameters of the part being created will change, but the preliminary design focuses on creating the general framework to build the project.

### f) FEED & Detailed Design

Following FEED is the Detailed Design (Detailed Engineering) phase which may consist of procurement as well. This phase builds on the already developed FEED, aiming to further elaborate each aspect of the project by complete description through solid modeling, drawings as well as specifications.




**Stages of the Engineering Design Process**

This Engineering Standard Specification covers:

"FEASIBILITY STUDY and CONCEPTUAL DESIGN"

## 1. SCOPE

This Recommended Practice is set forth to explore the problems encountered in carrying out the various studies required during the feasibility studies of an industrial, oil/gas and petrochemical investment projects.

**Note 1:**

**This standard specification is reviewed and updated by the relevant technical committee on Oct. 2003. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 219 on Oct. 2003. These modifications are included in the present issue of IPS.**

**Note 2:**

**This is a revised version of this standard, which is issued as revision (1)-2016. Revision (0)-1997 of the said standard specification is withdrawn.**

## 2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of change(s) in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendor/Consultant:

**"Manual for Preparation of Industrial Feasibility Studies",**

By: W.BEHENSE & P.M. HAWRANEK, for Unido Publication, November 1991.

**"Supply and Material Management",**

By: CROMPTON, H.K., 2nd., Ed. 1989.

**"Unido Guide to Industrial Purchasing, Unido Publication, 1989".**

**"Economic Evaluation of a Manufacturing Project",**

By: Chemical Engineering, December, 1992.

**"American National Standard for Cost Engineering", July, 1992.**

**UBC (UNIFIED BUILDING CODE), Latest Edition.**

## 3. DEFINITIONS AND TERMINOLOGY

### 3.1 Administrative Expense

The overhead cost due to general direction of the Company, above the plant manager level. Generally includes top management salaries, and the costs of legal, central purchasing, traffic, accounting, and other staff functions.

### 3.2 Break-Even Point

The percentage of capacity at which incomes of a Company or facility just cover all fixed and variable costs. Depreciation is normally included.

### 3.3 Consultant Fee

The charge for the use of the Consultants (or Contractor's) organization for the period and to the

extent specified in the contract.

### 3.4 Cost Index (Price Index)

A number which relates the cost of an item at a specific time to the corresponding cost at some arbitrarily specified time in the past.

### 3.5 Depreciation Costs

The allocation of the cost of fixed capital assets less salvage (if any), over the estimated useful life of the plant, in systematic and rational manner.

### 3.6 Direct Cost

The manufacturing expenses which may be affected by production rate. Direct costs are generally assignable to a specific product or process area usually including:

- Input material.
- Operating, supervision, clerical payroll.
- Fringe benefits.
- Maintenance.
- Utilities.
- Catalysts, chemicals, operating supplies.
- Miscellaneous.

### 3.7 Discounted Cash Flow (DCF)

The rate of compound interest at which the Company's outstanding investment is repaid by proceeds for project.

### 3.8 Expansion

Any increase in the capacity of a plant facility or Unit, usually by added investment. Scope of its possible application extends from the elimination of problem areas to the complete replacement of an existing facility with a larger one.

### 3.9 Indirect Cost

In a project, all costs other than direct costs, such as material, labor, which do not become a final part of the installation, but which are required for the orderly completion of the installation and may include, but not be limited to starting costs, Contractor fees, insurance, taxes etc.

### 3.10 Interest Rate

The rate earned by money expressed as a constant percentage of the unpaid balance at the end of the previous accounting period.

### 3.11 Labor Cost

The salary plus all fringe benefits of construction craftsmen and general labor on construct projects and labor crews in manufacturing or processing areas which can be definitely assigned to one product or process area or cost center.

### 3.12 Overhead Cost

A cost or expense inherent in the performing of an operation, i.e., engineering, construction, operating or manufacturing, which can not be charged to or identified with a part of the work, product, or asset, and therefore, must be allocated on some arbitrary basis believed to be equitable, or handled as a business expense independent of the volume of production.

### 3.13 Present Value

The discounted value of a series of cash flows at any arbitrary point in time. Also, the system of comparing proposed investments which involves discounting at a known interest rate, in order to choose the alternative having the highest present value per unit of investment.

### 3.14 Profitability

A measure of the excess of income over expenditure during a given period of time.

### 3.15 Working Capital

The funds in addition to fixed capital and land investment which a company must contribute to the project (excluding start-up expense) to get the project started and meet subsequent obligations as they come due. Working capital is normally assumed recovered at the end of the project without loss.

## 4. SYMBOLS AND ABBREVIATIONS

Symbols and abbreviations referred to in the Standard are as follows:

| SYMBOL/ABBREVIATION | CRIPTION |
|---|---|
| **a** | Discount Factor |
| **ARR** | Annual Rate of Return |
| **CIF** | Cost, Insurance and Freight |
| **$CF_n$** | Nominal value of a future cash flow |
| **CTO** | Coefficient of Turnover, (CTO = 360/MDC) |
| **$CF_p$** | The value at present time |
| **DCF** | Discounted Cash Flow. |
| **F** | Found (or Capital), paid for a project |
| **FOB** | Free On Board |
| **I** | Increment of found in a definite time |
| **ir=IRR** | Internal Rate of Return |
| **K** | Total investment cost (fixed assets and working capital) |
| **LPG** | Liquefied Petroleum Gas |
| **MDC** | Minimum Days of Coverage |
| **n** | Number of years |
| **$NCF_n$** | Annual Net Cash Flow of a Project |
| **NCU** | National Currency Units |
| **NPV** | Net Present Value |
| **NP** | Net Profit (after deduction of taxes and interest) |
| **NV** | Negative NPV (at the highest discount rate) |
| **OGP** | Oil, Gas and Petrochemicals |
| **PV** | Positive NPV (at lowest discount rate) |
| **r** | Interest rate. |
| **R** | Annual rate of return (in percent) |
| **SRI** | Stanford Research Institution |
| **UBC** | Unified Building Code |

## 5. UNITS

This standard is based on international system of units (SI), as per IPS-E-GN-100 except where otherwise specified.

## 6. FEASIBILITY STUDIES

### 6.1 General

The pre-investment phase comprises several stages:

Identification of investment opportunities (opportunity studies); analysis of project alternatives and preliminary project selection as well as project preparation 7 (prefeasibility and feasibility studies); and project appraisal and investment decisions (appraisal report).

### 6.2 Opportunity Studies

#### 6.2.1 General

**6.2.1.1** Identification of investment opportunities should be made at the starting-point in a series of investment-related activities. Information on the newly identified and viable investment opportunities should be obtained.

**6.2.1.2** These informations, data and required parameters should be generated, qualified and used as the main instrument to develop a project idea into a proposal. Compilation of necessary information, data and determining parameters followed with detailed analysis is termed as "Opportunity Study".

**6.2.1.3** The following objective points should typically be analyzed together with an overall look to investment potential of the company, general interest of other governmental autorities domestic and foreign investors in investment and promotion of the project(s):

- Natural resources with potential for processing and manufacture such as hydrocarbon resources for chemical and petrochemical industries and crude oil for refinery processing.
- Possible resources of utilities such as air, steam, fuel, power, water, etc. and their transportation alternates for chemical and petrochemical or refinery plants.
- The existing industrial pattern that serves as a basis for the proposed new hydrocarbon-based industries.
- Future demand of the products that should have been potentially grown up as a result of increased population or purchasing power or for newly developed consuming goods.
- Development in process technologies regarding the new or future demands of products.
- Imports, in order to identify areas for import substitution.
- Environmental impact.
- Manufacturing sectors successful in other countries with similar economic background and levels of development, capital, labor and natural resources.
- Possible inter-linkage with other industries, indigenous or transnational.
- Possible extension of existing production lines by backward or forward integration, linking for example, a downstream petrochemical industry with a refinery.
- Possibilities for diversification for example from a petrochemical complex into other commercial product manufacturing.
- Possible expansion of existing industrial capacity to attain economies of scale.
- The general investment climate.
- Industrial policies.
- Availability and cost of production factors.
- Export possibilities.

**6.2.1.4** Opportunity studies should be taken as a sketchy in nature relying more on aggregate estimates rather than on the detailed analysis. Cost data usually should be taken from comparable

existing projects and not from quotations of sources such as Licensors, engineering companies or equipment suppliers.

**6.2.1.5** Outline of a general opportunity studies is given under Appendix A. These parameters may be integrated and/or cross checked with those already practiced in the Company's planning and investment promotion departments for the purpose of adequate stimulating of Company's (as investor) response.

**6.2.1.6** It should be noted that, the information conveyed in a project opportunity study should not involve any substantial costs in its preparation, as it is intended primarily to highlight the principal investment aspects of a possible industrial proposition.

### 6.3 Pre-Feasibility Studies

#### 6.3.1 General

**6.3.1.1** A pre-feasibility study should be viewed as an intermediate stage between a project opportunity study and a detailed feasibility study; the difference being in the degree of detail of the information obtained and the intensity with which project alternatives are discussed.

**6.3.1.2** A detailed feasibility study.

**6.3.1.3** A detailed review of available alternatives should take place at the stage of pre-feasibility study. In particular, the review should cover the various alternatives identified in the following main fields of study:

- Project or corporate strategies and scope of the project.
- Market and marketing concept.
- Raw materials and supplies.
- Location, site and environment.
- Engineering and technology.
- Organization and overhead costs.
- Human resources, in particular managerial staff, labor costs, and training requirements and costs.
- Project implementation schedule and budgeting.

**6.3.1.4** The financial and economic impact of each of the above factors should be assessed. Occasionally, a well prepared and comprehensive opportunity study justify by-passing the pre-feasibility study stage. A pre-feasibility study should however be conducted if the economics of the project are doubtful.

### 6.4 Feasibility Studies

#### 6.4.1 General

**6.4.1.1** A feasibility study should provide all data necessary for an investment decision. The commercial, technical, financial, economic and environmental prerequisites for an investment project should therefore be defined and critically examined on the basis of alternative solutions already re-viewed in pre-feasibility study.

**6.4.1.2** A feasibility study should be carried out only if the necessary financing facilities, as determined by the studies, can be identified with a fair degree of accuracy. Possible project financing should be considered as early as the feasibility study stage, because financing conditions have a direct effect on total costs and thus on the financial feasibility of the project.

#### 6.4.2 Main objectives

The main objectives to be considered, as the minimum requirement, in feasibility studies of projects are classified and covered in the following chapters:

| | | |
|---|---|---|
| Chapter | I | Executive Summary. |
| Chapter | II | Project Background and Basic Idea. |
| Chapter | III | Market Analysis and Marketing Concept. |
| Chapter | IV | Raw Materials and Supplies. |
| Chapter | V | Location, Site and Environment. |
| Chapter | VI | Engineering and Technology. |
| Chapter | VII | Organization and Overhead Costs. |
| Chapter | VIII | Human Resources. |
| Chapter | IX | Implementation Planning and Budgeting. |
| Chapter | X | Financial Analysis and Investment Appraisal. |

Each of these chapters should separately be studied on the basis of specific procedure and guidelines given herein this Specification. For further detail studies of any and all of the scopes covered in these chapters, specific references are given at the end of each chapter.

## CHAPTER I - EXECUTIVE SUMMARY

### 1. GENERAL

**1.1** For convenience of preparation, the feasibility should begin with a brief executive summary, outlining the project data (assessed and assumed) and the conclusions and recommendations which would then be covered in detail in the body of the study.

**1.2** The executive summary should concentrate on and cover all critical aspects of the study, such as the following: the degree of reliability of data on the business environment; project input and output; the margin of error (uncertainty, risk) in forcast of market; supply and technological trends; and project design.

**1.3** The executive summary should have the same structure as the body of the feasibility study, and cover but must not be limited to the following areas:

**a) Summary of the Project Background and History (Chapter II)**

- Name and address of project promoter.

- Project background.

- Project (corporate) objective and outline of the proposed basic project strategy, including geographical area and market share (domestic, export), cost leadership, differentiation, market niche.

- Project location: orientation towards the market or torwards resources (raw materials).

- Economic and industrial policies supporting the project.

**b) Summary of Market Analysis and Marketing Concept (Chapter III)**

- Summarize results of marketing research: business environment, target market and market segmentation (consumer and product groups), channels of distribution, competition, life cycles (sector, product).

- List annual data on demand (quantities, prices) and supplies (past, current and future demand and supplies).

- Explain and justify the marketing strategies for achieving the project objectives and outline the marketing concept.

- Indicate projected marketing costs, elements of the projected sales program and revenues (quantities, prices, market share etc.).

- Describe impacts on: raw materials and supplies, location, the environment, the production program, plant capacity and technology etc.

**c) Raw Materials and Supplies (Chapter IV)**

- Describe general availability of:
    - Raw materials
    - Processed industrial materials and components
    - Factory supplies
    - Spare parts
    - Supplies for social and external needs

- List annual supply requirements of material inputs.
- Summarize availability of critical inputs and possible strategies (supply marketing).

**d) Location, Site and Environment (Chapter V)**

- Identify and describe location and plant site selected, including:
    - Ecological and environmental impact
    - Socio-economic policies, incentives and constraints
    - Infrastructural conditions and environment
- Summarize critical aspects and justify choice of location and site.
- Outline significant costs relating to location and site.

**e) Engineering and Technology (Chapter VI)**

- Outline of production program and plant capacity
- Describe and justify the technology selected, reviewing its availability and possible significant advantages or disadvantages, as well as the life cycle, transfer (absorption) of technology, training, risk control, costs, legal aspects etc.
- Describe the layout and scope of the project
- Summarize main plant items (equipment etc.), their availability and costs
- Describe required major civil engineering works.

**f) Organization and Overhead Costs (Chapter VII)**

- Describe basic organizational design and management and measures required.

**g) Human Resources (Chapter VIII)**

- Describe the socio-economic and cultural environment as related to significant project requirements, as well as human resources availability, recruitment and training needs, and the reasons for the employment of foreign experts, to the extent required for the project
- Indicate key persons (skills required) and total employment (numbers and costs).

**h) Project Implementation Schedule (Chapter IX)**

- Indicate duration of plant erection and installation
- Indicate duration of production start-up and running-in period
- Identify actions critical for timely implementation.

**i) Financial Analysis and Investment Appraisal (Chapter X)**

- Summary of criteria governing investment appraisal
- Total investment costs
- Major investment data, showing local and foreign components
- Land and site preparation
- Structures and civil engineering works

- Plant machinery and equipment
- Auxiliary and service plant equipment
- Incorporated fixed assets
- Pre-production expenditures and capital costs
- Net working capital requirements
- Total costs of products sold
- Operating costs
- Depreciation charges
- Marketing costs
- Finance costs
- Project financing
- Source of finance
- Impact of cost of financing and dept service on project proposal
- Public policy on financing
- Investment appraisal: key data
- Discounted cash flow (internal rate of return, net present value)
- Pay-off period
- Yield generated on total capital invested and on equity capital
- Yield for parties involved, as in joint venture projects
- Significant financial and economic impact on the national economy and environmental implications
- Aspects of uncertainty, including critical variables, risks and possible strategies and means of risk management, probable future scenarios and possible impact on the financial feasibility of the investment project.
- National economic evaluation.
- Conclusions.
- Major advantages of the project.
- Major drawbacks of the projects.
- Chances of implementing the project.

**Note:**

**For executive details if required refer to "Economic Evaluation of a Manufacturing Project in Chemical Engineering", December 1992 and other appropriate references.**

## CHAPTER II - PROJECT BACKGROUND AND BASIC IDEA

### 1. GENERAL

**1.1** To ensure the success of the feasibility study, it must be clearly understood, how the project idea fits into the framework of general conditions and industrial development of the country.

**1.2** The project should be described in detail and the sponsors identified, together with a presentation of the reasons for their interest in the project.

### 2. PROJECT BACKGROUND AND BASIC IDEA

**2.1** Description of the project idea as:

- List the major project parameters that served as the guiding principles during the preparation of the study.

- Project (corporate) objectives and description and analysis of proposed basic project strategy, including:

    - Geographical area and market share (domestic, export)

    - Cost leadership

    - Differentiation

    - Market niche.

**2.2** Project promoter or initiator as:

- Names and addresses

- Financial possibilities

- Role within the project

- Other relevant information.

**2.3** Project history as:

- Historical development of the project (titles, authors, completion dates)

- Studies and investigations already performed

- Conclusions arrived at and decisions taken on the basis of former studies.

**2.4** Feasibility study as:

- Author, title

- Ordering party.

**2.5** Cost of preparatory studies and related investigations as:

- Pre-investment studies.

- Opportunity studies.

- Pre-feasibility studies.

- Feasibility studies.

- Any other supporting studies.

- Expert, Consultant and Engineering Fees (if their services are utilized).

- Preparatory investigations such as:

- Land surveys.
- Quantity surveys (quantification of building materials).
- Quality (laboratory) test.
- Other investigations and tests (if performed).

- For calculation use Schedule II-1 of Appendix C, and insert in Schedule X-2 and X-5 of Appendix K.

**2.6** COMFAR, is basically a typical standardized simulation model for financial and economic analysis of projects. The new COMFAR generation, developed for guiding the users through the data entry system by requesting exactly the input required for the computation of the system output as predefined by the users. The schedules contained in Appendices C through X of this Specification, constitute a format compatible with COMFAR for economic, cost-benefit analysis of the projects.

## CHAPTER III - MARKET ANALYSIS AND MARKETING CONCEPT

### 1. GENERAL

**1.1** The basic objective of any industrial investment project is to benefit either from the utilization of available resources or from the satisfaction of existing or potential demand for the output of the project. Market analysis is the key activity for determining the scope of an investment, the possible production programs, the technology required and often also the choice of a location.

**1.2** The marketing experts should communicate and cooperate with the other members of the feasibility study team from the very beginning of the work, so as to avoid isolated marketing or engineering solutions that could prove to be financially unsound.

### 2. MARKETING CONCEPT

**2.1** When a project strategy has been defined, a suitable marketing concept should be designed in accordance with the phases described below:

**a) Strategic Dimensions of Marketing**

The marketing strategy to be considered involves;

**1)** Identification of target groups and the products to win their favor.

**2)** Determination of competition policies, that is, whether a low-price strategy or differentiation strategy should be pursued to defeat competitors.

**b) Operative Dimensions of Marketing**

Main marketing tools, namely product, price, promotion and place should be distinguished and the combination impact on marketing concept which is known as "Marketing Mix" should be specified. Table 1 hereunder lists the activities to be made relating the four components. Any of these components may be referred to as a sub-mix component.

**TABLE 1 - MARKETING MIX**

| PRODUCT | PROMOTION |
|---|---|
| - Scope of product mix<br>- Dept. of product mix<br>- Quality<br>- Design<br>- Packaging<br>- Maintenance<br>- Service<br>- Warranty service<br>- Possibility of returning a purchase | - Advertising<br>- Public relations<br>- Personal sale<br>- Sales promotion<br>- Brand polity |
| **PRICE** | **PLACE** |
| - Price positioning<br>- Rebates and conditions of payment<br>- Financing conditions | - Channels of distribution<br>- Distribution density<br>- Lead time<br>- Stock<br>- Transport |

### 3. MARKETING MEASURES AND MARKETING BUDGET

**3.1** For the feasibility study, it is necessary to determine the marketing activities and to prepare a time schedule indicating the starting- point and duration of these activities.

**3.2** For the development of the project strategy and marketing concept, a careful marketing research should be conducted.

The scope of marketing research required for a feasibility study should be covered to fulfill three principal aims as;

- Market-Project relations should be made clear for the management.
- Strategic constraints and problems should be identified.
- Strategic options for the project should be outlined.

**3.3** The work on market analysis should be organized along the following lines:

- Assessment of the target market structure.
- Customer analysis and market segmentation.
- Analysis of the channels of distribution.
- Analysis of the competition.
- Analysis of the socio-economic environment.
- Corporate (internal) analysis.
- Projections of marketing data.
- Conclusions, prospects and risks.

**3.4** The depth or degree of detail of the analysis should be determined according to the complexity of each problem and its importance for the project evaluation.

## 4. DATA ASSESSMENT

**4.1** Two types of market information can be distinguished, namely "general market data" and "specific market data" for a particular market segment (consumer group or product group). General market data should be accomplished with studies on the following:

- General economic indicators relating to product demand, such as population level and growth rate, per capita income and consumption, gross domestic product per capita and annual growth rate, and income distribution.
- Government policies, practice and legislation, to the extent directly related to consumption, productions, imports and exports of the product(s) in question, standards, restrictions, duties, taxes, as well as subsidies or incentives, credit control and foreign regulations.
- Present level of domestic production, by volume and value, including production intended for internal consumption and not placed on the market.
- Present level of imports, by volume and value (CIF and local cost).
- Production and imports of substitute and near-substitutes.
- Critical imputes (see also Chapter IV).
- Production targets determined in national economic plans, where applicable for products in question, substitutes and complementary product.
- Present level of exports, by volume and value (FOB).
- Behavioral patterns, such as consumer habits and responses, individual and collective, and trade practice.

**4.2** The specific demand and market data for a particular market segment should be identified and its availability for feasibility study should be ascertained. typically following items and similars should be studied in this regard:

- The demand for a product may have been suppressed by market imperfections due to trade policies, high import tariffs, which would not be portable on domestic products.
- Artificially high domestic prices may be imposed on certain products whose import are severely restricted, but the pattern of demand, and consequently of product pricing, would change materially once the product become available in large quantities.

**4.3** It is however, necessary to identify the specific demand and market data required, the extent to which such data are available and could be utilized in the feasibility study.

**4.4** The possibility of extending the market to other countries should be explored for most projects of any size, as export sales have to be taken into consideration in determining plant capacity.

**4.5** International competition should be studied through economies of scale, for example, in production or marketing through comparative locational advantages, the development of international cooperation, access to technologies etc.

**4.6** The geographical divisions of possible exports should be defined in content of a particular product.

Regarding export analysis, the feasibility study should therefore deal with the following questions:

- Will the enterprise gain strategic advantages by operating more internationally?.
- What advantages will it gain in particular (example: economies of scale in production)?.
- To what degree and in which fields does international competition pose a treat to the project?.
- What will be the future extent of the advantage of the enterprise operating on a geographically limited field?

## 5. OUTLINE OF THE PROJECT STRATEGY

**5.1** Upon introduction of marketing and dimension for feasibility studies, the following main steps for defining the project strategy and corresponding marketing concept should essentially be studied:

**- Geographical area of strategy;**

On the basis of the assessment of the project situation, the feasibility study should consider different strategic alternatives with regard to the geographic limitations.

**- Market share and basic strategy;**

For an investment project it is necessary to define the long-term market position or market share and corresponding profitability of the project. Since each market has its individual characteristics, the feasibility study should analyze each profitability and market share relationship very carefully.

**- Strategy of cost leadership;**

The cost advantage attributable to the "learning and experience", provides protection against competition. In order to achieve cost leadership, the following assets required for this strategy should be evaluated:

- High investment capacity, i.e., access to capital.
- Process innovations and improvements.
- Thorough supervisions of labor force.
- Products designed for easy manufacturing.
- Low-cost distribution system.

**- Differentiation strategy;**

Differentiation strategy aims to protect against competition, in that binds the buyers to the brand or the firm and thus reducing price sensitivity. The following assets and similars should be subject to differentiation strategy:

- Powerful marketing potential.
- Strengths in research and development.
- Customer groups with higher purchasing power.
- Parts of the product line.
- Tradition in the industry.
- Cooperation with supply and distribution channels.

**- Project strategy;**

When a project strategy is selected, the feasibility study should always consider possible alternative strategies.

When assessing such alternatives, the following points should be considered.

- To what extent do the strategic alternatives fulfill the original aims of the feasibility studies.
- What is the financial impact of the alternatives (profitability, return on investment).
- What risks are linked with each alternatives (political, ecological, financial, etc.).
- For determining of project alternative strategies the following problems should be addressed:
- What is the geographical area in which the project will operate?
- What basic strategy should be chosen (cost leadership, differentiation or market niche)?
- What market position (market share) is aimed at, and how much time is required to reach the target?
- Which product-market relation should be basis for the marketing concept?
- What will be the product range (products, price level)?
- Which target group of consumers will be focused on?
- Which strategy will be chosen (competition or market expansion)?
- What core skills are required for success in respect of actual or potential competitors?
- Will the project develop the market position exclusively by its own means or are there possibilities for cooperation?.

## 6. MARKETING COST

**6.1** The projection of marketing costs comprises all costs components resulting from the marketing activities described in this section. Depending on the scope of study and the depth of analysis marketing costs should be projected for each product separately or for a group of products.

**6.2** For detail analysis, the direct variable and direct fix unit costs as well as indirect marketing costs (marketing overhead costs) should be determined in line with check-list shown in Schedules III-1, III-2 and III-3 of Appendix D.

**Note:**

**For detail studies on marketing and project strategy, see the Sections of Chapter III of "Manual for the Preparation of Industrial Feasibility Study", issued by UNIDO in 1991.**

# CHAPTER IV - RAW MATERIALS AND SUPPLIES CONCEPT

## 1. GENERAL

**1.1** The selection of raw materials and supplies depends primarily on the technical requirements of the project and analysis of supply markets. Important determinant factors for selection of raw materials and factory supplies are environmental factors and criteria relating to project strategies, for example minimizing supply risks and cost of material inputs.

**1.2** In order to keep the cost of feasibility studies at a reasonable level, key aspects should be identified and analyzed in terms of requirements, availability, cost and risk, which will be significant for feasibility of the project. the following approach should necessarily be taken to specify the requirements, check their ability and estimate their costs:

**a)** Characteristics of raw materials, auxiliary materials and utilities.

**b)** Specification of requirements.

**c)** Availability and supply.

**d)** Input alternatives.

**e)** Supply marketing and supply program.

**f)** Cost of raw materials and supplies:

**f.1)** The costs of materials and supplies used or kept in stock should be specified as per Schedule IV-1 of Appendix E. Cost estimates for materials and inputs can be expressed either as the cost per unit produced or in terms of a certain production level.

**f.2)** The following information should be presented in Schedule IV-1 of Appendix E:

- Type of material and input.
- Unit of measurement (barrels, tones, cubic meters, etc.)
- Estimated costs per unit produced.
- Estimated cost per input unit.
- Number of input units consumed per unit produced.
- Estimated cost per unit produced divided into direct (predominately variable) and indirect (predominantly fixed) cost components.
- Direct cost per unit produced divided into foreign and local currency components (although expressed in one common currency).
- Indirect cost per unit produced divided into foreign and local currency components.

**f.3)** When calculating indirect costs, the amounts resulting from environmental protection, pollution control measures, etc., should be established per unit of production, or per accounting period. Schedule IV-2 of Appendix E should be used to project the costs over the production period. The total per main category of inputs should be recorded in this schedule, and the grand totals, for direct and overhead costs (factory and administrative overheads) should then be inserted in Schedule X-3 of Appendix K.

**Note:**

**For more information on marketing and supply see following recommended references:**

**a) Supply and Material Management by CROMPTON, H.K. 2nd ed., 1989.**

**b) UNIDO Guide to Industrial Purchasing, Unido Publications, 1989.**

## CHAPTER V - LOCATION, SITE AND ENVIRONMENT

### 1. GENERAL

Following the assessment of demand and the definition of basic project strategies with regard to the sales and production programs, plant capacity and input requirements, a feasibility study should determine the location and site suitable for an industrial project. Location and site are often used synonymously but must be distinguished. The choice of location should be made from a fairly wide geographical area, within which several alternative sites can be considered.

### 2. LOCATION ANALYSIS

**2.1** Feasibility study should identify locations suitable for an industrial project under consideration. The feasibility study should also indicate on what grounds alternative locations have been identified, and give reasons for leaving out other locations that were suitable but not selected.

**2.2** The impacts and requirements to be identified, should be classified as follows:

- Natural environment, geophysical conditions and project requirements.

- Ecological impact of the project, environmental impact assessment.

- Socio-economic policies, incentives and restrictions, government plans and policies.

- Infrastructral services, such as existing industrial infrastructure, the economic and social infrastructure, the institutional framework, urbanization and literacy.

### 3. NATURAL ENVIRONMENT

**3.1** Climatic conditions as an important locational factor should be specified in terms of air temperature, humidity, sunshine hours, winds, precipitation, hurricane risk etc. Each of these should be specified in detail such as maximum, minimum and average temperatures on an average day, in particular months or over a period of 10 years.

**3.2** Geodestic aspects such as soil conditions, subsoil water levels and a number of special site hazards (earthquakes, susceptibility to flooding) should be studied.

**3.3** Ecological requirements with specific regards to water supply with quality requirements, waste water disposal, pollution of area and health risks should be studied and demonstrated in the feasibility study.

### 4. ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

**4.1** The feasibility study should include a thorough and realistic analysis of the environmental impact of industrial investment project. This impact is often of crucial importance for socio-economic, financial, and technical feasibility of the project.

**4.2** The following specific objective of environmental impact assessment shall be performed by an expert and qualified consultant, covering all the below items and it's report shall be annexed to the feasibility study report.

- To promote a comprehensive, interdisciplinary investigation of environmental consequences of the project and it's alternatives for the affected natural and cultural human habit.

- To develop an understanding of the scope and magnitude of incremental environment impacts of the proposed project for each of alternative project design.

- To incorporate in the designs any existing regulatory requirements.

- To identify measures for mitigation of adverse environmental impacts and for possible enhancement of beneficial impacts.

- To identify critical environmental problems requiring further investigation.

- To assess environmental impacts qualitatively and quantitatively as required for the purpose of determining the overall environmental merit of each alternative.

## 5. SOCIO-ECONOMIC POLICIES (ROLE OF PUBLIC POLICIES)

**5.1** Investments in export processing zones and other specified regions may sometimes be and are exempted from taxes or would benefit from other types of study. Such possibilities should be considered in the feasibility study.

## 6. INFRASTRUCTURAL CONDITIONS

**6.1** The availability of a developed and diversified economic and social infrastructure is often of key importance for a project. The feasibility study should identify such key infrastructural requirements, because they are vital to the operation of a project.

**6.2** In conformity with 5.1 above, technical infrastructure for the choice of location, and other characteristics such as reliability, quality and physical aspects should be studied. Transport and communication facilities, utility requirements, labor, lands should be studied. Infrastructural services, effluent and waste disposal should also as studied as critical factors be studied and clearly monitored in the feasibility study report.

## 7. FINAL CHOICE OF LOCATION

**7.1** The feasibility study should indicate, where the project in question shall be located, with specific concern to raw material, supplies (water, power, fuel, labor etc.), climate, social welfare facilities available (such as education, medical services, and recreation facilities), proximity to raw materials and downstream product consuming markets. etc.

**7.2** As far as financial feasibility of alternative locations is concerned, the following data as well as data related to financial risks should be carefully assessed:

- Production costs (including environment protection cost).

- Marketing costs.

- Investment costs (including environmental protection).

- Revenues.

- Taxes, subsidies, and allowances.

- Net cash flows.

## 8. SITE SELECTION

**8.1** The feasibility study should analyze and assess alternative sites on the basis of key aspects and site specific requirements.

For sites available within the selected location, the following requirements and conditions should be assessed:

- Ecological conditions on site (soil, site hazards, climate etc.).

- Environmental impact (restrictions, standards, guidelines).

- Socio-Economic conditions (restrictions, incentives, guidelines).

- Local infrastructure at site location (existing industrial, infrastructure, availability of critical project inputs such as labor and factory supplies).

- Strategic aspects (corporate strategies, regarding possible future expansion, supply and marketing policies).

- Cost of land.

- Site preparation and development, requirements and costs.

## 9. COST ESTIMATES

**9.1** Schedule V-1 of Appendix F should be used for the estimates of investment costs at site. Examples of costs are acquisition of land, taxes, legal expenses, rights of way, site preparation and development. Different cost items are to be identified, quantified (if relevant), estimated and divided into components of foreign and local currency origin.

**9.2** It should be carefully stated whether factory-external facilities, possibly judged as necessary (such as disposal and treatment of effluents, generation of electricity, water supply system, storage, housing and schools etc.) should be included in the cost estimate.

**9.3** Schedule V-2 of Appendix F may be used for investment costs related to environmental protection.

**9.4** Schedule V-3 and V-4 of Appendix F should be used for the presentation of annual costs related to the site and environmental protection costs respectively. This may comprise annual payments for rent and other costs.

## CHAPTER VI - ENGINEERING AND TECHNOLOGY

### 1. GENERAL

The scope of an investment project is first of all defined by the project or corporate objectives and strategies determined by the potential investors, taking into account the overall business environment, and secondly by the marketing concept as well as the available project inputs (resources). It is the task of engineering to design the functional and physical layout for the industrial plant necessary to produce the defined products (output), and to determine the corresponding investment expenditures as well as the costs arising during the operational phase. The scope of engineering also includes the plant site and all activities required to deliver both inputs and outputs and to provide the necessary ancillary infrastructure investments. This comprehensive approach should help to determine which technical solution would best serve the intentions of the investors or any third party participating in the project.

**1.1** An integral part of engineering at the feasibility stage is the selection of an appropriate technology and of the corresponding know-how. While the choice of technology defines the production processes to be utilized, the effective management of technology transfer requires that the technology and know-low are acquired on suitable terms and conditions and that the necessary skills are available or developed.

**1.2** The required machinery and equipment should be determined in relation to the technology and processes to be utilized, the local conditions, the state of the art and human capabilities and training programs at various levels.

**1.3** The analysis should also outline the specific requirements of each individual technology, if selected, and specify the need for technical documentation and maintenance procedures.

**1.4** In particular the analysis should include a thorough survey of spare parts and the format of necessary lists of spare parts.

### 2. PRODUCTION PROGRAM AND PLANT CAPACITY

**2.1** The detailed production program should be designed in a feasibility study when the required sales program is determined.

#### 2.2 Determination of Production Program

**2.2.1** Full production capacity should not be considered as practical in OGP process plants during the initial production operations. Owing to various technological, production and commercial difficulties, most projects experience initial problems that take the form of only a gradual growth of sales and market penetration, on the one hand, and a wide range of production problems on the other.

**2.2.2** A production and sales target of 65 to 70 percent of overall capacity should be considered for the first year and 75 to 90 percent for the second year and full production capacity for third year and then after.

#### 2.3 Input Requirements

**2.3.1** Once the production program is defined, the nature and general requirements of materials, should be identified and the specific quantities needed for each stage of the production program and the costs that these entail should be determined. The costs should be assessed for: basic materials such as raw materials, semi-processed and bought-out items, major plant supplies (auxiliary materials and utilities), other supplies and labor requirements.

### 2.4 Determination of Plant Capacity

**2.4.1** A feasible normal capacity should be specified in the study under normal operating conditions, taking into account not only the installed equipment and technical conditions of the plant such as normal stoppages, down time, holidays, maintenance, tool changes, desired shift patterns and management sy stem applied.

**2.4.2** A feasible nominal maximum capacity should also be specified which frequently corresponds to the installed capacity as guaranteed by the supplier of the plant. This capacity should entail overtime, excessive consumption of plant supplies, utilities, spare parts, wear-and-tear parts and de-proportionate production cost increases.

### 2.5 Economies of scale

Production capacity must also be related to economies of scale. In most industries, the niinin1um economic level of production has been generally defined in relation to the technologies applied and the prevailing prices in industrialized countries.

### 2.6 Minimum Economic Size and Equipment Constraints

**2.6.1** When determining the minimum economic size of a project, experience gained elsewhere should be evaluated and used. There should be full treatment of the resulting higher production costs and prices and inability to compete with a cost leadership strategy in external market.

## 3. TECHNOLOGY CHOICE

**3.1** The selection of appropriate technology and know-how is a critical element in any feasibility study. Such selection should be based on a detailed consideration and evaluation of technological alternatives and the selection of the most suitable alternative in relation to the project or investment strategy chosen and to socio-economic and ecological conditions.

**3.2** Technology choice should be directly related to market, resource and environmental conditions and the corporate strategies recommended for a particular project. The form of foreign participation, national objectives and policies, industrial growth strategy, availability of local resources and skills and several other factors which can directly impinge on technology choice should be assessed.

### 3.3 Ecological and Environment Impact

**3.3.1** Ecological and environmental impact and especially any possible hazards that may result from the use of particular technologies should be studied and used in technology selection.

### 3.4 Assessment of Technology Required

**3.4.1** The primary goals of technology assessment are to determine and evaluate the impacts of different technologies on the society and national economy (cost-benefit analysis, employment and income effects, satisfaction of human needs etc.), impacts, on the environment, and techno-economic feasibility assessment from the Company's point of views should be made.

### 3.5 Technology Description and Project Layout

**3.5.1** A preliminary project layout should be established in feasibility study report and should provide the overall framework of the project which can serve as a broad basis for: plant engineering, order-of-magnitude projections of civil works, machinery requirements and other investment elements and site development, plant and other buildings, transport facilities (road, railway, sidings etc.), utility linkages including electric power substations, water connections, sewage lines, gas and telephone links, storage and other facilities.

**3.5.2** The preliminary project layout should include several charts and drawings (need not to be in scale). The functional charts and layout drawings at this stage should include the following:

- General functional layout, defining the principal physicals, or locational, features and flow relationships, civil works and constructions, various ancillary and service facilities.
- Basic characteristics of the technology.
- Material-flow diagrams indicating the flow of materials and utilities.
- Transport layout, indicating roads, railways, and other transport facilities up to their point of connection to public networks.
- Utility lines for electric power, water, gas, telephone, sewage and emissions (both internal and external up to the point connecting with public networks).
- Area for expansion and extension.

### 3.6 Technology Evaluation and Selection

**3.6.1** Alternative techniques should be evaluated in the feasibility study to determine the most suitable technology for the plant. This evaluation should be related to plant capacity, and should commence with a quantitative assessment of output, production build-up and gestation period, a qualitative assessment of product quality and marketability.

**3.6.2** The technology should have been proven and utilized in the manufacturing process, preferably in the company from which it came. While unproven, new and experimental techniques should not be considered appropriate. Obsolescent technology should be avoided.

## 4. TECHNOLOGY ACQUISITION AND TRANSFER

**4.1** When a technology has to be obtained for a specific project, the means of acquisition should be determined. These can take the form of technology licensing, outright purchase of technology or a joint venture involving participation in ownership by the technology supplier. The implication of these methods should be analyzed.

**4.2** The feasibility study should indicate the measures and action to be taken for technological absorption and adoption of the acquired technology to local conditions.

**4.3** The feasibility study should identify the various categories of personnel to be recruited and the training programs they need to undergo.

### 4.4 Contract Terms and Conditions

**4.4.1** The contractual terms and conditions for technology acquisition and transfer which are likely to be of particular significance to the project, need to be highlighted in the feasibility study.

**4.4.2** The negociation strategy should also be indicated, and draft of the principal terms and conditions from the view point of the prospective Licensee should be prepared.

## 5. SELECTION OF MACHINERY AND EQUIPMENT

**5.1** Equipment selection at feasibility study stage should broadly define the optimum group of machinery and equipment necessary for a specific production capacity.

### 5.2 Level of Automation

**5.2.1** Degree of sophistication and automation as an important issue in OGP production plants should carefully be assessed, capital cost of automation trend, competitive nature of production should be evaluated. Thus the use of computer-aided designs for production or numerically controlled machine tools etc. should be specified in the feasibility stage of the project.

### 5.3 Categories of Equipment/Spare Parts

**5.3.1** The equipment should be listed and categorized. The classification should be listed under; plant machinery, mechanical equipment, electrical equipment, instrumentation and controls, transport and conveying equipment, testing and research equipment and other machinery items with estimated prices.

**5.3.2** A list should be prepared of required spare parts and tools with their estimated prices. Spare parts needs, should depend on the nature of the project, availability, import facilities. In common practice a stock of 2 years consumption is feasible for OGP industries.

## 6. CIVIL ENGINEERING WORKS

**6.1** The feasibility study should provide plans and estimates for the civil works related to the project. This should cover site preparation and development, other buildings, civil engineering works relating to utilities, transport, emissions and effluent discharges, internal roods, fencing and security, and other facilities and requirements of the plant.

### 6.2 Building

**6.2.1** Plans and estimates for buildings and structures should include: the main plant buildings; buildings for ancillary production facilities, ancillary building.

For maintenance and repair; testing and research and development; storage and warehouses for stock of raw material or finished products; non-factory or plant buildings; staff welfare facilities; residancial buildings and such other buildings.

## 7. ESTIMATES OF OVERAL INVESTMENT COSTS (CAPITAL COST ESTIMATES)

**7.1** On the basis of estimates for technology, machinery and equipment and civil engineering works, the feasibility study should provide an overall estimate of the capital costs of the project. Such an estimate should undergo modification in accordance with the bids and offers received from suppliers and Contractors, but should nevertheless provide a fairly realistic estimate of capital costs. These costs should be reflected in Schedules VI-1, VI-2, VI-3, and VI-4 of Appendix G.

**7.2** A physical contingency allowance should commonly be added. a typical degree of accuracy should be considered for ±10 percent. However careful consideration should be given to this estimate, and in particular to the contingency allowed.

### 7.3 Estimating Methods

#### 7.3.1 Estimating based on full design

**7.3.1.1** The most accurate estimate of investment costs should be based on a detailed and complete design of each project component. Since competitive quotations should be obtained for plant equipment, machnineries, erection, civil works etc., estimating based on full design would usually not be appropriate for a feasibility study, but would occur during the project implementation

phase, once the project has been approved.

### 7.3.2 Exponential cost estimating

**7.3.2.1** This method should be used only for similar types of plants or plant items, i.e., exponential factors are only valid if the technical scope of the project and process technologies are similar.

If this is not the case, the margin of error of cost estimates will be greater than the required reliability of estimate.

**7.3.2.2** Exponential cost estimating is based on the following function.

$$C_2 = C_1 \left(\frac{S_2}{S_1}\right)^n \qquad \textbf{(Eq. 1)}$$

**Where:**

| | |
|---|---|
| $S_1/S_2$ | is relative size of two plants/plants items; |
| $C_1/C_2$ | is relative costs of two plants or plants items; |
| $n$ | is exponential factor that for many plants and equipment lies between 0.6 and 0. 7. |

**7.3.2.3** Exponential cost factors are published, but should be checked regularly against prices obtained through tendering. (Exponential factor is published periodically by some important and reliable institutions such as Institution of Chemical Engineers, Stanford Research Institution (SRI), Nelson Refinery Index).

### 7.4 Recommended Check-Lists and Schedules

**7.4.1** The various aspects discussed in Chapter VI regarding feasibility study of projects are summarized and some additional aspects deem necessary to be covered in the feasibility study stage is given in the form of a Check-lists VI-1 and VI-2 of Appendix G hereinafter.

**7.4.2** The requirements under this list should adequately be weighed and assessed for various stages of project engineering and technology selection, acquisition and management and remarked in the feasibility study report.

**Note:**

**See Economic Evaluation of a Manufacturing project, issued by Chemical Engineering December, 1992; for further information on the engineering and technology aspects in feasibility study of projects.**

## CHAPTER VII - ORGANIZATION AND OVERHEAD COSTS

### 1. GENERAL

This chapter is intended to describe the process organizational planning and the structure of overhead costs, which can be decisive for the financial feasibility of the project, as it is essential for feasibility of a project that a proper organizational structure should be determined in accordance with the corporate strategies and policies.

While the other chapters specifically deal with direct cost for feasibility study of the projects, this chapter will deal with indirect or overhead costs. It should be noted that, neglecting or under estimation of this cost may have a significant impact on the project profitability.

## 2. PLANT ORGANIZATION AND MANAGEMENT

**2.1** The organizational structure of an enterprise should indicate the delegation of responsibilities to the various functional units of the project or the Company and should normally be shown in a diagram.

**2.2** The organizational functions should be prepared in the form of building blocks in accordance with requirement of a specific project and grouped in the following organizational units: - General management of the project/company.

- Finance, financial control and accounting.
- Personnel administration.
- Marketing, sales and distribution.
- Supplies, transport, storage.
- Production:
    - Main plant.
    - Service plants.
    - Quality assurance.
    - Maintenance and repair.

– General management of the project/company.

## 3. ORGANIZATIONAL DESIGN

**3.1** A rough outline of organizational structures and related costs may be included in pre-feasibility study, of a project, an organizational set-up design should be covered in the feasibility study for the following two reasons:

- First, the organization of a project should aim at the optimal coordination and control of all project input.

- Second, the organizational set-up serves to structure the investment and production costs and to determine the costs linked with the corresponding organizational unit. These costs should be treated as overhead cost unless, they can be directly related to a specific product.

**3.2** To facilitate cost planning and control, the project should be divided into definite cost centers. Check-list VII-1 of Appendix H is provided to indicate some of the important cost centers to be assessed in organizational design.

## 4. OVERHEAD COSTS

**4.1** The overhead costs should be grouped as outlined below:

**a) Plant overheads;** are costs that accrue in conjunction with the transformation, fabrication or extraction of raw materials. Typical cost items are listed below:

**- Wages and salaries** (including benefits and social security contributions) of manpower and employees not directly involved in production.

- **Plant supplies**

  - Utilities (water, power, gas, steam...).
  - Effluent disposal.
  - Office supplies.

**- Maintenance**

These cost items should be estimated by the service cost centers where they occur.

**b) Administrative overheads;** should only be calculated separately in cases where they are of considerable importance. Otherwise they could be included under plant overheads. Typical cost items are listed below:

- Wages and salaries.
- Office supplies.
  - Utilities.
  - Communications.
- Engineering.
  - Rents.
  - Insurances (property).
- Taxes (property).

These cost elements should be estimated for administrative cost centers such as managements, bookkeeping and account, legal services and patents, traffic management and public relations.

**c) Marketing overheads;** direct selling and distribution costs, such as special packaging and forwarding costs, commissioning and discounts, should be calculated separately for each product as described in Chapter X. Indirect marketing costs which can not easily be linked directly with the product cost should be treated as overhead costs.

Typical cost items are:

- Wages and salaries.
- Office supplies.
  - Utilities.
- Communications.
- Advertising.
- Training etc.

**d) Depreciation costs;** Annual depreciation charges are frequently included under overhead costs; however, these costs could be shown separately from overhead costs i.e., including them for calculating plant costs and for financial evaluation.

**e) Financial costs;** these costs such as interest on term loans, should be shown as a separate item. When forecasting overhead costs, attention should be given to the problem of inflation. In view of numerous cost items in overhead costs, it will not be possible to estimate their growth individually but as a whole to the magnitude of the overall inflation rate of overhead costs.

The estimation and projection of overhead (indirect) costs are typically tabulated in Schedule VII-1 and VII-2 of Appendix H respectively.

## CHAPTER VIII - HUMAN RESOURCES

### 1. GENERAL

Once the production program, plant capacity technological processes to be employed and plant organization have been determined, the human resources requirement at various levels and during different stages of the project should be defined as well as their availabilities and costs.

The feasibility study should identify the project needs to different categories of human resources, management, staff and workers with sufficient skills and experiences.

### 2. CATEGORIES AND FUNCTIONS

**2.1** Human resources as required for implementation and operation of industrial projects should be defined by categories, such as management and supervision personnel and skilled and unskilled workers and by functions such as general management, production management, production control, machine operation etc.

**2.2** Personnel requirement should be defined by categories and function for preparation of Detailed Manning Table (see Schedule VIII-1 of Appendix I) and Estimation of Personnel Costs (see Schedule VIII-2 of Appendix I).

**2.3** The feasibility study should define the personnel requirements by quantity on a shift-to-shift basis or at the department level and state the qualifications and experience necessary.

**2.4** In order to specify the minimum training and professional experience required for different posts, the kinds of professional staff, skilled labors and unskilled workers should be provided.

### 3. MANNING TABLES

**3.1** Labor planning should start at the department level, defining the labor and staff requirements by functions and categories. The manning table should be set-up according to Schedule VIII-1 of Appendix I.

**3.2** The manning table of the entire project should be obtained by aggregating the department manning tables in Schedule V-III-2 of Appendix I for labor and staff.

**3.3** Available working days per year considering weekends and national holidays, etc. should be specified. The manning tables should be related to a certain production level and show how requirements are expected to develop over a period of time (for example, whether the requirements refer to the first year of operation or some future year, the production level and the number of shifts).

**3.4** The manning tables shall be used to analyze availability and requirement of human resources as well as to estimate operating costs related to these resources.

### 4. AVAILABILITY AND RECRUITMENT

**4.1** The following factors should be given due consideration when availability and employment aspects are analyzed in feasibility study:

- The general availability of relevant human resource categories in the country and project region.
- The supply and demand situation in the project region.
- Requirement policy and methods.
- Training policy and program.

**4.2** Assessments and estimates should as for as possible be explained and justified in feasibility study. For example, a certain technology, safety hazards, sophisticated machinery and equipment, international market orientation and other factors may justify special skills and experience.

**4.3** The study should analyze the ability of the project to attract the human resources required. Recruitment policy and methods should therefore be assessed in the feasibility study.

**4.4** The feasibility study should assess the labor needs and availability of suitable domestic managerial skills and, when foreign assistance is necessary, the duration and conditions of obtaining such assistance should be prescribed.

## 5. TRAINING PLAN

**5.1** Extensive training programs should be designed and carried out as part of the implementation process of investment projects.

**5.2** Training programs may need considerable funds. This may well prove to be the most necessary and appropriate investment. The requirement of training for various levels of plant personnel, the duration of such training for each category, and the location and arrangements for training should be defined.

## 6. COST ESTIMATES

**6.1** The manning tables prepared for each department can be used for estimating labor costs. Practically, nonproduction labor costs should be considered as fixed costs, while the production labor costs as variable costs.

**6.2** The feasibility study should present the estimated labor costs for each department and function. The cost should be divided into foreign and local currency components.

**6.3** When estimating the total; wage and salary costs, provision should be made for the following personnel overhead costs:

- Social security, fringe benefits and welfare cost (if any applicable within Company's policy).
- Installation grants, subsistence payments and similar cash costs that occur in connection with recruitment and employment.
- Annual deposits to pension funds.
- Direct and indirect costs of training.
- Payroll taxes.

**6.4** The total labor costs are to be aggregated and transferred to Schedule X-3 of Appendix K).

## CHAPTER IX - IMPLEMENTATION, PLANNING AND BUDGETING

### 1. GENERAL

**1.1** The project implementation phase embraces the period from the decision to invest to the start of commercial production. A eries of simultaneous and interrelated activities taking place during the implementation phase should be defined.

**1.2** When preparing the implementation plan for the feasibility study, it should also be borne in mind that, at a later stage, this plan will be the basis for monitoring and controlling the actual project implementation.

**1.3** The implementation schedule should present the costs of project implementation, as well as the schedule for the complete cash outflows, in order to allow the determination of the corresponding inflows of funds, as required for financing the investments.

### 2. OBJECTIVES OF IMPLEMENTATION PLANNING

**2.1** As an essential part of the feasibility study a realistic time schedule should be drawn up for the various stages of the project implementation phase.

**2.2** The objectives of project implementation planning is considered to draw the attention of the project planner to the financial implications of project scheduling and to the possibilities of the early detection of implementation delays and their financial consequences.

**2.3** A comprehensive assessment should be made at the feasibility study stage on all of the implementation costs for determining the financial requirements and the accruing financial costs. The costs of this assessment should also constitute a part of the initial investment costs.

**2.4** Implementation planning and budgeting includes the following major tasks:

**2.4.1** Determination of the type of work tasks, on- and off-site, that are necessary to implement the project

**2.4.2** Determination of the logical sequence of events in the work tasks

**2.4.3** Preparation of a time-phased implementation schedule, positioning all the work tasks correctly in time and allowing for adequate time to complete each individual task

**2.4.4** Determination of the resources needed to complete the individual tasks and the extraction of the corresponding costs

**2.4.5** Preparation of an implementation budget and cash flow that will ensure the availability of adequate funds throughout the implementation phase

**2.4.6** Documentation of all implementation data allowing the implementation plan and budget, as well as the forecasts made in the feasibility study, to be updated

### 3. IMPLEMENTATION SCHEDULING

**3.1** Various methods of analysis and scheduling are available. The bar-chart/Gantt chart planning method can be applied to every project, without difficulty. This method gives the best overview of the main sequence of events. Particularly, in a feasibility study and in pre investment phase of the project, the bar chart method is considered to be a sufficient planning tool for implementation planning.

A typical project implementation chart is given under Schedule IX-1 of Appendix J.

## 4. PROJECTING THE IMPLEMENTATION BUDGET

**4.1** The feasibility study should determine the cost of resources in accordance with the timing of the various stages of project implementation. The estimated implementation costs are capitalized. Pre-production costs forming part of the total initial investment costs.

**4.2** The Check-list IX-1 of Appendix J and a schedule for the preparation of the implementation budget (see Schedule IX-2 of Appendix J) are given herein this part. The cost items are based on the implementation activities and tasks determined for the projects including such cost items as; housing, transport. The estimate should include acceptable contingencies for probable price increases when the actual starting date is delayed.

# CHAPTER X - FINANCIAL ANALYSIS AND INVESTMENT APPRAISAL

## 1. SCOPE AND OBJECTIVES OF FINANCIAL ANALYSIS

**1.1** 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 to finance such a project.

**1.2** The financial analysis and final project appraisal should involve the assessment, analysis and evaluation of the required project inputs, the outputs to be produced and the future net profits and should all be mentioned in financial terms.

## 2. PRINCIPAL ASPECTS OF FINANCIAL ANALYSIS AND CONCEPT OF INVESTMENT APPRAISAL

**2.1** An important aspect to be considered when undertaking a financial analysis is that, the decision makers usually give different weights to the various criteria used for investment appraisal. The financial analysis should indicate and highlight any and all of the critical impacts that would have to be considered when appraising a project. The followings are typical aspects in this regards:

**a) Interest of parties involved**

The interest in future net profits is common for each party participating in a project, to cope with this the financial analysis should begin with;

- Determination of the required project inputs and generated outputs, valued at market prices;
- Determination of annual and accumulated net surpluses;
- using the methods described in this chapter, the net profits (yield or profitability) generated by the investment are determined in financial terms.

**b) Public interest**

The public interest can be achieved only when an investment is properly integrated within the business environment (see Chapter III), so an industrial investment should be considered as an integrated part of a socioeconomic and ecological system within which it performs.

**c) Basic criteria for investment decisions**

- Any decision on industrial investments should be based on the following criteria relating to the overall feasibility of investment project:

  - 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 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?

  - 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.

**Note:**

**see the sections on marketing and project strategy in Chapter. III. of "Supply and Material Management".**

**d) Accounting systems**

- Accounting systems always cover the financial status of the firm in terms of the wealth (assets) and obligations (liabilities) recorded in balance sheet, the costs accounted for over the reporting period, and the corresponding income shown in the net income statement.

- The accounting system should determine the 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 should not be classified among the cash outflows, but should be regarded as a cost item, and not as a cash item.

- The financial costs (interest paid) should be included among the cash outflows. However, for the computation of discounted cash flow (IRR and NPV), the financial cost shall be excluded.

- Cost accounting should 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. A profit plan that defines the cost-volume-profit relationship should be constructed.

- 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 Clause 3 on the analysis of cost estimates has already been used in the schedules of Chapters III andIX.

**e) Pricing of project inputs and outputs**

- 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.

- 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.

- 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 rate should be applied to local and imported materials, utilities, labors, etc., when projecting working capitals.

- Price changes should be anticipated in projecting sales price. If relative prices change significantly over time, the future inflation rates and it’s impact on relative prices, and of deciding whether to use current or constant prices.

**f) Planning horizon and project life**

- Planning is the anticipations and assumptions, that should be made about the future need to be explicated and should be analyzed in order to find optimal development path.

- 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 to formulate his investment development plan.

- 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.

- When determining the economic life span of the project, various factors, such as followings should be considered:

  - Duration of demand (position in the product life cycle).
  - Duration of raw materials deposits and supply.
  - Rate of technical progress.
  - Life cycle of the industry.

- Duration of building and equipment.

- Opportunities for alternative investment.

- Administrative constraints.

- 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, and should there be considered when appraising an investment project.

## 3. ANALYSIS OF COST ESTIMATES

**3.1** It is necessary to check carefully all cost items that could have a significant impact on financial feasibility. The estimates should be grouped into local and foreign components and may be expressed either in constant or current (real or nominal terms) prices depending on the price basis used in the feasibility study and for financial analysis allowances for prices increases (contingencies) should be provided.

**3.2** 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 feasibility study.

**3.2.1** Initial investment costs; are defined as the sum of fixed assets and net working capital. Fixed assets constitute the resources required for constructing and equipment of an even investment project. The net working capital correspond to resources needed to operate the project totally or partially.

**3.2.2** Investment required during plant operation; in order to keep a plant in operation, each item should therefore be replaced at the appropriate time and the replacement costs must be included in feasibility study.

**3.2.3** Pre-Production expenditures; including but not limited to the following:

**1)** Expenditures for pre-investment studies. Opportunity, pre-feasibility, feasibility and support of functional studies.

**2)** Consultant fees for preparing studies, engineering, supervision of erection and construction (if not included in fixed investment costs).

**3)** Other expenses for planning the project.

**4)** Salaries, fringe benefit and social security contribution of personnel engaged during the pre-production period.

**5)** Travel expenses.

**6)** Preparatory expenses, such as worker, camps, temporary offices, and stores.

**7)** Pre-Production marketing costs, creation of sales network.

**8)** Training costs, including fees, travel, living expenditures, salaries and stipends of trainees and fees payable to external institutions.

**9)** Know-how and patent fees.

**10)** Interest on loans accrued or payable during construction.

**11)** Insurance costs during construction.

**12)** Trial runs, start-up and commissioning expenditures.

**13)** Important notes:

**a)** Pre-Production expenditures can be tabulated according to Schedule X-2 of Appendix K.

**b)** In allocating pre-production expenditures, one of two practices should generally be followed:

**1)** 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.

**2)** A part of pre-production expenditures may be initially allocated, where attributable, to the respective fixed assets and the sum of both amortized. The rests that are not attributable are capitalized and amortized over a certain period.

### 3.3 Fixed Assets

**3.3.1** Fixed assets comprise fixed investment costs and pre-production expenditures. 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.

**3.3.2** The estimates should include the cost of supply packing and transport, duties and installation charges. Provisions should be made for physical contingency allowances.

**3.3.3** To arrive at the total fixed investment costs, the final amounts derived from Schedules VI-1, and VI-2 of Appendix G and Schedules VII-1, and VII-2 of Appendix H should be inserted in Schedules X-1 and X-2 of Appendix K respectively, and added up.

**3.3.4** Any investment required during the operational phase to maintain the operation of the plant, should be inserted in Schedule X-1 of Appendix K.

### 3.4 Working Capital

**3.4.1** Working capital is defined to embrace current assets (the sum of inventories, marketable securities, prepaid items, accounts receivable and cash), minus current liabilities (accounts payable).

**3.4.2** In the analysis of investment costs, it should be carefully checked whether the initial working capital requirements as well as changes during plant operation are properly considered in the cost estimates.

**3.4.3** 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.

**3.4.4** 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.

**3.4.5** If materials are locally available and in plentiful supply and can rapidly be transported, then only limited stock should be maintained.

If the materials are imported and import procedures are dilatory, then inventories equivalent to as much as six months consumption may be considered for working capital estimate.

**3.4.6** Level of spare parts inventories should depend on the local availability of supplies, import procedures and maintenance facilities in the area, and on the nature of the plant itself.

**3.4.7** Finished product inventory depends on a number of factors, such as the nature of the product and trade usage. The valuation is based on the factory costs plus administrative overhead. (See Schedules X-3 of Appendix K).

**3.4.8** Calculation of working capital at the stage of 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 investment funds such as pre-production expenditures and fixed investment costs.

### 3.5 Schedules for Total Investment Costs and Total Assets

**3.5.1** By adding up the fixed investments, pre-production expenditures and working capital estimates, the total initial investment costs of the project under consideration can be calculated.

**3.5.2** The phasing of such costs, including plant and equipment replacement costs and end-of-life costs (if any) is shown in Schedule X-5 and X-6 of Appendix K. It should be noted that, when phasing the total investment outlay, the initial investments should be inserted in the schedule first, and then subsequent increments, until operation of full capacity is reached.

### 3.6 Production Costs

**3.6.1** The production costs should be calculated as total annual costs and preferably also as cost per unit produced.

Production costs should 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.

**3.6.2** All cost elements required for the calculation of total production costs therefore have to be projected and scheduled in line with the production program and for the full planning period.

**3.6.3** All of the cost items entering into production costs have been described in preceding parts. These cost elements should be assembled in order to arrive at production costs, and Schedule X-3 of Appendix K should be used for this purpose.

**3.6.4** The production costs is estimated by dividing it into following four major categories:

**a) Factory (plant) costs;** including the following cost items:

- Materials, predominately variable costs, such as raw materials, factor supplies and spare parts.

- Labor (production personnel) (fixed or variable costs, depending on type of labor and cost elements).

- Factory/plant overhead costs.

**Note:**

**To arrive at factory/plant costs (Schedule VI-4 of Appendix G), the final amounts drived from Schedules IV-1 of Appendix E,V-3 of Appendix F, VI-1 of Appendix G (if applicable ), VII-1 of Appendix H, and VIII-2 of Appendix I should be inserted in Schedule VI-4 of Appendix G and Schedule X-3 of Appendix K.**

**b) Administrative overheads;** The composition of administrative overhead costs as well as procedures for their computation were described in Chapter VII.

So, all that is need at this stage is to transfer the final amounts from Schedule VII-1 of Appendix H and Schedule VIII-2 of Appendix I to Schedule X-3 of Appendix K.

**c) Depreciation costs;** depreciation costs should be used for computation of the balanced sheet and net income projections, they present investment expenditures (cash outflow during the investment phase) instead of production expenditure (cash outflow during production).

- Depreciation charges should therefore be added back if not cash flows are calculated 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.

### 3.7 Units Costs of Production

**3.7.1** For the purpose of cash flow analysis, it is sufficient to calculate the annual costs. At the feasibility stage, however, an attempt should be made to calculate units costs to facilitate the comparison with sales prices per unit.

**3.7.2** Unit costs are simply calculated by dividing production costs to the number units produced (these unit costs varies with capacity utilization).

### 3.7.3 Direct and indirect costs

**3.7.3.1** Production costs should be divided into direct and indirect costs. Direct costs are attributable to production materials and production labor.

**3.7.3.2** Since indirect costs (plant administrative overheads such as management and supervision, communications, depreciation and financial charges) can not easily be allocated directly to a particular units of output, the direct variable and direct fixed costs should be deducted from the revenues generated by a certain product (group of products) and the remaining surplus or margin together with the margins generated by other products will be available to cover the indirect costs.

### 3.7.4 Marketing costs

**3.7.4.1** Marketing costs comprise the costs for all marketing as described in Chapter III, (see also Schedule III-2 of Appendix D).

## 4. METHOD OF INVESTMENT APPRAISAL

**4.1** For the purpose of investment appraisal, it is necessary to assess and evaluate over a certain period (as defined herein "The planning horizon of the decision maker") all inputs required and all outputs produced by the project. Although the information can be contained in the net income statements and projected balance sheets, but they are sufficient for feasibility evaluation, and therefore the discounted cash-flow concept has become the generally accepted method for investment appraisal.

### 4.2 Definition and Computation of Cash Flows

**4.2.1** Cash flows are basically either receipts of cash (cash inflow) or payments (cash outflow).

**4.2.2** For the purpose of financial planning and determination of the net cash returns of an investment, it is necessary to distinguish between the financial flow, which are related to financing of an investment, and cash flows (expenditures and revenues), representing the performance or operation of the project (operational cash flow.)

**4.2.3** Operational cash flows are shown in Schedule X-6 of Appendix K (discounted cash flow) as:

| OPERATIONAL CASH FLOW IN | OPERATIONAL CASH FLOW OUT |
|---|---|
| - Revenues from selling of fixed assets | - Increase in fixed assets, (investment) |
| - Recovery of salvage valves (end of project) | - Increase in net working capital |
| - Revenues from decrease of networking capital | - Operating costs (see note)* |
| - Sales revenues | - Marketing expenses |
| - Other income due to plant operations | - Production and distribution losses |
| | - Corporate (income) taxes |

**Note:**

**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.**

### 4.3 Cash-Flow Discounting

**4.3.1** 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 future. This difference is expressed as a percentage rate with respect to a given period (usually a year).

**4.3.2** Considering that a project may obtain a certain amount of found F, if this is repaid after one year with an agreed interest I, the total sum to be paid after a year would be F+I, where:

$$F + I = F(1 + r) \qquad \textbf{(Eq. 2)}$$

and r is interest rate.

**4.3.3** If $CF_n$ 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 r is constant):

$$CF_p = CF_n / (1 + r)^n \qquad \textbf{(Eq. 3)}$$

**or**

$$CF_p = CF_n (1 + r)^n \qquad \textbf{(Eq. 4)}$$

**4.4 Main Discounting Method**

**4.4.1** 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 (DCF) method is used for the appraisal of investment projects.

**4.4.2 Net present value**

**4.4.2.1** The present value of a project is defined as the value obtained by discounting at a constant interest rate and separately for each year (i.e., the differences of all annual cash outflows and inflows accuring throughout the life of a project).

**4.4.2.2** 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:

$$NPV = NCF_o + (NCF_1 \times a_1) + (NCF_2 \times a_2) + ....+ (NCF_j \times a_j) \quad \textbf{(Eq. 5)}$$

**or**

$$NPV = \sum_{n=0}^{n=j} \frac{NCF_n}{(1+r)^n} \quad \textbf{(Eq. 6)}$$

**Where:**

| | |
|---|---|
| ***NPV*** | is the annual net (N stands for Net); |
| $NCF_n$ | is cash flow of a project in the years n=1,2 ...j; |
| $a_n$ | is the discount factor in corresponding years, relating to the discount rate applied through the equation. |

$$a_n = (1 + r)^n \quad \textbf{(Eq. 7)}$$

**Note:**

**Discount factors ($a_n$) can be obtained from present value tables.**

**4.4.2.3** The discount rate or cut-off rate should be equal 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. (See the note below).

**Note:**

**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.**

**4.4.2.4** The discount rate should reflect the opportunity cost of capital. i.e., the possible return on investor (financier) would obtain on the same amount of capital if invested elsewhere, assuming the financial risks are the same for both investment alternatives.

**4.4.2.5** The discount rate in the other words should be the minimum rate of return, below which an entrepreneur would consider that it does not pay for him to invest.

**4.4.2.6** 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 count for uncertainty has been included.

**4.4.2.7** An important decision criterion for invest should be not only the profitability of his investment but also deterring the time limit, within which, the capital invested including a certain minimum interest rate could be taken back. So a discounting rate giving positive NPV should be employed. For this, the net cash return on equity should have to be used for discounting.

**4.4.2.8** Schedule X-6 of Appendix K shows that the working capital and the salvage value of fixed assets will be recovered by the end of project life.

In order to obtain the real end-of-life net worth of the assets, any outstanding debt balances should be deducted from the salvage values.

### 4.4.3 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. The ratio of the NPV and the present value of the investment (PVI) required is called the net-present-value ratio (NPVR), and yields a discounted rate of return. The formula is as follows:

NPVR= NPV/PVI

### 4.4.4 Internal rate of return (IRR)

**4.4.4.1** The IRR is the discount rate at which the present value of cash inflows is equal to the present value of cash outflows. This mathematically means that in Equation 6 of this chapter, the value of r should be found for which at defined value for $CF_n$, the NPV equals zero.

**4.4.4.2** The calculation procedure of IRR is the same as one used for calculation of NPV. i.e., a cash flow table should be prepared and an estimated discount rate is then used to discount the net cash flow to the present value.

**4.4.4.3** The following interpolation formula can be used to obtain an acceptable and reliable IRR value.

$$i_r = i_1 + \frac{PV(i_{2-}i_1)}{PV + NV} \qquad \textbf{(Eq. 8)}$$

**Where:**

***$I_r$*** is IRR;

***PV*** is Positive NPV (at lowest discount rate $i_1$);

***NV*** is Negative NPV (at the highest discount rate $i_2$).

**4.4.4.4** The absolute values of PV and NV should be used in Equation 8 and it should be noted that, $i_1$ and $i_2$ should differ by more than one or two percentage point (absolute). The Equation 8 will not yield realistic results if the difference is too large, since the discount rate and NPV are not related linearly.

**4.4.4.5** Table 2 is an example of cash flow discounting. It shows that, discounted at 18 percent, the NPV is steel positive, but it becomes negative at 20 percent. Consequently the proposed IRR should lie between 18 and 20 percent.

**TABLE 2 - EXAMPLE OF CASH FLOW DISCOUNTING**

| YEAR | ANNUAL NET CASH FLOW (THOUSAND DOLLARS) | DISCOUNT FACTOR AT 18 PERCENT | NPV (THOUSAND DOLLARS) | DISCOUNT FACTOR AT 20 PERCENT | NPV (THOUSAND DOLLARS) |
|---|---|---|---|---|---|
| 1 | (3291) | 1.000 | (3291) | 1.000 | (3291) |
| 2 | (5127) | 0.847 | (4343) | 0.833 | (4271) |
| 3 | (88) | 0.718 | (63) | 0.694 | (61) |
| 4 | 1722 | 0.609 | 1049 | 0.579 | 997 |
| 5 | 2700 | 0.516 | 1393 | 0.482 | 1301 |
| 6 | 3343 | 0.437 | 1461 | 0.402 | 1344 |
| 7 | 2259 | 0.370 | 836 | 0.335 | 757 |
| 8 | 1208 | 0.314 | 339 | 0.279 | 337 |
| 9 | 2192 | 0.266 | 583 | 0.233 | 511 |
| 10 | 2170 | 0.225 | 488 | 0.194 | 421 |
| 11 | 2170 | 0.191 | 414 | 0.162 | 352 |
| 12 | 1995 | 0.162 | 323 | 0.135 | 269 |
| 13 | 1805 | 0.137 | 247 | 0.112 | 202 |
| 14 | 1805 | 0.116 | 209 | 0.093 | 168 |
| 15 | 1805 | 0.099 | 177 | 0.078 | 141 |
| 16 | 1805 | 0.084 | 152 | 0.065 | 117 |
| 17 | 1805 | 0.071 | 128 | 0.054 | 97 |
| 18 | 2723 | 0.060 | 163 | 0.045 | 123 |
| Accumulated total | --- | --- | 265 | --- | (486) |

**Notes:**

**1) Figures in parentheses are negative.**

**2) 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.**

### 4.4.5 Annual rate of return (ARR)

**4.4.5.1** The annual rate of return (some times may be referred to as simple rate of return) method relies on the operational accounts (see note here below). It is defined as the ratio of the annual net profit on capital. However, it may also be calculated for various degrees of capacity utilization (sensitivity analysis) or for different years during start-up phase. Eq. 9 is used to calculate annual rate of return.

$$R = \frac{NP + I}{K} \times 100 \qquad \textbf{(Eq. 9)}$$

**Where:**

***R*** is annual rate of return, in (percent);

***NP*** is net profit (after deduction of interest charges and taxes);

***I*** is the interest;

***K*** is the total investment cost (fixed assets and working capital).

**4.4.5.2** The annual rate of return method has a few serious disadvantages which should be taken into account. Since this method uses annual data, it is difficult to choose the normal (representative) year of the project as the basis for calculation. So it is recommended to use an average rate of return (accumulated net profits divided by the number of years) which would solve the problem of selecting the representative year.

**4.4.6 Sensitivity analysis**

**4.4.6.1** 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.

**4.4.6.2** To determine the critical variables the structure of cash flows should be analyzed 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. With the help of sensitivity analysis it is possible to identify the most important project inputs, such as raw materials, labor and energy, and to determine any possibilities of input substitution, as well as the critical elements of the marketing concept (see note below).

**Note:**

**When analyzing 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.**

**4.4.7 Break-Even analysis**

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

**4.4.7.2** When sales (and the 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 breakeven 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 program includes a variety of products, for any given breakeven sales volume there would exist a variety of combinations of product prices, but no single break-even price.

**4.4.7.3** 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;

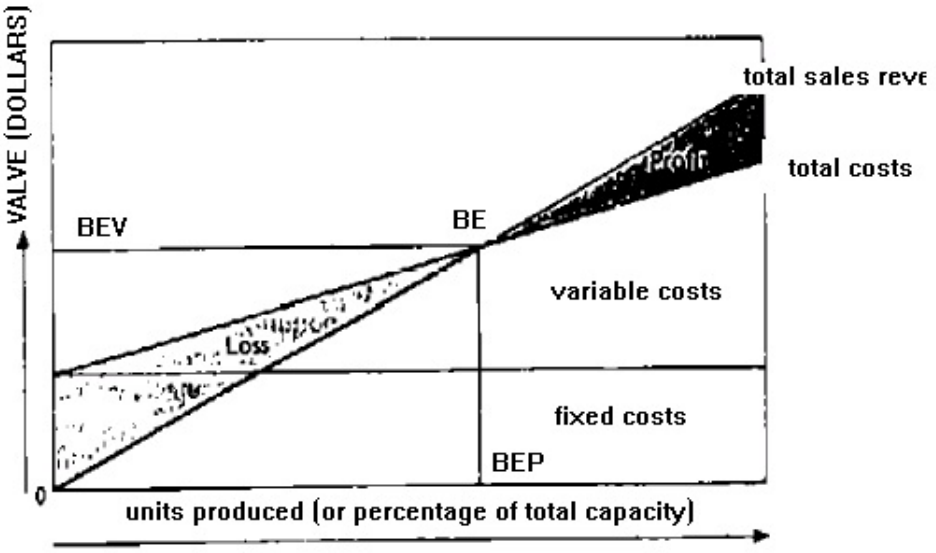
- The level of unit sales prices and variable and fixed operating costs remain constant, that is, the price elasticity of demand for inputs and outputs is zero;

- 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.

**4.4.7.4** Since the above assumptions may 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.

**4.4.7.5** For the interpretation of the results of break-even analysis, a graphical presentation (see Fig. 2) 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, analysis can often identify potential weaknesses.

**4.4.7.6** 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.




notes: all costes an sales are annual valves
BEV= break even valve
BEP= break even production

**DETERMINATION OF THE BREAK-EVEN CONDITIONS**

**Fig. 2**

**Note:**

**For further information on cost structures, analysis of critical cost variables, investment costs, production cost analysis, profitability etc. see;**

**1) "Chapters IX and X of the Manual for the Preparation of Industrial Feasibility Studies", issued by UNIDO, November, 1991.**

**2) American National Standard for "Cost Engineering", July, 1992.**

## APPENDICES

## APPENDIX A

## OUTLINE OF GENERAL OPPORTUNITY STUDY

### A.1 Outline of an Area Study

**1)** Basic features of the area: area size and leading physical features, with maps showing the main characteristics.

**2)** Population, occupational pattern, per capita income and socio-economic back-ground of the area, highlighting differences in the area considered.

**3)** Leading exports from and imports to the area.

**4)** Basic exploited and potentially exploitable production factors.

**5)** Structure of any existing manufacturing industry utilizing local resources.

**6)** Infrastructural facilities, especially in the field of transport and power, fuel, water, conductive to development of industries.

**7)** A comprehensive check-list of industries that can be developed on the basis of the available resources and infrastructural facilities.

**8)** A check-list revising the one mentioned in item 7 by a process of elimination, excluding the following industries:

- Those for which present local demand is too small and transport costs are too high.
- Those which face too severe competition from adjoining areas.
- Those which can be more favorably located in other areas.
- Those which would have unacceptable environmental impacts.
- Those which require feeder industries not available in the area.
- Those requiring substantial export markets, if the area is located in the interior and transport to the port is difficult or freight costs are high.
- Those for which markets are distantly located.
- Those which are geographically not suited to the area.
- Those which do not fit in with national plan priorities and allocations.

**9)** Estimation of present demand and identification of opportunity for development based on other studies or secondary data, such as trade statistics, for the list of industries left after the revision referred to in item 8.

**10)** Identification of recommendable project objectives and suitable strategies determining the type and scope of the project, including approximate capacities of new or expanded Units that could be developed.

**11)** Estimated capital costs of selected projects (lump sum), taking into account the following:

- Land.
- Technology.
- Equipment.
- Production equipment.
- Auxiliary equipment.

- Service equipment.
- Spare parts, wear-and-tear parts, tools.
- Civil engineering works.
- Site preparation and development.
- Buildings.
- Outdoor works.
- Project implementation.
- Pre-Investment capital expenditures, including expenditures for preparatory investigations.
- Working capital requirements.

**12) Major input requirements**

For each project approximate quantities of essential inputs should be estimated, 50 as to obtain the total input requirements. Sources of inputs should be stated and classified (local, shipped from other areas of the country, or imported). Inputs should be classified as follows:

- Raw materials.
- Processed industrial materials and components.
- Factory supplies, such as auxiliary materials and utilities.
- Labor.

**13) Further project requirements**

**13.1** Estimated production costs to be derived from item 12.

**13.2** Estimated annual sales revenues.

**13.3** Organizational and management aspects typical for the industry.

**13.4** An indicative time schedule for project implementation.

**13.5** Estimated level of total investment contemplated in projects and peripheral activities, such as development of infrastructure.

**13.6** Projected and recommended sources of finance (estimated).

**13.7** Estimated foreign exchange requirements and earnings (including savings).

**13.8** Financial evaluation: approximate pay-off period, approximate rate of return. Assessment of possible enlargement of product-mix, increased profitability and other advantages of diversification (if applicable).

**13.9** A tentative analysis of overall economic benefits, and especially those related to national economic objectives, such as balanced dispersal of economic activity, estimated saving of foreign exchange, estimated generation of employment opportunities, and economic diversification. Indicative figures based on reference programming data, such as surveys and related studies, secondary data and data on the performance of other similar industrial establishments should be sufficient for this purpose.

**A.2 Outline of Resource-Based Opportunity Studies**

**1)** Characteristics of the resource, prospective and proven reserves, past rate of growth and potential for future growth.

**2)** Role of the resource in the national economy, its utilization, demand in the country and exports.

**3)** Industries currently based on the resources, their structure and growth, capital employed and labor engaged, productivity and performance criteria, future plans and growth prospects.

**4)** Major constraints and conditions in the growth of industries based on the resource.

**5)** Estimated growth in demand and prospects of export of items that could utilize the resource.

**6)** Identification of investment opportunities based on items A.2.3, A.2.4 and A.2.5.

The items numbered from 11 to 13.9 from Section A.1 of this Appendix follow items of the resource based opportunity studies, since the structural requirements of the studies are the same once the investment opportunities have been identified.

### A.3 Outline of Other Factor-Based Opportunity Studies

**1)** Present size and growth rates of demand for items that are not imported and for those which are wholly or partially imported.

**2)** Rough projections of demand for each item.

**3)** Identification of the items in short supply that have growth or export potential.

**4)** A broad survey of the raw materials indigenously available.

**5)** Identification of opportunities for development based on headings items A.1.2, A.1.5 and A.1.6, and on other important factors such as transport costs and available or potentially available infrastructure.

The items numbered from A.1.10 to A.1.13.9 in Section A.1 of this Appendix follow item A.1.7 of the subsector opportunity studies, since the structural requirements of the studies are the same once the investment opportunities have been identified.

## APPENDIX B
## OUTLINE OF PRE-FEASIBILITY STUDY

**B.1 Executive Summary-A Synoptic Review of All the Essential Findings of Each Chapter.**

**B.2 Project Background and History:**

- Project sponsors.
- Project history.
- Cost of studies and investigations already performed.

**B.3 Market Analysis and Marketing Concept:**

- Definition of the basic idea of the project, objectives and strategy.
- Demand and market.
- Structure and characteristics of the market.
- The estimated existing size and capacities of the industry (specifying market leaders), its past growth, estimated future growth (specifying major programs of development), local dispersal of industry, major problems and prospects, general quality of goods.
- Past imports and their future trends, volume and prices.
- Role of the industry in the national economy and the national policies, priorities and targets related or assigned to the industry.
- Approximate present size of demand, its past growth, major determinants and indicators.
- Marketing concept, sales forecast and marketing budget.
- Description of the marketing concept, selected targets and strategies.
- Anticipated competition for the project from existing and potential local and foreign producers and supplies.
- Localization of markets and product target group.
- Sales program.
- Estimated annual sales revenues from products and by-products (local and foreign).
- Estimated annual costs of sales promotion and marketing.
- Production program required.
- Products.
- By-Products.
- Wastes (estimated annual cost of waste disposal).

**B.4 Material Inputs (Approximate Input Requirements, Their Present and Potential Supply Positions, and a Rough Estimate of Annual Costs of Local and Foreign Material Inputs):**

- Raw materials.
- Processed industrial material.
- Components.
- Factory supplies.
- Auxiliary materials, utilities.

**B.5 Location, Site and Environment:**

- Pre-selection, including, if appropriate, an estimate of the cost of land.
- Preliminary environmental impact assessment.

**B.6 Project Engineering:**

- Determination of plant capacity.
- Feasible normal plant capacity.
- Quantitative relationship between sales, plant capacity and material inputs.
- Preliminary determination of scope of project.
- Technology and equipment.
- Technologies and processes that can be adopted, given in relation to capacity.
- Technology description and forecast.
- Environmental impacts of technologies.
- Rough estimate of costs of local and foreign technology.
- Rough layout of proposed equipment (major components).
- Production equipment.
- Auxiliary equipment.
- Service equipment.
- Spare parts, wear and tear parts, tools.
- Rough estimate of investment cost of equipment (local and foreign), classified as above.
- Civil engineering works.
- Rough layout of civil engineering works, arrangement of buildings, short description of construction materials to be used.
- Site preparation and development.
- Buildings and special civil works.
- Outdoor works.
- Rough estimate of investment cost of civil engineering works (local and foreign), classified as above.

**B.7 Organization and Overhead Costs:**

- Rough organizational layout.
- General management.
- Production.
- Sales.
- Administration.
- Estimated overhead costs.
- Factory.
- Administrative.
- Financial.

**B.8 Human Resources:**

- Estimated human resource requirements, broken down into labor and staff and into major categories of skills (local/foreign).
- Estimated annual human resource costs, classified as above, including overheads on wages and salaries.

**B.9 Implementation Scheduling:**

- Proposed approximate implementation time schedule.
- Estimated implementation costs.

**B.10 Financial Analysis and Investment:**

- Total investment costs.
- Rough estimate of working capital requirements.
- Estimated fixed assets.
- Project financing.
- Proposed capital structure and proposed financing (local and foreign) cost of finance.
- Production cost (significantly large cost items to be classified by materials, personnel and overhead costs, as well as by fixed and variable costs).
- Financial evaluation based on the above-mentioned estimated values.
- Payback period.
- Simple rate of return.
- Break-even point.
- Internal rate of return.
- Sensitivity analysis.
- National economic evaluation (economic cost-benefit analysis).
- Preliminary tests, for example, of
    - Foreign exchange effects.
    - Value-added generated.
    - Absolute efficiency.
    - Effective protection.
    - Employment effects.
    - Determination of significant distortions of market prices (foreign exchange, labor, capital).
    - Economic industrial diversification; estimate of employment-creation effect.

**Note:**

**Additional information may be taken from the detailed check-lists and schedules given in each chapters of this Standard Specification.**

**APPENDIX C**

**SCHEDULE II-1- COSTS OF PRE-INVESTMENT STUDIES**

**AND PREPARATORY INVESTIGATIONS**

**(INSERT IN SCHEDULE X-2)**

**Project:**

**Date:**

**Source:**

**Currency:** **Units:**

| ITEM DESCRIPTION | COSTS OF FOREIGN COMPONENTS | COSTS OF LOCAL COMPONENTS | TOTAL COSTS | YEAR |
|---|---|---|---|---|
| Pre-investment studies<br>…<br>…<br>… | | | | |
| Total costs .pre-investment studies | | | | |
| Preparatory investigations<br>…<br>…<br>… | | | | |
| Total costs Preparatory investigations | | | | |
| Grand total | | | | |

**APPENDIX D**

**SCHEDULE III-1-, PROJECTED SALES PROGRAM**

**(INSERTED IN SCHEDULES X-6)**

**project:**

**Date:**

**Source:**

| PRODUCT/COST CENTER:<br><br>CODE: | | | MAKET: | | | CURRENCY:<br><br>UNITS: | |
|---|---|---|---|---|---|---|---|
| YEAR | LOCAL SALES | | | EXPORTS | | | TOTAL REVEUES |
| | UNITS SOLD | PRICE | REVEUES | UNITS SOLD | PRICE | REVEUES | |
| | | | | | | | |

**(to be continued)**

**APPENDIX D (continued)**

**SCHEDULE III-2 - ESTIMATE OF TOTAL MARKETING COSTS (DIRECT/INDIRECT COSTS OF SALES AND DISTRIBUTION) (INSERT IN SCHEDULE III-3)**

**project:**

**Date:** **[I Direct costs**

**Source:** **[I Indirect costs**

| PRODUCT/COST: | MARKET: (LOCAL,EXPORT) | | CURRENCY: UNITS: | |
|---|---|---|---|---|
| CODE: | COST PROJECTIONS FOR YEAR: | | | |
| COST ITEM | LOCAL COSTS | | FOREIGN COSTS | |
| | VARIABLE PER UNIT | FIXED PER PERIOD | VARIABLE PER UNIT | FIXED PER PERIOD |
| | | | | |
| TOTAL UNIT COSTS | | | | |
| TOTAL UNITS PER PERIOD | | | | |
| TOTAL COSTS PER PERIOD | | | | |
| TOTAL MARKING COSTS | | | | |

**Note:**

**Units of products sold are defined in Schedule III-1 for each product. The grand total for each profit center may be computed using the same forms. However, data may also be introduced directly into the data input file of the UNIDO COMFAR system.**

**(to be continued)**

**APPENDIX D (continued)**

**SCHEDULE III-3 - PROJECTION OF TOTAL MARKETING COSTS**

**(INSERT IN SCHEDULE X-3 AND X-9 OF APPENDIX K)**

**project:**

**Date:**

**Source:**

| PRODUCT/COST CENTER:<br><br>CODE: | MAKET: | CURRENCY:<br><br>UNITS: |
|---|---|---|

| YEAR | LOCAL SALES | | | EXPORTS | | | GRAND TOTAL |
|---|---|---|---|---|---|---|---|
| | VARIABLE | FIXED | TOTAL | VARIABLE | FIXED | TOTAL | |
| | | | | | | | |

**Note:**

**Units of products sold are defined in Schedule III-1 for each product. The grand total for each profit center may be computed using the same forms. However, data may also be introduced directly into the data input file of the UNIDO COMFAR system.**

**APPENDIX E**

**SCHEDULE IV-1 ESTIMATE OF COSTS OF RAW MATERIALS AND SUPPLIES (INSERT IN SCHEDULE IV-2)**

**project:**

**Date:**

**Source:**

| Product/cost center | | First year of production | | | Currency<br>Units | |
|---|---|---|---|---|---|---|
| | | Cost projections for year | | | | |
| Cost item | F L | Quantity | Line | cost per unit | Total costs | Variable Share of Total % |
| | | | | | | |
| Total unit cost ,local | | | | | | |
| Total unit cost foreign | | | | | | |
| Total unit per period | | | | | | |
| Total cost per ,period local | | | | | | |
| Total cost per period foreign | | | | | | |
| Total cost of raw materials And supplies | | | | | | |

F- foreign L-local

**(to be continued)**

**APPENDIX E (continued)**

**SCHEDULE IV-2, - ESTIMATE OF COSTS OF RAW MATERIALS AND SUPPLIES (INSERT IN SCHEDULE IV-3)**

**project:**

**Date:**

**Source:**

| Product/cost centre | First year of production | | Currency<br><br>Units | |
|---|---|---|---|---|
| | Cost projections for year | | | |
| Cost item | LOCAL COSTS | | FOREIGN | |
| | VARIABLE<br>Per unit | Fixed<br>Per period | VARIABLE<br>Per unit | Fixed<br>Per period |
| | | | | |
| Total unit cost | | | | |
| Total unit per period | | | | |
| Total unit per period | | | | |
| Total cost of raw materials and supplies | | | | |

**Note:**

**Units of products sold are defined in Schedule III-1 for each product. The grand total for each profit center may be computed using the same forms. However, data may also be introduced directly into the data input file of the UNIDO COMFAR system.**

**(to be continued)**

**APPENDIX E (continued)**

**SCHEDULE IV-3 - PROJECTION OF TOTAL COSTS OF RAW MATERIALS AND SUPPLIES (INSERT IN SCHEDULE X-3 OF APPENDIX K)**

**project:**

**Date:**

**Source:**

| Product/cost centre | | | First year of production | | Currency<br><br>Units | | |
|---|---|---|---|---|---|---|---|
| Year | Total local costs | | | Total foreign costs | | | Grand total |
| | VARIABLE | FIXED | TOTAL | VARIABLE | FIXED | TOTAL | |
| | | | | | | | |

**APPENDIX F**

**SCHEDULE V-1, ESTIMATE OF INVESTMENT COSTS: LAND AND SITE PREPARATION (INSERT IN SCHEDULE X-1 OF APPENDIX K)**

**project:**

**Date:** **I]Construction phase**

**Source:** **I] operational phase**

| ESTIMATE OF INVESTMENT COSTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Landsite preparation | | | | | Currency units | | | |
| N | C | V | Item description | Unit Cost | Cost | | | Year* |
| | | | | | Foreign | local | total | |
| | | | Purchase price of land<br>Tares<br>Legal expentes<br>…<br><br>lump-sun payments for purchasing oplions<br>rights of way<br>etc<br><br>site preparation works<br>equipment<br>site clearing works<br>etc<br><br>(for investment costs environmental project see schedule V.2) | | | | | |
| Total investment costs Land and site preparation (carry over to schedule x.1) | | | | | | | | |

N=NUMBER U=unit Q=quantity

**a Of investment.**

**(to be continued)**

**APPENDIX F (continued)**

**SCHEDULE V-2 - ESTIMATE OF INVESTMENT COSTS:**

**ENVIRONMENTAL PROTECTION MEASURES**

**(INSERT IN SCHEDULE X-1 OF APPENDIX K)**

**project:**

**Date:** **I] Construction phase**

**Source:** **I] Operational phase**

**I] Post- operational phase**

| ESTIMATE OF INVESTMENT COSTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Environmental protection measures | | | | | Currency Units | | | |
| N | C | V | Item description | Unit Cost | Cost | | | Year* |
| | | | | | Foreign | local | total | |
| | | | | | | | | |
| Total investment costs Land and site preparation (carry over to schedule x.1) | | | | | | | | |

N=NUMBER U=unit Q=quantity

**a Of investment.**

**(to be continued)**

**APPENDIX F (continued)**

**SCHEDULE V-3 - ESTIMATE OF OPERATING COSTS RELATED TO THE SITE (INSERT IN SCHEDULE VI-4 OF APPENDIX G OR CHAPTER VII)**

**project:**

**Date:** **I] Direct costs**

**Source:** **I] Indirect costs**

| **Product/cost centre**<br><br>**CODE:** | **First year of production** | | **Currency**<br><br>**Units** | |
|---|---|---|---|---|
| | **Cost projections for year:** | | | |
| **Cost item** | **LOCAL COSTS** | | **FOREIGN** | |
| | **VARIABLE**<br>**Per unit** | **Fixed**<br>**Per period** | **VARIABLE**<br>**Per unit** | **Fixed**<br>**Per period** |
| | | | | |
| **Total unit cost** | | | | |
| **Total unit per period** | | | | |
| **Total unit per period** | | | | |
| **Total local and foreign Costs related the site** | | | | |

**(to be continued)**

**APPENDIX F (continued)**

**SCHEDULE V-4 - ESTIMATE OF OPERATING COSTS RELATED TO ENVIRONMENTAL PROTECTION MEASURES (INSERT IN SCHEDULES VI-4 OF APPENDIX G)**

**project:**

**Date:**

**Source:**

**I] operational phase**

**I]post-operational phase**

**I] Direct costs**

**I] Indirect costs**

| Product/cost centre<br><br>CODE: | First year of production | | Currency<br><br>Units | |
|---|---|---|---|---|
| | Cost projections for year: | | | |
| Cost item | LOCAL COSTS | | FOREIGN | |
| | VARIABLE<br>Per unit | Fixed<br>Per period | VARIABLE<br>Per unit | Fixed<br>Per period |
| | | | | |
| Total unit cost | | | | |
| Total unit per period | | | | |
| Total unit per period | | | | |
| Total local and foreign Environmental class | | | | |

**APPENDIX G**

**SCHEDULE VI-1, ESTIMATE OF TECHNOLOGY COSTS**

**(INSERT IN SCHEDULES VI-4, X-3 AND X-1 OR X-2 OF APPENDIX K)**

**a) Technology selected (description, specifications, suppliers...)**

**b) Costs:**

| LUMP-SUM PAYMENTS (incorporated fixed assets) [a] | | | | |
|---|---|---|---|---|
| Technology. know .how | LUMP-SUM PAYMENTS | | | year |
| | Foreign | Local | Total | |
| | | | | |
| Total | | | | |

| Fixed royalty payments (operating or marking costs) [b] | | | | |
|---|---|---|---|---|
| year | Technology. know .how | Royalty payments | | |
| | | Foreign | Local | Total |
| 1<br>2<br>3<br>.<br>.<br>n | | | | |

| Royalty payments (_%of annual sales revenues)[b] | | | | |
|---|---|---|---|---|
| year | Technology. know .how | Royalty payments | | |
| | | Foreign | Local | Total |
| 1<br>2<br>3<br>.<br>.<br>n | | | | |

[a] **Insert in Schedule 1 of Appendix L or Schedules 2/2 of Appendix H or Schedule 2 of Appendix L.**

[b] **Insert in Schedules 4 of Appendix F and Schedule 3 of Appendix L.**

**(to be continued)**

**APPENDIX G (continued)**

**SCHEDULE VI-2/1- ESTIMATE OF INVESTMENT COSTS:**

**PLANT MACHINERY AND EQUIPMENT (INSERTINSCHEDULEVI2/2)**

**project:**

**Date:** **I]Construction phase**

**Source:** **I] operational phase**

| ESTIMATE OF INVESTMENT COSTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Plant machinery and equipment | | | | | Currency units | | | |
| Main plant item or plant unit [a] | | | | | | | | |
| N | Q | V | Item description[b] | Unit Cost | Cost | | | Year* |
| | | | Plant machinery[c] | | Foreign | local | total | |
| | | | Per. moring unit<br>Heat exchange<br>Derlilling column<br>Pectification unit<br>etc<br>Plant equipment<br>…<br>…<br>… | | | | | |
| Total investment costs<br>Plant unit (item)<br>(carry over to schedule V:2/2) | | | | | | | | |

N=NUMBER U=unit Q=quantity

[a] Insert name or description of plant or main plant item.

[b] Plant machinery, plant equipment, auxiliary and service equipment, primary stock of spare parts, wear and tear parts, tools etc.

[c] Insert detailed list of individual items.

[d] Of investment.

(to be continued)

**APPENDIX G (continued)**

**SCHEDULE VI-2/2- SUMMARY SHEET OF INVESTMENT COSTS:**

**MACHINERYANDEQUIPMENT(INSERTINSCHEDULEX1OFAPPENDIX K)**

**project:**

**Date:** **I]Construction phase**

**Source:** **I] operational phase**

| | | | | | |
|---|---|---|---|---|---|
| | | | | | **SUMMARY SHEET OF INVESTMENT COSTS** |
| | **Plant machinery and equipment [ ]**<br>**Auxiliary and service plant [ ]**<br>**Envrionmental protection**<br>**Plant machinery fixed assets [ ]**<br>**Stock of primary spare plants etc [ ]** | | | | **Currency :**<br><br><br>**Units:** |
| **N** | **Main plant item or Plant unit (cost centre)** | **Cost** | | | **Year[b]** |
| | **Insert from schedule VI-2/1** | **Foreign** | **Local** | **Total** | |
| | | | | | |
| | **Total investment cost (carry over to schedule X-1)** | | | | |

**N=number**

**Note:**

**For the purpose of economic cost-benefit analysis, local (foreign) cost elements contained in imported (national) equipment should be identified.**

**[a] Use different sheets for each item.**

**[b] Of investment (if necessary show subtotals for each year and plant item).**

**(to be continued)**

**APPENDIX G (continued)**

**SCHEDULE VI-3/1- ESTIMATE OF INVESTMENT COSTS:**

**CIVIL ENGINEERING WORKS (INSERT IN SCHEDULE VI-3/2)**

**project:**

**Date:** **I]Construction phase**

**Source:** **I] operational phase**

| ESTIMATE OF INVESTMENT COSTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Civil engineering work[a] | | | | | Currency units | | | |
| Man plant item or plant unit[b] | | | | | | | | |
| N | Q | V | Item description[c] | Unit Cost | Cost | | | Year* |
| | | | Structures [d] … … … | | Foreign | local | total | |
| Total investment costs cant unit (item) (carry over to schedule VI.3.2) | | | | | | | | |

N=number U=unit Q=quantity

[a] Covering construction works, structures, buildings etc., but not site preparation (see Schedule V-1).

[b] Insert name or description of plant or main plant item.

[c] Structures, stores, factory buildings, office buildings, office equipment etc.

[d] Insert detailed list of individual items.

[e] Of investment.

(to be continued)

**APPENDIX G (continued)**

**SCHEDULE VI-3/2 - SUMMARY SHEET OF INVESTMENT COSTS:**

**CIVIL ENGINEERING WORKS (INSERT IN SCHEDULE X-1 OF APPENDIX K)**

**project:**

**Date:** **I]Construction phase**

**Source:** **I] operational phase**

| SUMMARY SHEET OF INVESTMENT COSTS | | | | | |
|---|---|---|---|---|---|
| Civil works structures out door works etc. [ ]<br>Buildings [ ]<br>Incorporated fixed assets [ ]<br>Civil works for environmental protection [ ] | | Currency :<br><br><br>Units: | | | |
| N | Main plant item or Plant unit (cost centre) | Cost | | | Year[b] |
| | Insert from schedule VI-3/1 | foreign | Local | Total | |
| | | | | | |
| Total investment cost (carry over to schedule X-1) | | | | | |

N=number

**Note:**

**For the purpose of economic cost-benefit analysis, local (foreign) cost elements contained in imported (national) equipment should be identified.**

**[a] Use different sheets for each item.**

**[b] Of investment (if necessary show subtotals for each year and plant item).**

**(to be continued)**

**APPENDIX G (continued)**

**SCHEDULE VI-4/1 - ESTIMATE OF PLANT COSTS**

**(INSERT IN SCHEDULE VI-4/2)**

**project:**

**Date:** **I]Construction phase**

**Source:** **I] operational phase**

| Product/cost centre<br><br>CODE: | First year of production | | Currency<br><br>Units | |
|---|---|---|---|---|
| | Cost projections for year: | | | |
| Cost item | Local costs | | Foreign costs | |
| | VARIABLE<br>Per unit | Fixed<br>Per period | VARIABLE<br>Per unit | Fixed<br>Per period |
| Rea materials (from IV.1)<br>Factory supplies (from IV.1)<br>Overheat costs of | | | | |
| Total unit costs | | | | |
| Total unit per period | | | | |
| Total costs per period | | | | |
| Total local and foreign factory costs | | | | |

**(to be continued)**

**APPENDIX G (continued)**

**SCHEDULE VI-4/2 - PROJECTION OF PLANT COSTS**

**(INSERT IN SCHEDULE X-3 OF APPENDIX K)**

**project:**

**Date:**

**Source:**

| Product/cost centre<br><br>CODE: | | First year of production | | | | Currency<br><br>Units | |
|---|---|---|---|---|---|---|---|
| year | Total local costs | | | Total factory casts | | | Giand total |
| | VARIABLE | Fixed | Total | VARIABLE | Fixed | total | |
| | | | | | | | |

**Note:**

**Units of products sold are defined in Schedule III-1 for each product. The grand total for each profit center may be computed using the same forms. However, data may also be introduced directly into the data input file of the UNIDO COMFAR system.**

**(to be continued)**

**APPENDIX G (continued)**

**CHECK-LIST VI-1 ENGINEERING AND TECHNOLOGY**

**Production program and plant capacity**

- Describe and justify the production program and plant capacity in relation to:
  - Market requirements and marketing strategy.
  - Input requirements and supply program.
  - Technology and economics of scale in the industry.
  - Minimum economic size and equipment constraints.
  - Resource and input constraints.
  - Project alternatives.

**Technology choice**

- Describe the technology to the extent significant for the project, and state the reasons for selection in relation to:
  - The basic project objectives and strategy.
  - Socio-Economic impacts.
  - Ecological impacts (environment impact assessment).
  - Technology development (technology forecast).
  - Input requirements and constraints.
  - Availability and possible alternatives.
- Describe and justify the preliminary project plan and layout selected and prepare diagrams and data as required for technology assessment and evaluation.
- Assess the technology and identify and consider alternatives and critical elements relating, for example, to:
  - Market and input requirements.
  - Production program and plant capacity.
  - Economies of scale and minimum economic capacity.
  - Infrastructure required and available.
  - Technology absorption capacity.
  - Hazards and ecological (environmental) impacts.
  - Availability, industrial property rights etc.
  - Evaluate the technologies assessed and justify the choice.

**Technology acquisition and transfer**

- Describe in the feasibility study critical elements of technology acquisition and transfer, including any significant conclusions and recommendations with regard to:
  - Licensing.
  - Disaggregation of the technology package.
  - Suppliers and available alternatives.
  - Contractual terms and conditions.
  - Negotiation strategies and purchase of technology.
  - Participation of the license holder, foreign equity participation.
  - Costs of technology.
  - Technology transfer.

**(to be continued)**

**APPENDIX G (continued)**

- Describe technology, know-how and related services to be performed by the Licensor, in particular:
  - Duration and renewal of agreement.
  - Non-restricted use of unpatented know-how after expiry of agreement.
  - Full and complete transfer of know-how available with Licensor.
  - Warranty on technology.
  - Access to improvements during period of agreement.
  - Industrial property rights usage rights on all patents and proprietary know-how and choice as to use of brand names.
  - Supply of imported components and intermediate products by Licensor exercise of option by Licensee and determination of suitable pricing formula.
  - Training, both in-plant and in the plant of the Licensor.
  - Territorial sales rights avoidance of undue restrictions.
- Other licensing terms:
  - Payments: lump-sum or royalty or combination.
  - Other provisions relating to governing law; settlement of disputes; confidentiality; quality control; sub licensing; reporting; assign ability, force majeure etc.
- Define adequate measures to be undertaken for technology absorption.
- Identify and recommend a program for continuing technology assessment, monitoring and forecasting in the relevant field of production.

**Plant layout and basic engineering**

- After selection of technology, prepare the plant layout, drawings, basic design and engineering. These charts and drawings should adequately reflect the interrelationship between environmental conditions and constraints, socio-economic infrastructure, technology, equipment, constructions and material flows and inputs.
- Make sure that the plant layout and basic engineering:
  - Are in accordance with the technology and know-how selected.
  - Are determined in relation to various equipment categories such as basic plant and production, auxiliary, testing and research, and replacement equipment, including spare parts and tools.
  - Provide for the levels of local integration or value-added sought to be achieved in the various processes of production.
  - Provide for the required levels of automation considered necessary for competitive production, and where a substantial level of automation is required, provide for skill development for operations and maintenance.
  - Consider any possible constraints and limitations in ordering capital equipment, including foreign exchange and government policies on machinery and maintenance equipment imports.
  - Take into account the availability of locally manufactured machinery and equipment including costs and delivery period.
  - Provide for specialized erection and installation of machinery that may be necessary.

**(to be continued)**

**APPENDIX G (continued)**

**CHECK-LIST VI-2 SUBDIVISION OF COST ESTIMATE**

**Site**

Land purchase, including all costs of purchase. Soil survey.
Survey of special hazards, such as earthquakes, flooding and abnormal meteorological conditions.

**Site preparation and development**

Location and relocation of structures, pipes, cables, power lines, roads.
Demolition and removal of existing structures and foundations.
Wrecking, grubbing.
Site grading, cutting and filling to establish general job levels but not detailed grading.
Diversion of streams etc.
Road improvements and diversions.
Railway sidings and improvements.
Pipe corridors.
Dock and wharfage requirements.
Water supply contribution.
Electric power supply contributions (high and low tension).
Sewerage and waste disposal works.
Communications (telephone, telex, fax etc.).
Temporary work for plant construction, if not covered under unit prices of civil works (site overheads).
Landscaping, including plants, grass, sods, water basins etc.

**Civil works-outdoor works, structures**

Foundations, pile foundations, slurry trench walls, walls, soil consolidation.
Drainage, lowering of groundwater table.
Steel sheet piling, ramps.
Foundations for all kinds of heavy equipment.

**Civil works-buildings**

Main plant buildings.
Plant structural steelwork.
Chimneys and stacks.
Buildings for service plants.
Stores, storage buildings, warehousing.
Laboratories, workshops, offices.
Medical and first aid centers, fire station.
Canteen, change rooms, lavatories.
Site security, fencing, gate houses.
Traffic lights, outdoor lights.

**(to be continued)**

**APPENDIX G (continued)**

Garages, car parks, cycle sheds.
Customs and excise offices, weighbridge.
Drainage, sewage system.
Pipe and cable ducts.
Land reinstatement, landscaping etc.
Railway tracks.
Residential buildings.

**Process plant**
Process plant machinery and equipment.
Special erection costs for plant items.
Special materials, such as catalysts, if they entail investment costs.
Inspections and tests.
Safety and fire protection equipment.
Ventilation, air conditioning (to remove toxic gases, vapors etc.).
Effluent treatment plant.
Instrumentation and control.
Pipework and valves.
Insulation and painting.
Costs of process development and prototype testing.
Stand-by plant.
Service plant and equipment
Steam-generating plant and auxiliaries.
Power generation plant and auxiliaries.
Electricity connection charges.
Transformer and switch gear.
Cabling.
Starters.
Stand-by power supplies.
Plant and pipework for water storage, treatment and distribution.
Process, cooling and drinking water supplies.
Emission-handling and treatment.
Oil and grease separators.
Pumping stations and screw conveyors.
Waste storage boxes.
Refuse burning plant etc.
Internal transport, conveying and storage of materials.
Supplies, fuel, intermediate and finished products.
Elevators, cranes etc.
Heating and lighting services.
Cooling, refrigeration equipment.
Compressed air, inert gas supplies.
Maintenance and repair equipment.
Spare parts, if investment costs are involved.
Operating and maintenance manuals, instructions, drawings.
Test equipment.
Lightning protection
Communication equipment and installations (telephone, telex etc.).

**(to be continued)**

**APPENDIX G (continued)**

**Overhead costs, incorporated fixed assets**

Engineering costs.
Process and plant design, basic engineering.
Detailed engineering if not covered under civil works or machinery and equipment.
Inspections costs, consultants and specialists, including travel.
Cost of models, prototype design.

**Temporary facilities required for construction**

Site engineer: office etc.
Temporary supply of power, water etc.
Temporary access, storage facilities, site security (fencing etc.).
Construction workshops.
Camp, canteen.

**Other direct costs of the project implementation**

Preparation and issue of bid documents for construction of civil works and other facilities in accordance with a phased program.
Evaluation of bids, negotiations and purchasing.
Inspection, commissioning (including travel).
Supervision of construction and start-up.
Direct labor, contract labor, including overtime work.
Transport costs, unloading and handling charges.

**Pre-Production expenditures**

Process of patent fees, agent fees.
Legal and insurance fees.
Consultant fees.
Research and development expenditures.
Central administration expenditures.
Pre-Production marketing costs.
Training expenditures.
Miscellaneous taxes and duties.
Commissioning and start-up expenditures.

**Working capital**

Inventories built up during the construction phase.
Raw materials.
Factory supplies.
Spare parts.
Products.

## APPENDIX H

## CHECK-LISTS AND SCHEDULES VII-1 COST CENTERS

**Production cost centers**

Production cost centers usually comprise the main production (or plant) Units or production lines, for which costs must be determined.

**Service cost centers**

- Social service.
- Plant management.
- Off-site transport.
- Purchasing.
- Stores.
- Repair and maintenance.
- Power, heat, light, air-conditioning.
- Steam.
- Water supply.
- Laboratories, quality control.
- Effluent disposal.

**Administration and finance cost centers**

- General administration.
- Personnel.
- Training.
- Accounting and bookkeeping.

**APPENDIX H**

**VII-2 OVERHEAD COSTS***

Plant maintenance.

Storage costs (personnel, materials and services etc.).

Internal transport services.

External transport costs.

Insurance.

Administrative and service personnel

Salaries, wages.

Social overhead costs (health etc.)

Communications and travel.

Office supplies.

Rents.

Leasing fees (unless covered under financial costs).

Recurring land charges.

Property taxes.

***Use Schedules for indirect costs: marketing costs (Schedule III-2 of Appendix D; plant costs (Schedule VI-4 of Appendix G); and estimate of overhead costs (Schedule VII-1 of Appendix H).**

**(to be continued)**

**APPENDIX H (continued)**

**SCHEDULE VII-1 - ESTIMATE OF OVERHEAD (INDIRECT) COSTS**

**(INSERT IN SCHEDULE VII-2)**

**project:**

**Date:** **I] Direct costs**

**Source:** **I] Indirect costs**

| **Product/cost centre**<br><br>**CODE:** | **First year of production** | | **Currency**<br><br>**Units** | |
|---|---|---|---|---|
| | **Cost projections for year:** | | | |
| **Cost item** | **LOCAL COSTS** | | **FOREIGN** | |
| | **VARIABLE Per unit** | **Fixed Per period** | **VARIABLE Per unit** | **Fixed Per period** |
| | | | | |
| **Overhead (indirect) costs** | | | | |
| **Total unit per period** | | | | |
| **Total costs per unit** | | | | |
| **Total Overhead costs** | | | | |

**(to be continued)**

**APPENDIX H (continued)**

**SCHEDULE VII-2 - PROJECTION OF OVERHEAD (INDIRECT) COSTS (INSERT IN SCHEDULE X-3 OF APPENDIX K)**

**project:**

**Date:**

**Source:**

| Product/cost centre<br><br>CODE: | | First year of seals: | | | Currency:<br><br>Units : | | |
|---|---|---|---|---|---|---|---|
| year | Total local costs | | | Total factory casts | | | Grand total |
| | VARIABLE | Fixed | Total | VARIABLE | Fixed | total | |
| | | | | | | | |

## APPENDIX I

## SCHEDULE, VIII-1 - DETAILED MANNING TABLE

| MANNING TABEL : | | Staff [ ] | | | | Labor [ ] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Department (cost centre) | Number of persons by salary ( P1,P2,……) OR By wage (w1,w2,……) category and shift | | | | | | | | | | | |
| Function | | __[b] 1 | | __ 2 | | ___ 3 | | ___ 4 | | | | |
| | S[c] | F | L | F | L | F | L | F | L | F | L | T |
| | 1 | | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |
| | 1 | | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | … … | | | | | | | | | | | |
| TOTAK LOCAL : | | | | | | | | | | | | |

S= shift
F=foreign personnel (recruited from abroad)
L=local personnel (recruited nationally)

[a] Use separate schedules for staff (P) and labor (W).

[b] Insert code for salary (P) or wage (W) category.

[c] Note that four shifts will have to be manned in case a plant is

(to be continued)

**APPENDIX I (continued)**

**SCHEDULE VIII-2 - ESTIMATE OF PERSONNEL COSTS**

**(INSERT IN SCHEDULES OF APPENDIX E VI-4 AND VII-1 OF APPENDIX H DEPENDING ON TYPE OF PERSONNEL)**

**project:**

**Date:**

**Source:**

| Product/cost centre<br>CODE: | | | | | First year of production | | | Currency<br>Units | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cost projections for year: | | | | |
| Direct costs by category | | | | | Annual costs per person | | | Total costs per year | |
| Code | F/L | V/F[a] | U [b] | Costs [c] per u | U per year | Costs per person | No. of persons | Total | Variable Of total [d] |
| | | | | F | | | | | |
| | | | | L | | | | | |
| | | | | T | | | | | |
| Total foreign costs | | | | | | | | | |
| Surcharge (%) | | | | | | | | | |
| Surcharge (costs) | | | | | | | | | |
| Grand total foreign costs | | | | | | | | | |
| Total local costs | | | | | | | | | |
| Surcharge (%) | | | | | | | | | |
| Surcharge (costs) | | | | | | | | | |
| Grand total foreign costs | | | | | | | | | |
| Total (foreign .local) | | | | | | | | | |
| Total surcharge | | | | | | | | | |
| Grand total persona l costs | | | | | | | | | |

F=foreign L=local T=total(foreign .local) U=unit

[a] **Indicate whether number of persons varies with capacity utilization (V) or remain fixed (F).**

[b] **Indicate whether costs are given by hour (H), day (D), week (W), month (M) or year (Y).**

[c] **Indicate foreign (local) cost components, if applicable.**

[d] **Indicate personnel costs, varying proportionally with capacity utilization (production volume).**

## APPENDIX J
## CHECK-LIST IX-1, SAMPLE BREAKDOWN OF PROJECT IMPLEMENTATION COSTS

**Costs of project implementation management**

- Salaries and wages of managerial staff.
- Rent and operation of offices, motor cars, living quarters etc.
- Travel and communication expenses.
- Fees for specially assigned consultants.
- Fees and cost of quality control inspections abroad.
- Printing and photocopying.
- Duties and taxes during the implementation period.
- Costs of legal assistance.

**Costs of company formation and organizational build-up**

- Costs and expenses directly related to company formation, such as financial costs, duties, taxes, fees and costs of legal assistance.
- Salaries and wages of managerial and administrative staff.
- Recruitment costs (advertising costs, fees paid for recruitment services etc.).
- Salaries and wages of recruited staff and labor from date of recruitment until commercial production
- Rent and operation of offices, training facilities, motor cars, living quarters etc.
- Travel and communication expenses.
- Fees for specially assigned consultants.
- Fees for consultants and experts as well as possible additional allowances for foreign staff.
- Fees for external training (locally and abroad) including travel and subsistence payments.
- Training documentation and training material (if not part of supplier contracts).

**Technology acquisition and transfer**

- Travel and communication expenses.
- Consulting fees.
- Testing, technology assessment costs.
- Detailed process engineering for lump-sum know-how payments and royalties (see also Chapter VI).
- Costs of know-how transfer (training costs).

**Detailed engineering of equipment and civil works, tendering, evaluation of bids, negotiations and contract awards**

- Salaries and wages of planning staff.
- Rent and operation of offices, motor cars etc.
- Travel, transport, communication, subsistence.
- Fees for various types of consultants on detailed engineering costs (see also Chapter VI).
- Site and laboratory tests.
- Printing of tender documents, drawings and specifications.
- Stamps and duties.

**(to be continued)**

**APPENDIX J (continued)**

**Supervision and coordination of construction work, installation, testing, trial runs, start-up and commissioning**

- Salaries and wages of site staff.
- Costs of local and foreign experts and consultants.
- Rents (living quarters, offices etc.).
- Erection, operation and camp maintenance.
- Raw and auxiliary materials, factory supplies for test runs, performance testing and initial production.
- Cost of interim warehousing off site.
- Cost of spare parts and maintenance.
- Insurance paid during project implementation.

**Arrangements for supplies**

- Salaries and wages for purchasing staff.
- Travel and other related expenses.
- Communications.

**Arrangements for pre-production marketing**

- Salaries and wages for sales and marketing staff.
- Advertising.
- Training of salesmen and dealers.
- Travel expenses.
- Communications.
- Cost of establishing distribution network including special equipment.
- Printing expenses for public relations materials etc.

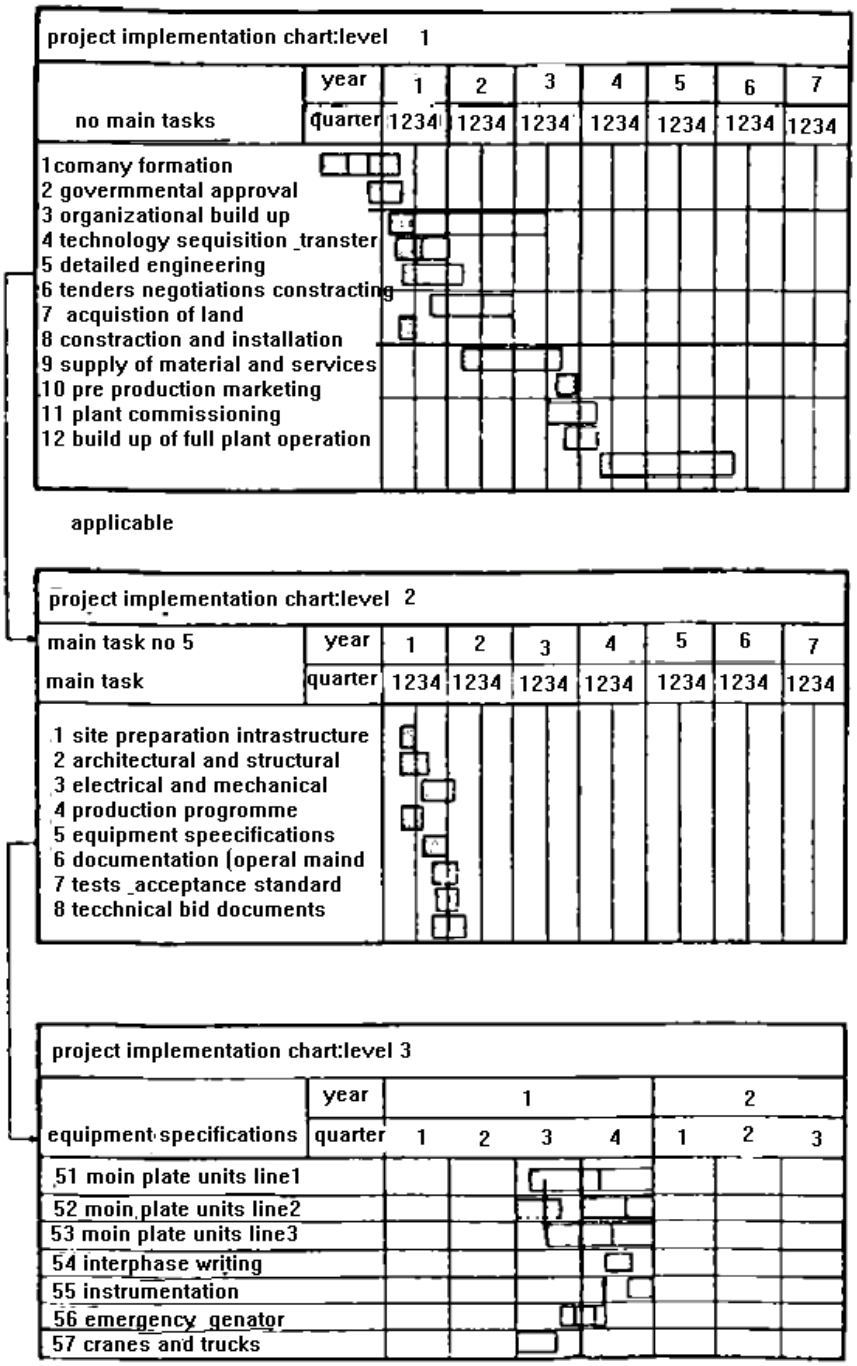
**Preliminary expenses and costs involved in capital issues (unless included already in cost groups listed above)**

- Registration and incorporation fees.
- Printing and incidentals expenses.
- Public relations expenses.
- Underwriting commissions.
- Brokerage.
- Legal fees.
- Insurance.
- Interest during construction (on term loans, current bank accounts etc.).
- Other pre-production expenses.

**(to be continued)**

**APPENDIX J (continued)**

**SCHEDULE IX-1 - PROJECT IMPLEMENTATION CHARTS**




**(to be continued)**

**APPENDIX J (continued)**

**SCHEDULE IX-2 - ESTIMATE OF INVESTMENT COSTS:**

**PROJECT IMPLEMENTATION (INSERT IN SCHEDULE X-1 OF APPENDIX K)**

**project:**

**Date:**

**Source:**

| ESTIMATE OF INVESTMENT COSTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Project implementation(insert main test from XI.1) | | | | | Currency | | | |
| MAIN PAIN ITEM OR PAIN UNIT[a] | | | | | Units | | | |
| N | C | V | Item description | Unit Cost | Cost | | | Year* |
| | | | | | Foreign | local | total | |
| | | | | | | | | |
| Total investment costs Project implementation (carry over to schedule x.1) | | | | | | | | |

| N=NUMBER | U=unit | Q=quantity |
|---|---|---|

**Note:**

**For the purpose of economic cost-benefit analysis, local (foreign) cost elements contained in imported (national) equipment**

**should be identified.**

**a Insert name or description of plant or main plant item.**

**b Of investment (if necessary show subtotals for each year and plant item).**

## APPENDIX K

## SCHEDULE X-1 - TOTAL FIXED INVESTMENT COSTS (THOUSAND NCU)

| INVESTMENT CATEGORY | | FROM SCHEDULE | TOTAL [a] CONSTRUCTION | TOTAL [b] PRODUCTION |
|---|---|---|---|---|
| 1. | Land purchase | V-1 | | --- |
| 2. | Site preparation and development | V-1 | | --- |
| 3. | Civil works, structures and buildings | VI-3 | | --- |
| 4. | Plant machinery and equipment | VI-2 | | |
| 5. | Auxiliary and service plant equipment | VI-2 | | |
| 6. | Environmental protection | | --- | --- |
| | Site preparation | V-2 | --- | --- |
| | Civil works | VI-3 | --- | --- |
| | Plant machinery and equipment | VI-2 | --- | --- |
| 7. | Incorporated fixed assets | | | --- |
| | (project overheads) | | --- | --- |
| | Technology | VI-1 | | |
| | Project implementation | IX-2 | --- | --- |
| | Miscellaneous project overhead costs | IX-2 | --- | --- |
| 8. | Contingencies | | --- | --- |
| TOTAL FIXED INVESTMENT COSTS | | | | |
| Foreign share (%) | | | | |

**Date:**

**[a] Initial fixed investment.**

**[b] Fixed investment during plant operation.**

## SCHEDULE X-2 - TOTAL PRE-PRODUCTION EXPENDITURES (THOUSAND NCU)

| INVESTMENT CATEGORY | | FROM SCHEDULE | TOTAL [a] CONSTRUCTION | TOTAL [b] PRODUCTION |
|---|---|---|---|---|
| 1. | Pre-Investment studies | 11-1 | --- | --- |
| 2. | Preparatory investigations | 11-1 | --- | --- |
| 3. | Company formation costs, fees etc. | 1X-2 | --- | --- |
| 4. | Project management, organization | 1X-2 | --- | --- |
| 5. | Technology acquisition | 1X-2 | --- | --- |
| 6. | Detailed engineering, contracting | 1X-2 | --- | --- |
| 7. | Pre-Production supplies/marketing | 1X-2 | --- | --- |
| 8. | Plant commissioning, trial run etc. | 1X-2 | --- | --- |
| 9. | Other capital (issue) expenditures | 1X-2 | --- | --- |
| 10. | Contingencies | 1X-2 | --- | --- |
| PRE-PRODUCTION EXPENDITURES (NET OF INTEREST) | | | | |
| TOTAL PRE-PRODUCTION EXPENDITURES | | | | |
| Foreign share (%) | | | | |

**Project:**

**Date:**

**(to be continued)**

**APPENDIX K**

**SCHEDULE X-3 - TOTAL ANNUAL COSTS OF PRODUCTS SOLD (THOUSAND NCU)**

| COST ITEM | FROM SCHEDULE |
|---|---|
| **CAPACITY UTILIZATION (%)** | |
| 1. Raw materials | |
| Raw material A | VI-4/2 |
| Raw material B | VI-4/2 |
| 2. Factory supplies | VI-4/2 |
| 3. Spare parts consumed | VI-4/2 |
| 4. Repair, maintenance, material | VI-4/2 |
| 5. Royalties | VI-4/2 |
| 6. Labor | VI-4/2 |
| Skilled labor | |
| Unskilled labor | |
| 7. Labor overheads (taxes etc.) | VI-4/2 |
| 8. Factory overhead costs | VI-4/2 |
| Salaries, wages | |
| Social costs etc. (on salaries) | |
| Materials and services | |
| Rents, leasing costs (factory) | |
| **Insurance** | |
| **FACTORY COSTS** | |
| 9. Administrative overhead costs | VII-2 |
| Salaries, wages | |
| Social costs etc. (on salaries) | |
| Materials and services | |
| Rents, leasing costs | |
| Insurance | |
| **OPERATING COSTS** | |
| 10. Depreciation | |
| 11. Financial costs | |
| Interests | |
| Leasing costs | |
| **TOTAL PRODUCTION COSTS** | |
| 12. Direct marketing costs | III-3 |
| Salaries etc. | |
| Rents, leasing costs | |
| Other direct costs | |
| 13. Marketing overhead costs | III-3 |
| Salaries etc. | |
| Rents, leasing costs | |
| Other indirect costs | |
| **COSTS OF PRODUCT SOLD** | |
| Foreign share (%) | |
| Variable share (%) | |

**Project:**

**Date:**

**(to be continued)**

## APPENDIX K

## SCHEDULE X-4 - TOTAL NET WORKING CAPITAL REQUIREMENTS (THOUSAND NCU)

| INVESTMENT CATEGORY | FROM SCHEDULE | COEFFICIENT OF TURNOVER [a] | CONSTRUCTION | PRODUCTION |
|---|---|---|---|---|
| CAPACITY UTILIZATION (%) | | | | |
| 1. Total inventory | X-3 | | | |
| Raw materials in stock | X-3 | | | |
| Raw materials A | X-3 | | | |
| Raw materials B | X-3 | | | |
| Factory supplies in stock | X-3 | | | |
| Spare parts in stock | X-3 | | | |
| Work in progress | | | | |
| Finished products | | | | |
| 2. Accounts receivable | | | | |
| 2. Accounts receivable<br>3. Cash-In-hand | | | | |
| CURRENT ASSETS<br>4. Current liabilities<br>Accounts payable | X-3 | | | |
| TOTAL NET WORKING CAPITAL REQUIREMENTS<br>INCREASE IN NET WORKING CAPITAL | | | | |
| Foreign share (%) | | | | |

**Project:**

**Date:**

**[a] The coefficient of turn over (CTO) is obtained as follows:**

**CTO = 360/MDC (minimum days of coverage).**

## SCHEDULE X-5 - TOTAL INVESTMENT COSTS (THOUSAND NCU)

| INVESTMENT CATEGORY | FROM SCHEDULE | TOTAL [a] CONSTRUCTION | TOTAL [b] PRODUCTION |
|---|---|---|---|
| 1. Total fixed investment | X-1 | | |
| 2. Total pre-production expenditures | X-2 | | |
| Net of interest | X-2 | | |
| Interest accrued | | | |
| 3. Total net working capital (increase) | X-4 | | |
| TOTAL INVESTMENT COSTS | | | |
| Foreign share (%) | | | |

**Project:**

**Date:**

**(to be continued)**

## APPENDIX K

## SCHEDULE X-6 - DISCOUNTED CASH FLOW-TOTAL CAPITAL INVESTED

| | FROM SCHEDULE | CONSTRUCTION | PRODUCTION |
|---|---|---|---|
| **TOTAL CASH INFLOW** | | | |
| 1. Inflow operation<br>Sales revenue<br>Interest on securities<br>2. Other income | III-1 | | |
| **TOTAL CASH OUTFLOW** | | | |
| 3. Increase in fixed assets<br>Fixed investments<br>Pre-Production expenditures (net of interest paid)<br>4. Increase in net working capital<br>5. Operating costs<br>6. Marketing coasts<br>7. Corporate tax paid | X-1<br>X-2<br>X-4<br>X-3<br>X-3 | | |
| **NET CASH FLOW**<br>**CUMULATIVE NET CASH FLOW** | | | |
| Net present value (at 12%)<br>Cumulative net present value | | | |
| **NET PRESENT VALUE (at 12%)** | | | |
| **INTERNAL RATE OF RETURN** | | | |

**Project:**

**Date:**

**PART TWO**

**CONCEPTUAL DESIGN**

**CONTENTS:** **PAGE No.**

## 0. INTRODUCTION

The Standard Practice Manuals titled as "Fundamental Requirements for the conceptual Design and Engineering" is intended for convenience of use and pattern of follow-up and also guidance. These Standard Engineering Practice Manuals also indicate the check points to be considered by the process engineers for assurance of fulfillment of pre-requisitions at any stage in the implementation of process plant projects.

It should be noted that these Iranian Petroleum Standards (IPS), as Practice Manuals do not profess to cover all stages involved in every process project, but they reflect the stages that exist in general in process projects of oil, gas and petrochemical industries of Iran.

These preparation stages describe the Recommended Practice Conceptual Requirement phases which can be distinguished in every Project.

These preparation stages describe the recommended practice for the project stages which can be distinguished in every Project:

| | |
|---|---|
| **Stage I:** | Feasibility Study |
| **Stage II:** | Conceptual Design |
| **Stage III:** | Basic Design |
| **Stage IV:** | front end engineering design (FEED) |
| **Stage V:** | Detailed Design |
| **Stage VI:** | Procurement |
| **Stage VII:** | Construction and Installation |
| **Stage IIX:** | Pre Commissioning and Commissioning |
| **Stage IX:** | Operating and Maintenance |

This Engineering Standard Specification covers:

"CONCEPTUAL DESIGN"

## 1. SCOPE

This part of Engineering Standard Specification defines the Company's minimum requirements for the "Fundamental Requirements for the Conceptual Design" package which is to be prepared by the design team or Contractor, concerning the format of the package and contents. But prior of the preparation of this Package a feasibility study should be carried out according to procedure presented as per Part One standard.

## 2. REFERENCE

- Conceptual design and feasibility studies: "Emersson Process Engineering Managemet Article" 2010
- Concept Selection Procedure for Basis Design "Concept Selection Handbook"
- Oil and gas production handbook: ABB eng. Co. Aug. 2013
- Ways to Improve the Bid and FEED Phases of Capital Projects, by Ron Beck, Industry Marketing Director, Aspen Technology, Inc.
- Transformation of Process Engineering – Innovations and Best Practices, Dr. Vikas Dhole, Vice President of Engineering Product Management, Aspen Technology, Inc.
- Project Execution Plan, 2011-09-22 Shell Design Paractice

## 3. DEFINITIONS AND TERMINOLOGY

Throughout this Standard words have specific meaning as described below:

**Title Needed**

**-"Company" / "Employer" / "Owner"**

Means as mentioned in General Definitions of Foreword.

**-"Contractor"**

Refers to the persons, firm or company whose tender have been accepted by the "Employer", and includes the Contractor's personnel representative, successors and permitted assigns.

**-"Employer" / "Owner"**

Refers to the "Company" as above.

**- "Project"**

Refers to the equipment, machinery and materials to be procured by the "Contractor" and the works and/or all activities to be performed and rendered by the "Contractor" in accordance with the terms and conditions of the contract documents.

**- "Unit" or "Units"**

Refers to one or all process, offsite and/or utility Units and facilities as applicable to form a complete operable refinery and/or complex/plant.

## 4. SYMBOLS AND ABBREVIATIONS

Symbols/Abbreviations mentioned in this Engineering Standard are according to the following table:

| SYMBOL / ABBREVIATION | DESCRIPTION |
|---|---|
| **APC** | Advanced Process Control |
| **API** | American Petroleum Institute |
| **BEDD** | Basic Engineering Design Data |
| **DCS** | Distributed Control System |
| **IPS** | Iranian Petroleum Standards |
| **NPSH** | Net Positive Suction Head |
| **PFD** | Process Flow Diagram |
| **P&ID** | Piping & Instrumentation Diagrams |
| **CAPEX** | Capital Expenditure |
| **OPEX** | Operating Expenditure/Expense |
| **DMP** | Decision Making Process |

## 5. UNITS

This standard is based on international system of units (SI), as per IPS-E-GN-100 except where otherwise specified.

## 6. FORMAT

### 6.1 Covers and Size

The basic design package shall be presented in the form of a book of one or more volumes, the format of which shall essentially conform to the requirements stipulated in this Standard. The format of following items shall essentially specified by company requirement, but not limited to:

**1)** Size of covers
**2)** Size and type of back covers
**3)** Color of covers and back covers
**4)** Color of title in covers and back covers
**5)** Form of title character
**6)** Printing of character

### 6.2 Titles

The basic design package shall be called:

**"Basic Design Package"**

The titles shall include:

**1)** Country's name
**2)** Company's name and emblem
**3)** Project name of location

**4)** Project designation

**5)** Plant/Unit name and number

**6)** Volume number, if more than one volume

**7)** Date of issue

**8)** Contractor's name and mark

**9)** Licensor's name and mark, (if any).

The typical arrangement of titles for the front and bottom are shown on Figs. 1 & 2 respectively.

## 7. GENERAL

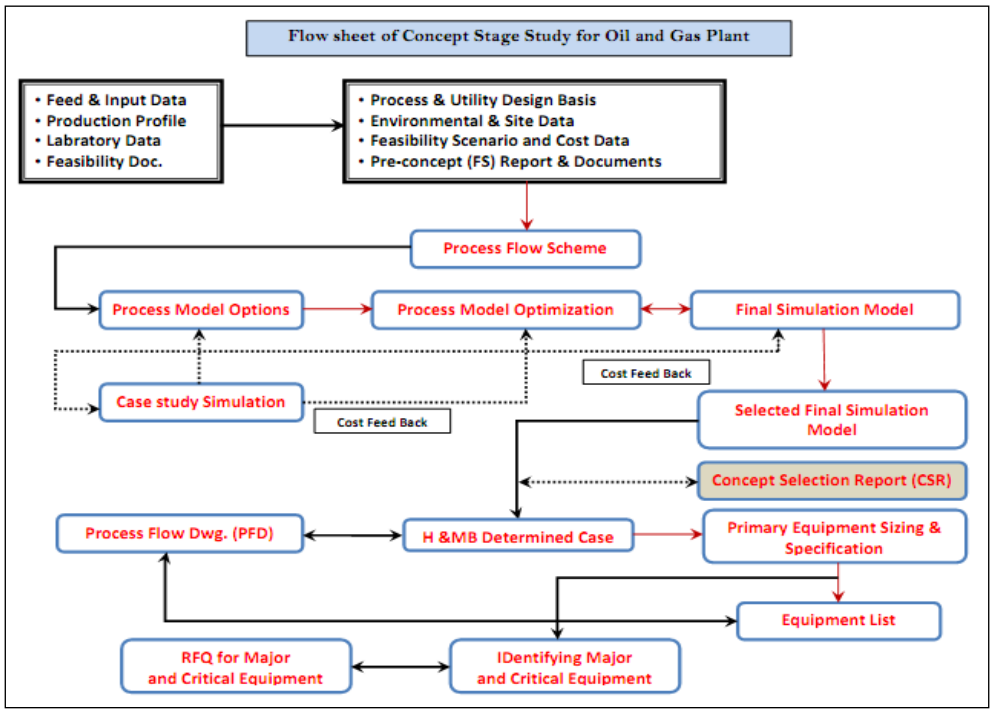
During the conceptual design stage, the individual requirements have to be compiled and the targets of the project have to be defined. An optimum process is designed based on this information.
Knowledge in process engineering and energy technology, know-how in the respective industrial sector and experience with the implementation of processing plants, and not least creativity – all that is required for conceptual design.

Below item should be considered as target of conceptual design strategy:

- Compilation of User Requirements (URS)
- Definition of Project Targets Together with the Company/Contractor
- Mass and Energy Balances (for main /alternative scenario(s))
- Primary Process Simulation
- Process Selection /Requirement/Strategy
- Evaluation and Comparison of Design Options (Best Case Scenario)
- Layout Including Zone and Logistic Concepts
- Cost Estimates (CAPEX & OPEX)
- Feasibility Studies Summary & Result
- Value Engineering

Concept Engineering is the engineering activity in support of Project Development and is closely integrated with the subsurface Field Development Planning and surface facilities for Oil & Gas and Petrochemical (OPG) developments.

Below figure is a typical flow sheet of concept stage study for OPG plants:




Flow Sheet of Concept Design Study for Oil and Gas Plant

Contractor's conceptual design and feasibility study team shall offerings to perform operational analysis, quantify benefits, evaluate potential investments, develop business cases, and define specific project requirements from which a project budget and execution plan can be developed.

The goal of conceptual selection report shall be business objective to improving quality, increasing production, lowering costs, improving capital utilization, increasing inventory turn or a combination of all the above stage

Conceptual design studies aim shall be according to the following but not limited to:

- Facilitation to develop overall vision
- Program planning for plant wide or multi-site modernization initiative
- Define and plan future automation upgrade programs
- Economic justification and prioritization for project implementation
- Roadmap new automation technology within existing infrastructure
- Define a starting point for Basic Design or frontend engineering and design (FEED)
- end up with a roadmap, clearly outlining and prioritizing
- overall Plant/Project Cost estimates
- Analysis and quantification of expected process improvements and economic benefit
- Final report documenting results, benefits analysis, recommended technology enhancements, financial analysis, and recommended project implementation plans

## 8. OIL & GAS CONCEPT EVALUATION & SELECTION

Conceptual Study is done in the oil and gas and petrochemical industry at the very early stage of a Grass root/revamp /expansion project to identify all the possibilities and conditions to develop targeted project. During the conceptual study, the team of engineers will investigate the multiple technologies to be used.

Below items should be considered for Conceptual Stage Evaluation/Selection & Final Result:

**8.1** Typical activities of concept engineering team are as follows:

Review Feasibility Report

Review applicable codes, standards & legislation

Develop preliminary Process Design (H&MB, PFD, Equipment List)

Develop preliminary Equipment datasheets and Plot Plan

Develop preliminary Engineering Philosophies (HSE, Electrical, and Civil)

Perform Primary HAZID and Risk Analysis

Generate cost estimate (± 30% accurate)

Develop preliminary Project Development, Execution and Procurement Plans

Prepare and Issue Concept Design Report and Basis of Design.

**8.2** Development a base case concept, Development optional concepts and present these to client in a conceptual selection matrix ,Development criteria for concept selection and initiate the screening process shall be done by Conceptual Design Teams

**8.3** Multi-disciplinary teams of specialist engineers and consultants will during this phase study facilities options, Perform Process Simulations, Flow-Assurance, Develop The digital Oil Filed or Process Plant Strategy and perform all the Associated Engineering to support the successful availability of product export to the market.

**8.4** In parallel to the Technology and Engineering Development, the other project activities will be prepared, e.g. HSE screening, Risk assessment, Development schedule, Equipment listing, CAPEX, OPEX and Economics based on the concept margins and requirement

**8.5** Evaluate the costs of each case, especially during the total life cycle of the project including capital expenditure for the construction (CAPEX) and operational expenditure (OPEX) to run the plant

**8.6** Estimate construction challenges versus benefits in operations and vice versa

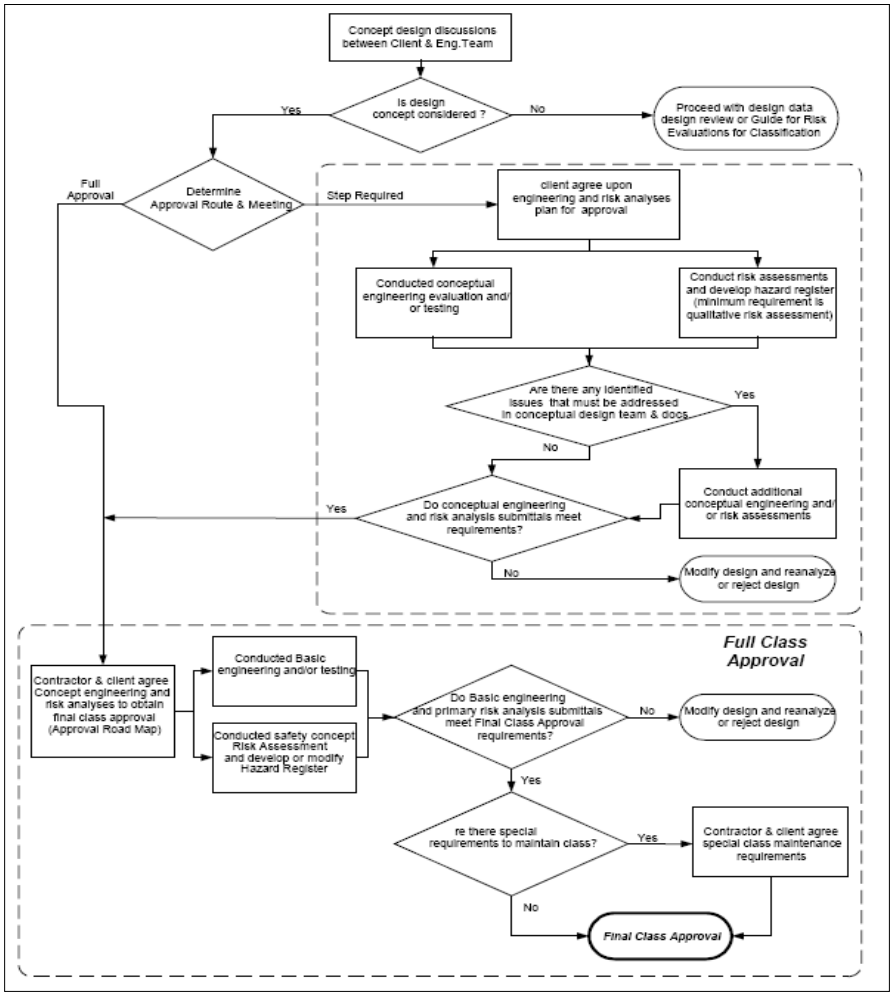
**8.7** Measure the impact on the environment (foot print, water and energy consumption, $CO_2$ emissions, local acceptance, decommissioning and restoration costs approximately)

**8.8** Draft planning corresponding to each case to identify critical items, Identify potential risks on the project and hazards for personnel, List all the required off-sites and utilities; Determine all the infrastructures needed to bring in the feedstock and to export the production; Include local constraints about regulation, taxations, employment, content.

**8.9** After this technical and budgetary evaluation, select the optimized process for a specific project. When completed, and if validated, the conceptual study will be the base for the Basic engineering and design of the project.

**8.10** The permissible cost estimation accuracy during concept stage itself is +/- 30%~35% for larger EPC projects.

**8.11** Below table show the algorithm of selection of final conceptual repot between concept teams and client and related approval.



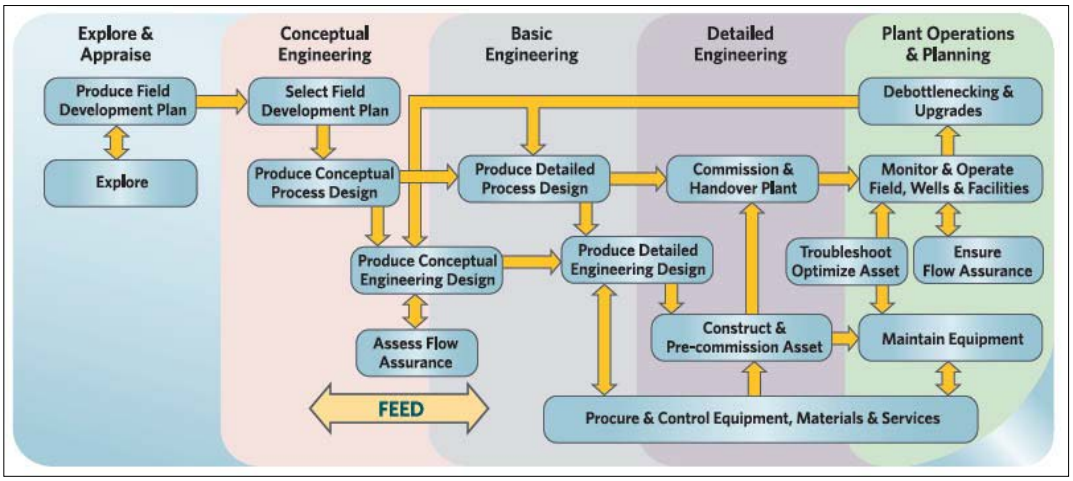

Algorithm of selection of final conceptual repot

**8.12** Deliverables items for Conceptual Engineering consultancy services are:

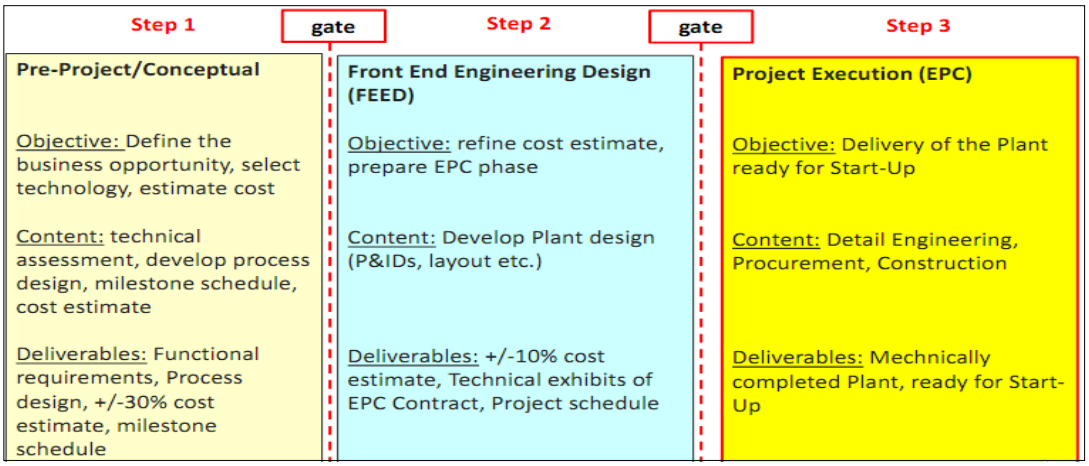
- **Conceptual study engineering report Package: typically includes development engineering; conceptual selection; technology review; facilities definition based on process simulation and flow-assurance(if required), cost estimation, project controls; Risks, HSE, Schedule; CAPEX and OPEX estimates and Economics, etc.**
- **Data & documents for Basic or FEED Basis of Design**
- **Data & documents for Basic or FEED Scope of Work**

| Identify | Assess | Select |
|---|---|---|
| Project Initiation Note<br>Decision-Based Roadmap<br>Risk and Opportunity Management plan<br>Stakeholder Engagement Plan | Feasibility Study Report<br>Map of “solution space”<br>Stakeholder Engagement Plan<br>Ranked Decision Criteria/ Value Drivers | Field Development Plan*<br>Concept Selection Report (CSR)<br>Execution and Contracting Strategy<br>Preliminary PEP/PES<br>Cost Estimate and Schedule<br>Basis of Design |

Below flow chart shown the level of concept engineering during the project activities:




Flowchart Level of Concept Engineering




The cost estimate will consider market conditions, construction methodology, country specific infrastructure and labor productivity. Our estimating function utilizes the very latest cost information through our worldwide procurement capability.

## 9. ESTIMATING CAPITAL COSTS

### 9.1 Accuracy and Purpose of Capital Cost Estimates

The accuracy of an estimate depends on the amount of design detail available, the accuracy of the cost data available, and the time spent on preparing the estimate.

In the early stages of a project, only an approximate estimate will be required, and justified, by the amount of information available.

The Association for the Advancement of Cost Estimating International (AACE International) is the professional association representing the cost engineering profession in the United States. AACE International classifies capital cost estimates into five types according to their accuracy and

purpose:

**a)** Order of magnitude estimates (‘‘ballpark estimate,’’ ‘‘guesstimate,’’ ‘‘Class 5 estimate’’), accuracy typically +30–50%, usually based on the costs of similar processes and requiring essentially no design information. These are used in initial feasibility studies and for screening purposes.

**b)** Preliminary (‘‘approximate,’’ ‘‘study,’’ ‘‘feasibility,’’ ‘‘Class 4’’) estimates, accuracy typically +30%, which are used to make coarse choices between design alternatives. They are based on limited cost data and design detail.

**c)** Definitive (‘‘authorization,’’ ‘‘budgeting,’’ ‘‘control,’’ ‘‘Class 3’’) estimates, accuracy typically +10–15%. These are used for the authorization of funds to proceed with the design to the point where an accurate and more detailed estimate can be made. Authorization may also include funds to cover cancellation charges on any long delivery equipment ordered at this stage of the design to avoid delay in the project. In a contracting organization this type of estimate could be used with a large contingency factor to obtain a price for tendering.

Normally, however, an accuracy of about +5% would be needed and a more detailed estimate would be made, if time permitted. With experience, and where a company has cost data available from similar projects, estimates of acceptable accuracy can be made at the flowsheet stage of the project. A rough P and I diagram and the approximate sizes of the major items of equipment would also be needed.

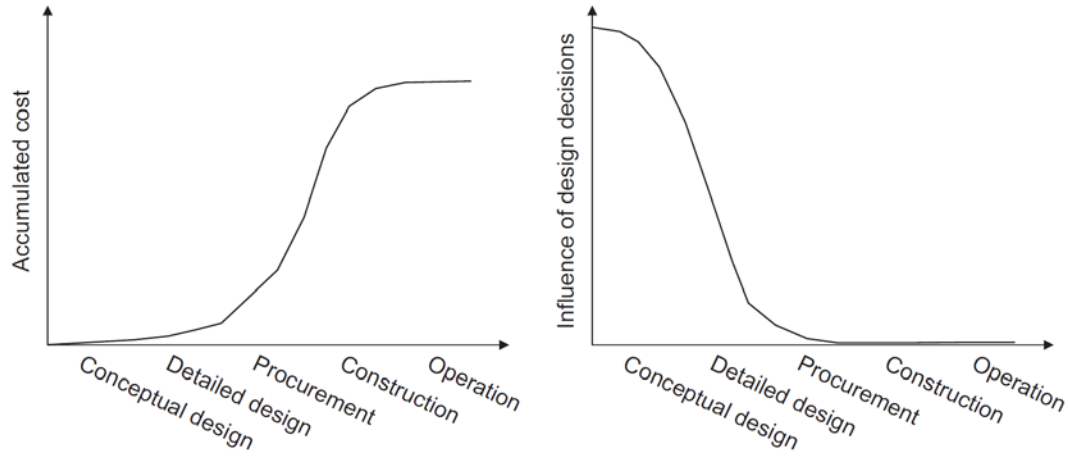
**d)** Detailed estimates (‘‘quotation,’’ ‘‘tender,’’ ‘‘firm estimate,’’ ‘‘contractor’s estimate,’’ ‘‘Class 2 estimate’’), accuracy +5–10%, which are used for project cost control and estimates for fixed price contracts. These are based on the completed (or near complete) process design, firm quotes for equipment, and a detailed breakdown and estimation of the construction cost. By this stage the contractor can usually present a list of all the items that must be purchased and can make a firm commitment to the client.

**e)** Check estimates (‘‘tender,’’ ‘‘as-bid,’’ ‘‘Class 1 estimate’’), accuracy +5–10%. This is based on a completed design and concluded negotiations on procurement of specialized items and long lead-time items.

The cost of preparing an estimate increases from about 0.1% of the total project cost for +30% accuracy, to about 3% for a detailed estimate with an accuracy of +5%.

As a project proceeds from initial concept through detailed design to startup, costs begin to be accumulated, particularly once procurement and construction get underway (Figure 6.1a). At the same time, the ability of the design engineer to influence project cost decreases and is minimal by the time construction begins (Figure 6.1b).

There is therefore a strong incentive to try to estimate project costs at as early a stage as possible, even if the design information is incomplete, so that the project can be optimized, evaluated, and abandoned if it is not attractive.




(a) Accumulation of costs (b) Influence of design decisions